LA BELLE: RIGGING IN THE DAYS OF THE SPRITSAIL TOPMAST, A RECONSTRUCTION OF A SEVENTEENTH-CENTURY SHIP'S RIG

A Thesis

by

CATHARINE LEIGH INBODY CORDER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

December 2007

Major Subject: Anthropology

LA BELLE: RIGGING IN THE DAYS OF THE SPRITSAIL TOPMAST, A RECONSTRUCTION OF A SEVENTEENTH-CENTURY SHIP'S RIG

A Thesis

by

CATHARINE LEIGH INBODY CORDER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Approved by:

Chair of Committee,	Kevin J. Crisman
Committee Members,	Cemal Pulak
	Cynthia A. Bouton
Head of Department,	Donny L. Hamilton

December 2007

Major Subject: Anthropology

ABSTRACT

La Belle: Rigging in the Days of the Spritsail Topmast,
a Reconstruction of a Seventeenth-Century Ship's Rig. (December 2007)
Catharine Leigh Inbody Corder, B. A., Baylor University
Chair of Advisory Committee: Dr. Kevin J. Crisman

La Belle's rigging assemblage has provided a rare and valuable source of knowledge of 17th-century rigging in general and in particular, French and small-ship rigging characteristics. With over 400 individual items including nearly 160 wood and iron artifacts, this assemblage stands out as one of the most substantial and varied among all available rigging assemblages and currently is the only assemblage of 17th-century French rigging published. Furthermore, French rigging in general has not been as well defined as English rigging, nor has the 17th century been as well researched as the 18th. As such, *La Belle*'s rigging assemblage has provided a valuable source of knowledge whose research will hopefully provide a valuable foundation on which future studies can be built. Specifically, this project has attempted to catalogue these artifacts and reconstruct a plausible 17th-century French rig. This project has further attempted to define the differences between the better known English rigging features and those more characteristic of the French and Dutch. The reconstruction is based on the specific details derived from *La Belle*'s artifacts as well as contemporary French and other continental sources such as rigging assemblages, ship models, treatises, and nautical dictionaries. Together, these have suggested that *La Belle* probably carried a relatively simple rig with decidedly seventeenth-century characteristics and a Dutch influence.

DEDICATION

Odi et amo.

ACKNOWLEDGEMENTS

Many, many people have contributed significantly to the research of *La Belle*'s rigging by generously offering their time, resources and knowledge. It has been a pleasure to work with and get to know many generous and talented scholars and friends in the process of researching this project, and I hope I can adequately express my gratitude for all I have learned from each of you and your contributions to understanding *La Belle*'s rigging.

I am particularly indebted to Olof Pipping, who devoted considerable time in reviewing *La Belle*'s artifacts as well as my analysis and reconstruction; he acquainted me with *Vasa*'s rig, and, with his family, generously shared his country's rich maritime history with me.

Leif Malmberg of the Vasa Museum very generously allowed me complete access to *Vasa*'s rigging artifacts, the catalogue, and the ship itself. The entire archaeological staff made room for me for two weeks during which time I was able to peruse *Vasa*'s rigging in detail as well as the archives of the museum.

Susanna Allesson of the Statens Sjöhistoriska Museet in Stockholm generously made the *Amaranthe* rigging available to me, allowing me to photograph the disassembled elements of the model's original rigging that were in storage at that time. She also sent me samples of *Juthomen*'s and *Riksäpplet*'s rigging artifact records from the museum's archives.

Lars Einarsson of the Kalmar Läns Museum in Kalmar, Sweden allowed me unlimited access to *Kronan*'s rigging artifacts and records, allowing me to photograph many of the artifacts and making room for me in the museum's offices for several days.

Lisbeth B. Ehlers of Kronborg Castle in Helsinborg, Denmark arranged for me to photograph the model of the Danish frigate that was at that time in storage.

Jakob Seerup and Søren Nørby of Orlogsmuseet in Copenhagen not only allowed me access to the Danish Church Model, but with much trouble and effort on their part, removed it from its glass casing in order that I could photograph the model's rigging in detail.

Thomas Oertling traveled to College Station to examine *La Belle*'s rope artifacts and lent his considerable knowledge of rigging to me in order to interpret the 3100 and 3101 rigging assemblage as well as many other small details that would have been overlooked if not for his considerable experience. His help was invaluable to the study of *La Belle* and his generosity is much appreciated.

Many scholars very openly shared their ongoing research. I want to thank Peter Waddell and Charles Bradley, of Parks Canada, who sent me the entire artifact catalogue of the rigging artifacts from *Le Machault*. I would also like to personally thank the many scholars who returned my emailed inquiries about potential rigging artifacts from other contemporary shipwrecks: Annas Coetzee and John Gribble (*Merestyn*), Colin Martin (*Dartmouth*), Tim Sharpe (*Wrangles Palais*), Myra Stanbury (*Zeewijk*, and *Batavia*), and Tommy Watt (*Kennemerland*).

Helen DeWolf, Amy Borgens and John Hamilton of the Conservation Research Laboratory at Texas A&M University moved artifacts of interest to me to the head of the line for conservation or photography in order to facilitate my research.

Glenn Grieco, Director of the Ship Model Laboratory in Texas A&M's Nautical Archaeology Program, and Taras Pevney, a former graduate student in the Program, both contributed the results of their research on *La Belle*

Cliff Corder, Database Architect at Quick Internet Software Solutions (QISS) in College Station, Texas, designed and developed the database and reporting system that produced the artifact catalogue.

Finally, I would like to thank Jim Bruseth, of the Texas Historical Commission, and Donny Hamilton, of the Nautical Archaeology Program at Texas A&M, who first offered me the opportunity to research *La Belle*'s rigging artifacts. It has been a singular experience. I would also like to thank Kevin Crisman, chair of my thesis committee, for the time and thought he has given to reading and editing all of the papers I have written about *La Belle* over the past several years.

My research required multiple trips through Sweden, Denmark and France that were funded through research and travel grants from the MSC L. T. Jordan Foundation of Texas A&M University and the American Scandinavian Foundation. These foundations allowed me to do what I could not otherwise have done. I am grateful for the opportunities they provided me and hope I have justified their investment with this work.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Unlike 18th-century rigging, which has been the subject of much research and is well represented by primary documents, 17th-century rigging is not well defined by primary sources nor has it been well defined in secondary research. Furthermore, far more focus has been placed on the ship-of-the-line or large merchant vessels than has been afforded to the more numerous small vessels of the era. This may be attributed to the naval and merchant ship's association with those large-scale historical events of war, global trade, exploration, and colonization that have figured equally prominently in historical research for centuries. Modern historians have begun to recognize the equally valuable, if somewhat smaller, voices of history by attempting to reconstruct pictures of domestic life and home economics. The story of *La Belle*, however, is something of a hybrid between these two. It was not one of Colbert's "*premier rang extraordinaire*" that heralded the heyday of the three-decker and French and Dutch naval dominance following the Anglo Dutch wars, nor was it the stately merchant vessel one imagines plying the seas for the Dutch East India Company; however, neither was it one of the ubiquitous but now nameless fishing vessels that supported countless local economies and private families.[1] *La Belle* made its contribution to the grand schemes of colonization and global trade and the struggle for dominance among European powers at the time, but it did so as a relatively small ship whose various designations as barque, barque long, and little frigate speak to its status as something below the official rated vessels of Colbert's navy.[2]

This thesis follows the style of *American Journal of Archaeology* (AJA).

[1] Lavery 1992, 11-26.
[2] Gardiner 1992b, 46-62.

Ironically, it is precisely because of this that *La Belle* has been able to make a most significant contribution to nautical archaeology and the current body of evidence for small ships of the 17th century.

La Belle was one of four ships that left France in 1684 for the New World under the direction of French explorer Robert Cavelier, Sieur de la Salle. It was originally intended to be carried *en faggot*, or in pieces, to the new world and assembled there for use by the colonists. But space did not allow for this and so the ship was assembled before crossing the Atlantic. La Salle intended to locate the mouth of the Mississippi River and establish a colony that would help maintain France's claim to the river's watershed; however, he overshot his mark by some 644 kilometers, landing in Matagorda Bay on what is now the coast of Texas. Less than two years later, *La Belle* would be wrecked, leaving the remaining colonists without any ship at all. The ketch, *Saint-François* had been lost on the voyage out, taken by a Spanish pirogue or galley after having anchored at Port-de-Paix during a storm.[3] The flute *L'Aimable* was run aground and lost in February of 1685 in an attempt to explore a too-shallow bay, and the ship *Le Joly* returned to France the following month, abandoning the colonizing attempt because it was going so poorly.[4] La Salle remained with only *La Belle*, and in February of 1686, *La Belle* wrecked in a storm, effectively ending the colonization attempt.[5]

In June of 1995, the Texas Antiquities Committee merged with the Texas Historical Commission to locate and excavate *La Belle*, and in May of the following year, construction commenced on the coffer dam that was built around the ship, allowing for a terrestrial excavation on what had been a submerged site. The excavation continued through 1997, yielding a vast array of artifacts and 40% of the hull, which was disassembled and later reassembled for preservation at Texas A&M's Conservation

[3] Weddle 1987, 87.
[4] Weddle 1987, 112-13.
[5] Weddle 2001; The entire voyage is chronicled by Robert S. Weddle in this work.

Research Laboratory (CRL).[6] All of *La Belle*'s artifacts were conserved at the CRL, under the supervision of Helen DeWolf, a Postdoctoral Research Associate at Texas A&M. Nearly 160 artifacts associated with *La Belle*'s rigging were excavated in addition to hundreds of lengths of rope and cable. This amount of surviving rigging places *La Belle*'s artifacts among the few significant 17th-century rigging assemblages such as *Vasa* and *Kronan*. *La Belle*'s assemblage stands out still more because of its large percentage of iron hull fixtures, with the result that approximately 30% of the blocks and deadeyes in the reconstructed rig are represented by recovered artifacts.

The assemblage of artifacts recovered from *La Belle* reveals a relatively simple rig with features characteristic of the 17th century and the influence of Dutch rigging techniques. The rig's simplicity was probably dictated by the ship's small size but may also have been due to the large size of its crew. As a ship of exploration, *La Belle*, as well as the other three ships in La Salle's 1684 expedition, was adequately manned with sailors and soldiers. While it was in the best interest of merchant ships to carry the smallest crew necessary in order to maximize profit, naval ships had the benefit of large fighting crews who could follow orders and haul on lines; thus, managing a naval rig could depend on muscle rather than mechanical effort. Multi-sheave blocks that could do more work but at a slower rate were typically used by crews of smaller merchant ships; conversely, the larger crews of naval ships could use large single sheaved blocks, which were faster but required more physical labor. This may be what Enríquez Barroto referred to in his journal entry describing the discovery of *La Belle* the year after its wreck: "Even though they were ruined, the yards resting among the rocks, holding up the topsail sheets, we recognized by these things that she was a warship."[7]

Direct personal accounts of *La Belle*, such as that of Barroto, offer significant primary evidence for the reconstruction of the ship's rig. When combined with the sizeable

---

[6] Bruseth and Turner 2005, 32-63.
[7] Weddle 1987, 171.

assemblage of rigging artifacts, several significant conclusions about the rig present themselves: *La Belle*'s relative simplicity when compared to rated vessels addressed in contemporary treatises, its Dutch influence, and its characteristically 17th-century features. In order to reconstruct a complete picture of *La Belle*'s rig, the gaps in the material record must be filled in. This has been attempted in this work by means of scale drawings of the masts and spars, as well as the standing and running rigging, which have been based on the artifacts, primary accounts of *La Belle*, and contemporary sources such as nautical treatises, dictionaries, and ship models with original rigging. Because so little was recorded about rigging during the 17th century, particularly by the French, and even less about rigging a ship the size of *La Belle*, this effort has laid a foundation for future research into this subject, which, hopefully, the excavation of more French and other continental ships from this century will endeavor to expand upon.

The reconstruction of *La Belle*'s rigging is based first upon its artifacts, and second upon several primary records of *La Belle* itself: diaries kept by Henri Joutel and Jean-Baptiste Minet, sailors on La Salle's expedition, the ship's log kept by Enríquez Barroto, a Spanish sailor who later located the shipwreck, and archived documents from the shipyard at which *La Belle* was constructed. Beyond these primary accounts of *La Belle*, contemporary sources such as the material remains from other shipwrecks, shipbuilding treatises and nautical dictionaries, models with original rigging, and rigging plans were consulted to create a more complete picture. Because there is a dearth of 17th-century material relative to that available for the 18th century, it is necessary that all these sources be utilized in an attempt to create a more complete picture of a potential rig for a ship like *La Belle*. The following discussion addresses the merits of each source as it applies to such a reconstruction.

Primary Accounts of *La Belle*

The Diaries of Henry Joutel, Enríquez Barroto, and Jean-Baptiste Minet. The journals of two crewmembers in La Salle's company, Henry Joutel and Jean-Baptiste Minet, contain primary observations of *La Belle*, including details of its rigging and cannon.[8] Corroborating stories from these two men have been helpful in confirming interpretations from the material record. In addition, the journal of a Spanish sailor, Enríquez Barroto, who was among the crew who found *La Belle* a year after it wrecked, has been preserved with observations of the ship's rigging.

Minet left La Salle's expedition early with one of the two ships that remained, *Le Joly*. The flute *L'Aimable* had sunk and the ketch *Saint-François* had been captured on the voyage out. This left La Salle behind with only *La Belle* and remnants of his crew and settlers. Minet recorded that "the frigate *La Belle*" was given to La Salle by the king "instead of the little bark that was requested."[9] Minet continued to refer to *La Belle* as a frigate throughout his journal, but included little other information. In describing the events that led up to the wreck of *L'Aimable*, *La Belle*'s draft is hinted at when describing the depth of a bay which *La Belle* was able to enter, but *L'Aimable* with a draft of "eight to eight and a half feet" was not.[10] Minet included another brief account of an accident involving *La Belle* and *L'Aimable* that took place at two o'clock in the morning on December 17, 1684. Minet records that *La Belle* "was [driven upon her anchor] and struck *L'Aimable,* breaking the main yard. *La Belle* discovered that her mizzen mast and main topsail yard were broken."[11] This single observation is significant because it provides a firsthand reference to *La Belle*'s mizzen mast. Joutel's description of the accident with *L'Aimable* differs slightly, but not significantly. He

---

[8] Minet's first name was formerly unknown, but John de Bry, Director of the Center for Historical Archaeology in Melbourne, Florida, revealed its discovery in his June 1997 Letter to the Editor of Smithsonian magazine online, referencing the article *Sieur de La Salle's Fateful Landfall* published in the same journal by David Roberts: "In February I traveled to La Rochelle where I discovered the crew rolls for the *Aimable* and the *St. François*, as well as 37 individual contracts of engagement, all of them signed by each volunteer and La Salle. One of these contracts, dated July 3, 1684, was for Estienne Liotot, one of the two men responsible for La Salle's murder. In all, 70 new names have surfaced, including engineer Minet's first name: Jean-Baptiste" (June 1997 http://www.smithsonianmagazine.com/issues/1997/june/letters_june97.php?page=2).

[9] Weddle 1987, 84.

[10] Weddle 1987, 108.

[11] Weddle 1987, 92.

recounted that *La Belle* lost its mizzen, 100 fathoms of hawser and the anchor, and that *L'Aimable* lost its bowsprit yard and the topgallant sail, thus providing evidence for *La Belle*'s mizzen again.[12]

Barroto, a senior Spanish pilot, was sent to scan the wilderness coast west of Florida to locate the French invaders of what was then exclusively Spanish colonial territory.[13] In April of 1687, their expedition located the wrecked *La Belle*, and Barroto included many observations about its rigging and cannon in his diary. He first identified *La Belle* as French by the "three fleurs-de-lis on her poop." It was reported to him by scouts that it still had six cannon and two swivel guns. Most interesting was their observation that the yards and topsail sheets on the yard arms indicated that the wreck was a warship. Barroto concluded from his own observations that all its tackle was "very fine, new, and mostly of four strands."[14] At this point there is some confusion, either in original observation and recording, or in translation, because Barroto observed himself that five four-pound swivel guns "were still on their carriages, lashed to the ship's sides." This appears to be a description of the cannon and not the swivel guns. Barroto also described salvaging the double tackle that was not rotten, and other serviceable cordage including "30 fathoms of 8-inch cable." Most interestingly, he described the main yard, which was found on shore and measured at 16 cubits (24 English feet, 7.32 m). From this he estimated that *La Belle*'s keel was 24 cubits (36 English feet; 10.97 m). They took this yard as well as the yards from the mizzen and foresail, as well as several items not related to rigging.[15]

<u>Rochefort Archives</u>. *La Belle* was constructed at Rochefort in France during May and June of 1684, according to shipyard records dating to December of 1684 (after *La Belle* had reached the New World). These records report that *La Belle* was a bark of 40 to 45

[12] Warren 1998, 64.
[13] Weddle 1987, 129.
[14] Weddle 1987, 171.
[15] Weddle 1987, 172.

tons.[16] Research into the hull remains has shown the ship's recorded dimensions to be relatively accurate, but the recorded beam measurement has been shown to be 15 French feet (4.88 m), rather than 14 (4.27 m), through both geometric progressions as well as practical reconstructions from the preserved frames, the curves of which could only fit a 15-foot beam.[17]

Contemporary Rigging Assemblages

While there are no published reports on 17th-century French shipwrecks with which to compare *La Belle*'s assemblage, there are several European rigging assemblages from the century surrounding *La Belle*'s loss in the New World. Few rival *La Belle* in terms of size and variety, and most are not published and therefore their details are no easily available to general audiences. As a result, this research required extensive travel to various rigging assemblages in Sweden, where the most significant assemblages from the 17th century are housed.

Swedish Ships. Among the continental shipwrecks available for comparison, *Vasa* (1628) has the largest and most complete assemblage of rigging materials. On 10 August 1628, the Royal warship *Vasa* set sail on its maiden voyage from Stockholm harbor before large crowds of onlookers. Tragically, it sank in the harbor almost immediately with sails still set when a gust of wind forced the lower gun ports under water. *Vasa* was rediscovered in 1956 and brought to the surface intact in 1961, still equipped with ammunitions, sails, and provisions. Because of the way it was lost and subsequently exhumed, and due to the conditions of the frigid waters in which it rested for centuries, its preservation was remarkable. It would therefore be easier to list what the rigging assemblage lacks than what it includes. Unfortunately, very little rigging

---

[16] Rochefort Royal Shipyard Archives 1684.

[17] Grieco 2003a, 3-18; see also Grieco 2003b. Glenn Grieco, a model builder for Texas A&M's Nautical Archaeology Program, constructed a 1:12 scale model of *La Belle* based on Taras Pevney's (Texas A&M graduate student) hull analysis, which determined the basic hull proportions.

material is as yet published aside from the sails themselves.[18] This necessitated travel to Sweden in the winter and summer of 2002 during which time I personally examined the rigging items and the reconstructed rig that is on display in the Vasa Museum in Stockholm, Sweden. The artifacts have all been conserved and stored in the museum's large basement, where they are easily accessible and organized according to type. As well, an extensive database includes measurements and photographs of each. At the time of my visit, the museum was in the process of making formal photographs of each of the many artifacts, and is currently planning a formal publication of the rigging material. There are significant parallels between *La Belle* and *Vasa*, the most important of which are both types of töpplante blocks, or lift blocks, which will be discussed below.

Kronan (1665-1676), another famous Swedish warship, sank on 1 June 1676 in the Battle of Öland during the Scania War for control of the Baltic between Denmark and Sweden. Simon Rosenborg, an army Captain on board *Kronan* at the time of its loss, observed the response to the order to alter course during the battle that led to its loss: "make sure, for the love of Jesus, that the gun ports are closed and the cannon are secured, so that when we turn we do not suffer the accident that befell *Vasa*."[19] While the state of the gun ports is in dispute by other eyewitnesses, it is agreed that the ship was driven over onto its port side and that subsequently there was an explosion at midships, probably from the magazine. The ship and explosion are memorialized in a famous painting from 1686 by Claus Möinichen. In 1980, *Kronan* was discovered by Anders Franzén and, in 1981, Kalmar County Museum began its excavation, which yielded a significant rigging assemblage in terms of size, but not variety. Like *Vasa*, there is a significant amount published on *Kronan,* but very little about rigging has been

---

[18] Cederlund 2007; see also Bengtsson 1975, 27-41; Ohrelius 1962 includes photos of select blocks and deadeyes; Olausson, an unpublished paper on the conservation of the sails, on record at the *Vasa* Museum in Stockholm; Pipping 2000, 19-36, concerning the steering-gear.

[19] Einarsson 2001, 12.

included at this time.[20] While in Sweden in the winter of 2002, I also visited this assemblage, which is housed in the Kalmar Läns Museum in Kalmar, to study the rigging artifacts. This assemblage consists mostly of basic single, double, and treble blocks, deadeyes, and cleats. The most significant parallel with *La Belle* was the box-handle like fairleads, which are discussed in more detail below.

A small assemblage of rigging from the Jutholmen Wreck (ca. 1650-1700), a merchantman about half the size of *Vasa* that foundered in Dalarö Channel in the Stockholm Archipelago, has been published by Carl Olof Cederlund.[21] Other publications about the ship do not directly address rigging.[22] The rigging assemblage consists mainly of basic blocks and deadeyes with only two exceptions, but has a variety of cleats similar to *La Belle*'s as well. The assemblage itself is housed at the Sjöhistorika Museet in Stockholm, Sweden, from which I received a sampling of the artifact records.

Finally, several rigging items have been preserved from *Riksäpplet* (1663-1676), all the artifacts of which are housed at the Sjöhistorika Museet in Stockholm, Sweden. *Riksäpplet*, or Apple, along with *Kronan*, or Crown, and *Scepter*, or Scepter, was one of the *regalskepp* or "royal ships" of the Swedish Navy. Their names denoted the symbols of Swedish royalty. Like *Kronan, Riksäpplet* was sunk during the Scania War. I have not seen all of *Riksäpplet*'s rigging assemblage personally, but have seen records of selected items (blocks, parrels, sheaves, and deadeyes). None of these items provide significant parallels for *La Belle*, but it is interesting to note that at least one sheave had a bronze, triangular coak.[23] No coaks, nor evidence for them, were found on *La Belle.*

---

[20] Einarsson 1990, 279-97; see also Franzén 1989, 438-64.
[21] Cederlund 1982.
[22] Cederlund and Ingelman-Sundberg 1973, 301-27; see also Cederlund 1977, 87-99.
[23] Statens Sjöhistoriska Museet Archives 1981, 24.522; Record and photo of sheave with coak.

Finnish Ships. The Finnish frigate *Lossen* (1684-1717) has an interesting variety, but an apparently small assemblage, of rigging. Among the standard blocks, sheaves, and deadeye found was a cross-tree very similar to *La Belle*'s although more complete, with a portion of the trestle tree still attached. The cross-tree also had a vertical hole in the end through which a deadeye strap could extend for the futtock shrouds. On *Lossen*, however, this was most likely from a top mast, it being a larger ship than *La Belle*, which used this configuration on its lower masts as well. Cleats and fairlead trucks similar to *La Belle*'s were also recovered from *Lossen*. While this assemblage is published in Norwegian,[24] this ship is also discussed in an article in English that includes a summary of rigging artifacts.[25]

Dutch Ships. Probably more 17th-century Dutch ships have been excavated than those of any other nationality. Several have yielded rigging. A catalogue of artifacts from *Anna Maria* (1709), also know as "The Saltship," or Saltskutan in Swedish, has been published in Sweden. This assemblage is relatively large and has an interesting variety of items. The catalogue is published bilingually in English and Swedish and includes both photographs and drawings of the artifacts. Specific attention is given to a most interesting topsail sheet block, which is similar to, but not exactly the same as, the töpplante block found on *La Belle* and *Vasa*.[26] This block is also mentioned by Britt-Marie Petersen, who specifies that it was used on ships built in Holland or in Sweden by Dutch shipbuilders.[27]

The wrecks of four Dutch East India Company ships, *Batavia* (1628-1629), *Vergulde Draeck* (1656), *Zeewijk* (1725-1727), and *Zuytdorp* (1712), all have rigging assemblages but are unique in that they include iron components not commonly seen in ships that

---

[24] Molaug and Scheen 1983.
[25] Molaug 1998, 159-67.
[26] Petersen 1993.
[27] Petersen 1987, 296.

sank in northern waters.[28] *Zeewijk*'s rigging assemblage has been selectively published. The Western Australian Museum's Special Publication 10 is the most complete artifact catalogue available, while an initial site report published elsewhere provides a good description of the wreck site itself and the provenance of the artifacts.[29] The entire collection is available online through a database at the Western Australian Museum, but this does not include images of the artifacts or their measurements, only descriptions, notes, and artifact numbers. It is, however, an excellent means of knowing what materials are available for study.[30]

Batavia's rigging assemblage is still awaiting publication, although specific items were included with an artifact catalogue published by Jeremy Green.[31] The Western Australian Museum kindly provided a photo of a concreted chainplate from *Batavia* that indicates the ship had chain links rather than plates as used in *La Belle*.[32]

Many other Dutch ships from the century surrounding the loss of *La Belle* have been excavated, but they contained either very few or no rigging elements. This was due to a variety of reasons including the location of the wreck site, as in the cases of *Kennemerland* (1664), *Meresteyn* (1702), *De Liefde* (1711), and *Adelaar* (1728) (high-energy environments are not conducive to the survival of small objects made from organic materials), and the nature of the excavation itself, as in the cases of *Lastdrager*

---

[28] For *Vergulde Draeck* see Green 1977. *Zuytdorp* is only available through the online database at the Western Australian Museum: http://www.museum.wa.gov.au/collections/databases/maritime/artefacts/artefacts.asp.

[29] Ingelman-Sundberg 1978; see also Ingelman-Sundberg 1976, 18-33, Ingelman-Sundberg 1977, 230.

[30] Western Australian Maritime Museum (2007) http://www.museum.wa.gov.au/collections/databases/maritime/artefacts/artefacts.asp.

[31] Green 1989.

[32] On 6 January 2002, Myra Stanbury emailed me a digital photograph of artifacts 8417 and 8418, concreted deadeye strap and chainplates, from the *Batavia* archives at the Western Australian Museum, Perth.

(1653), *Witte Leeuw* (1613), *Curaçao* (1729), and *Slot ter Hooge* (1724).[33] In some cases, perhaps, there was no formal excavation, and only preliminary test pits were excavated (*Risdam* 1727).[34] In other cases, the ship was salvaged by looters and artifacts were sold or retained, or only later were the remains reported by archaeologists.[35]

A considerable amount of rigging was excavated from the Dutch East Indiaman *Amsertdam* (1749). Although it seems to be late for comparison to *La Belle*, its blocks and deadeyes are of similar form, and are made of the same material, elm (*Ulmus sp.*).[36]

English Ships. Two small naval vessels, *Dartmouth* (1690) and the Duart Point Wreck, the pinnace *Swan* (1653), have assemblages of rigging that will be published at a later date by Colin Martin. Some aspects of *Dartmouth*'s rigging are briefly outlined by Colin Martin.[37] An article about *Swan* includes references and excerpts from several primary sources, including a letter from a senior officer requesting, among other things, masts, sails, cable, blocks, parrels, and anchors. Many of these items include reference to sizes and quantities.[38]

Both the Port Royal Shipwreck (1692) and the English East India Company (EEIC) ship *Trial* (1621) have an insignificant amount of rigging. A catalogue of artifacts related to the Port Royal Shipwreck includes a deadeye (PR90 2076-19) and eyehook (PR90

---

[33] For *Kennemerland* see Forster and Higgs 1973, 291-300, in which the sheave recorded in figure 3 belongs to a much older wreck according to Tommy Watt, Curator at the County Museum in Lerwick, Shetland where the artifacts are house (27 November 2001, electronic communication); see also Price and Muckelroy 1977, 187-218, in which a coil of rope is included; Price and Muckelroy 1979, 311-20, for mention of rope fragments. For *Meresteyn*, on 18 December 2001 John Gribble of the South African Heritage Resources Agency (SAHRA) informed me that no small wood artifacts such as rigging survived. For *De Liefde* see Bax and Martin 1974, 81-90. For *Adelaar* see Martin 1992, 163-64.

[34] Green 1986, 93-104.

[35] For *Lastdrager* see Sténuit 1974, 213-56. For *Witte Leeuw* and *Slot ter Hooge* see Delgado 1998, 466, 389. For *Curaçao* see Sténuit 1977, 110-11.

[36] Marsden 1972, 89; see also Marsden 1975, 135, 153, figs. 20, 21, 24; Gawronski 1985, 75.

[37] Martin 1978, 29-58.

[38] Eames 1961, 49-55.

1052).[39] *Trial* may not have had more than one bronze pulley sheave, which is recorded in the online database available through the Western Australian Museum.[40]

Portuguese Ships. The rigging from the Portuguese frigate *Santo Antonio de Tanna* (1681-1697) comprises a large assemblage with some variety including iron components, which are rare.[41] Most interesting within this assemblage is a larger version of the topsail sheet block recovered from *Anna Maria*, a type of bock similar in appearance but not exactly the same as the töpplante blocks from *La Belle* and *Vasa*. As well, an interesting example of a fair lead was recovered.[42]

French Ships. Ships that sank about the same time as *La Belle* include the Le Natière Wrecks (early 18th century), and the ships from the Battle of Saint Vaast La Hogue (1692). Research from their excavation and rigging is not available. Web sites about each wreck site include photographs of blocks and tackle, but the finds are not discussed.[43]

Le Machault (1760) has a uniquely large assemblage of rigging, but these are probably slightly too late for effective comparison with *La Belle*. The wide variety in the assemblage includes both wood and iron artifacts. A complete artifact catalogue of the rigging has been published for internal use by Parks Canada.[44] The rigging artifacts are organized by type, and each artifact is introduced with a description of significant features, many measurements, and photographs from several perspectives. The

[39] Clifford 1993, 183, 237.
[40] Western Australian Maritime Museum (2007) http://www.museum.wa.gov.au/collections/databases/maritime/artefacts/artefacts.asp.
[41] Thompson 1988.
[42] Thompson 1988, 91-3, 121.
[43] For the St. Vaast La Hogue Wrecks, see L'Hour (2007) http://www.culture.gouv.fr/culture/archeosm/archeosom/en/houg-s.htm#retour. For the Le Natière Wrecks, see L'Association Adramar (2007) http://www.adramar.fr/index.php?id=20.
[44] Bradley 1980-1981.

assemblage consists of a wide variety of wood, iron, and rope artifacts; it is one of the most extensive assemblages of rigging excavated to date.

Shipbuilding Treatises and Nautical Dictionaries

Many naval treatises and nautical dictionaries were consulted in the reconstruction of *La Belle* in order to more clearly define the differences between English, French, and Dutch masting and rigging techniques in use during the 17th century. Seventeenth-century French treatises became the priority as research revealed the differences between each country's traditions, but 17th-century French sources on rigging are few and far between. Dassié's treatise, *L'Architecture navale*, the anonymous manuscript of 1670, SH 144, published by Jean Boudriot, and *Album de Colbert* of 1670 are significant in that they are among the few existing 17th-century French sources, and also because they are widely available. Sources not widely available are Desroche's *Dictionaire des termes propres de marine* (1687), and Estienne Cleirac's treatise *Explication des termes de marine* published first in 1636, and later in 1647 and 1660. The Phillips Library of the Peabody Essex Museum in Salem, Massachusetts, has Cleirac's treatise, and Lars Bruzelius has posted a transcription on his website, which includes an extensive collection of bibliographies and transcriptions of nautical sources such as this.[45] The special collections library of Louisiana State University owns Desroche's dictionary. Both may only be viewed in person.

L'Architecture navale. Dassié's treatise was first published in 1677, and was republished in 1695.[46] It is arranged into three books, the first of which includes 21 chapters on the construction of ships, including masts and yards and lines of rigging, as well as a list of French naval terms and their definitions. The second book is focused on

---

[45] Bruzelius (2005) http://www.bruzelius.info/Nautica/Etymology/French/Cleirac(1661).html.
[46] Dassié 1994 [1695].

the construction of galleys and chaloupes, which is outside the scope of this paper, and the third book discusses various anchorages and navigational routes.

The first book does not differ significantly between the first and second editions. It begins with a basic discussion of geometry, which is followed in chapters three through five with definitions of naval terms, types of ships, and ship parts. The most significant chapters relative to the reconstruction of *La Belle*'s rigging are chapters eight through twelve, which address proportions for masts and yards, the order of rigging a ship, the construction of the lines of rigging themselves, and the number and types of pulley blocks necessary for each line of rigging, mast, and yard.

While some of the definitions in the first chapters are vague, the rest of the text goes into great detail when compared to the nautical treatises that predate it. The discussion of the construction of the lines of rigging is unique in that it does not give the cords' diameters, but instead lists the actual number of strands and hawsers of which it should be made.

Manuscript SH 144. An anonymous manuscript, SH 144, included by Jean Boudriot in *The History of the French Frigate 1650-1850,* is housed at the Service Historique de la Marine at Vincennes. Boudriot has dated the manuscript to 1670 and translated into English the proportions recorded therein for masts, spars, and mast furniture for 4th and 5th rates and light frigates, primarily because proportions for ships of these sizes are rare.[47] The feature of greatest importance to this manuscript is the instruction that the ship's beam not include the frames, but to measure it inside the frames, which seems to be unique to this manuscript. Dassié does not further define "beam" among his masting equations, but does define it within chapters that deal with hull construction as a measurement including the frames. Because of this, in Appendix B of this thesis, where the mast and spar dimensions are recorded for each treatise, beam was measured inside the frames for SH 144.

---

[47] Boudriot 1993, 342 [SH 144 (1670)].

SH 144 also differs from other treatises, with the exception of Bouguer's (1746), because the proportions offered for calculating the diameters of masts are all large proportions of the mast's length ($^{1}/_{40}{}^{th}$ for example); the majority of others are given in terms of inches per yard in mast length, which is the same idea, but presented differently.

With both SH 144 and *L'Architecture navale* it appears that the fore yard was the primary yard. English and Dutch treatises treat the main yard as the primary yard and all other yard proportions are derived from it. Furthermore, Dassié clearly states that the fore yard is the primary yard, and bases its equation on the ship's beam, whereas the main yard is based on an equation involving the fore yard. Similarly, the fore yard in SH 144 is based on a calculation using the ship's beam; in this case, however, the main yard is calculated the same way.

Album de Colbert. The original *Album de Colbert* is preserved in the same location as the manuscript SH 144: The Service Historique de la Marine in Vincennes (catalogue no. 140-1 513). It consists of 50 plates that depict the building of a 17th-century first-rate ship. While this work is not a treatise like Dassié's and SH 144 discussed above, it belongs with this discussion because it is among those very few works detailing French naval practices from that century. While it does not contain lists of masting proportions, the plates are beautifully done and provide tremendous detail. Plates 38-50 include detailed masting and rigging that reveal several significant aspects of French rigging tradition, such as their use of blocks rather than hearts on the stays.

This variety of sources has been brought together in order to create a more comprehensive view of rigging in the 17th century. Comparisons between the physical evidence left from shipwrecks themselves and the textual evidence of contemporary treatises have revealed discrepancies, which provide interesting opportunities for interpretation. For example, a French ship may not necessarily have carried all the features of a rig suggested by a contemporary French treatise and, indeed, it may have incorporated some characteristically Dutch features. This approach is also necessitated by the lack of primary documents and rigging assemblages from the 17th century. No single primary document can provide a comprehensive view of a technology as complex and personalized as a sailing rig, but through a broad approach that considers textual and physical evidence, one can begin to see the variety of options available to the 17th century seaman.

CHAPTER II

ARTIFACT ANALYSIS

The excavation of *La Belle* produced an uncommonly large assemblage of rigging-related items–approximately 30 percent of the reconstructed rig is represented by recovered artifacts. Nearly 160 artifacts associated with the rig have been located in addition to hundreds of lengths of rope and cable. Several rope artifacts that were specifically identified include lower shrouds, futtock shrouds, portions of mainsail bolt rope, and a sheet. While the amount of surviving rigging places *La Belle*'s assemblage among the few significant assemblages of 17th-century rigging, it stands out even more because of the large percentage of iron artifacts. The iron preservation was the fortunate result of the wreck's location in waters more likely to preserve iron than those from which other ships of the 17th century have been excavated. It can also be attributed to conservation techniques that cast many of the iron artifacts from the natural moulds left inside concretions; this allowed for exact replicas of iron that had long since corroded.

Discussion of the artifacts is organized into sections first by material and then by type. Significant and unique artifacts are highlighted in the text, but a detailed record of every artifact can be found in the complete artifact catalogue in Appendix A.

Wooden Artifacts

The wooden artifacts consist of a variety of blocks (single, double, fiddle, pendant, and Dutch lift blocks), deadeyes, parrel trucks, cross-trees, a fid, cleats, and various types of fairleads. There were 69 individual items in all, and three composite artifacts of both wood and iron. The wood was treated in silicone oil rather than PEG (polyethylene glycol) resulting in a natural-looking wood that has retained a feel and weight similar to its original. Many of the artifacts look like they were only recently carved and not submerged for hundreds of years.

Blocks. Blocks are the most prominently represented wood artifact type. At least 42 blocks of several types are represented (table 1). The majority of the basic single and double blocks from *La Belle* had similar features (fig. 1). The shells were carved from one piece of wood, which in the case of *La Belle* was elm (*Ulmus* sp.) among analyzed samples.[48] This was a common material for blocks, and examples of other elm blocks were found on *Mary Rose* (1545), *Le Machault* (1760), and *Amsterdam* (1749). The sheaves of the blocks among tested samples were either ash (*Fraxinus* sp.) or elm (*Ulmus* sp.). This differs from those of *Le Machault* and *Amsterdam*, which had sheaves made of Lignum Vitae (*Guaiacum* sp.), a very strong wood commonly used in load-bearing rigging elements and peculiarly absent from among *La Belle*'s artifacts.[49] It also differs from *Mary Rose*, the majority of whose sheaves were of cast bronze, although its assemblage also included beech, birch, ash, and poplar sheaves.[50] The French shipwrecks from the Battle of La Hogue (1692) also had bronze sheaves, at least on their halliard blocks.[51] This is not to say that *La Belle* did not have sheaves of bronze or

[48] Samples from *La Belle* [artifacts 3302 (from sheave), 3315 (from shell), 3759 (from shell), 3389 (shell and sheave), 6013, and the mast fid] were analyzed by R. Bruce Hoadley, University of Massachusetts, Amherst.

[49] For *Le Machault*, see Bradley 1980-1981, 2; for *Amsterdam*, see also Gawronski 1985, 75.

[50] Mary Rose Trust (2007) http://www.maryrose.org/mary_rose_archive.html.

[51] L'Hour (2007) http://www.culture.gouv.fr/culture/archeosm/archeosom/en/houg-s.htm#retour.

Lignum Vitae; they may have been removed by the Spanish who discovered the ship a year after its wrecking and who recovered many items from its rig at that time.[52]

Table 1. *La Belle*'s blocks.

Artifact No.	Sub Type	Length (cm)	Width (cm)	Thickness (cm)	Sheave Diam. (cm)
NP	Single Sheave	23.9	18.4	9.9	14.5
695	Single Sheave	16.6	12.7	7.9	9.0
1592	Single Sheave	17.5	14.0	9.5	8.9
1599	Single Sheave	16.5	13.0	8.5	8.7
2083	Single Sheave	13.4	n/a	n/a	n/a
3100	Single Sheave	20.0	16.0	10.5	11.8
3101	Single Sheave	15.8	12.8	8.2	8.2
3315	Single Sheave	14.0	11.5	n/a	n/a
3326	Single Sheave	14.6	11.9	8.2	8.3
3419.80	Single Sheave	10.9	9.2	5.4	1.7
3759	Single Sheave	25.0	17.0	12.5	13.0
7215	Single Sheave	18.0	17.4	10.3	10.5
7727	Single Sheave	28.8	21.0	11.0	18.0
7737	Single Sheave	15.5	13.6	8.8	9.5
10445	Single Sheave	16.7	13.2	6.8	8.8
10513	Single Sheave	21.8	17.5	10.5	13.0
11305	Single Sheave	14.5	10.5	7.5	8.5
12209	Single Sheave	16.7	12.5	8.7	9.6
12504	Single Sheave	23.0	19.0	12.5	13.8
12947	Single Sheave	17.5	13.9	8.9	9.4
12981	Single Sheave	n/a	n/a	n/a	5.6
12995	Single Sheave	16.5	13.3	8.8	8.8
12997	Single Sheave	15.5	12.0	6.5	7.7

[52] Weddle 1987, 171-2.

Table 1. Continued.

Artifact No.	Sub Type	Length (cm)	Width (cm)	Thickness (cm)	Sheave Diam. (cm)
3302	Double Sheave	32.0	24.0	20.9	17.8
11302	Double Sheave	22.0	17.5	17.0	12.5
11317	Double Sheave	19.0	13.5	12.8	9.2
3395	Dutch Lift	27.5	10.5	7.3	8.4
12569	Dutch Lift	26.0	9.9	8.0	6.6
11341	Fiddle	29.1	11.3	7.0	8.8[53]
11379	Fiddle	31.8	13.3	8.5	9.7
11380	Fiddle	27.5	12.0	8.4	8.9
3389	Pendant	29.2	12.3	9.5	10.1

[53] The sheave measurements for the fiddle blocks' sheave diameters represent the larger of the two sheaves.

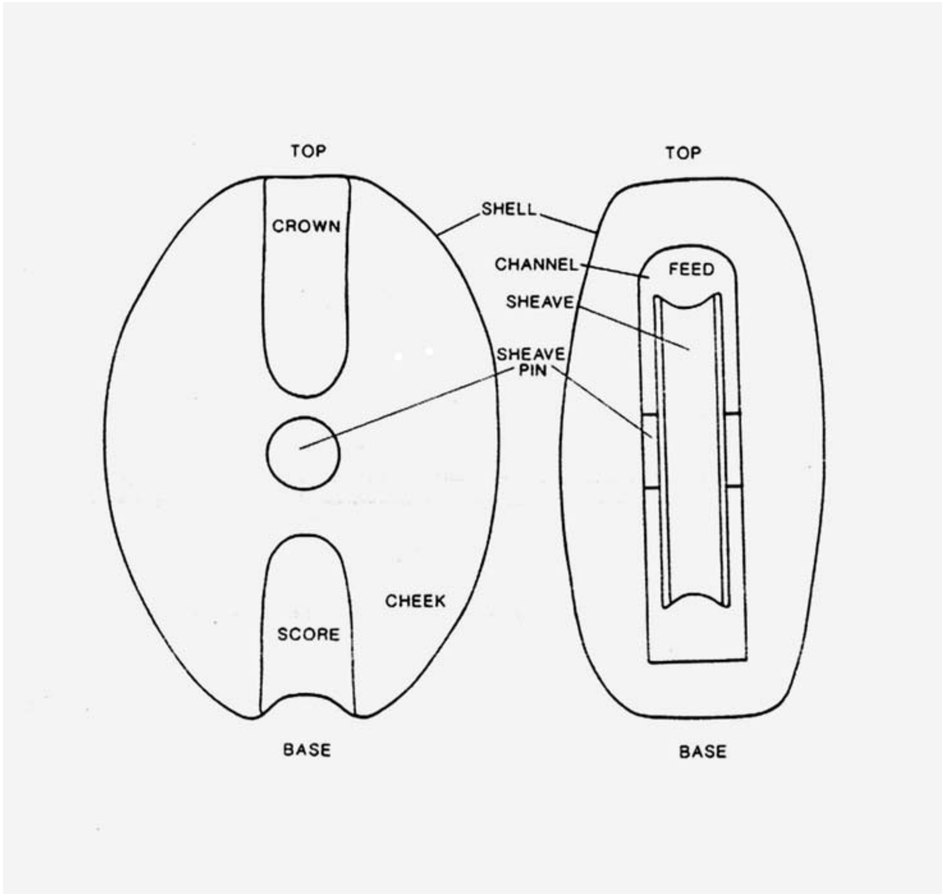


Fig. 1. Terminology for a standard pulley block. (Bradley 1980-81, fig. 1.)

Block 3740 is an excellent example of standard block construction (fig. 2). The shell is constructed of a single piece of wood with the channel carved out for the sheave, which is held in place by the sheave pin. The sheave pin works as an axle on which the sheave turns. A block that has been used will show concentric scoring marks on the pin or in the channel in the interior of the block. One side of the channel is rounded to accommodate the rope; this is the “feed”. The opposite end of the channel is flat, and not designed for rope to run through it.

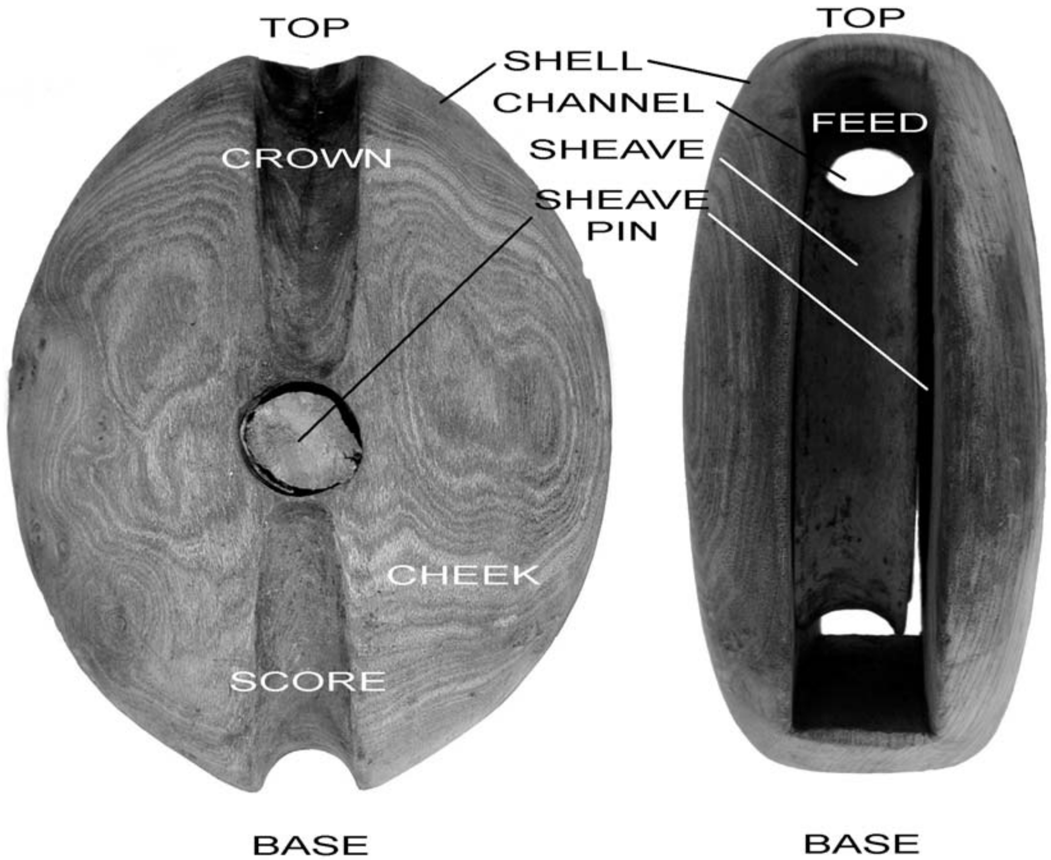


Fig. 2. Block 3740, a standard block, from *La Belle*. (C. Corder)

Blocks were stropped with rope that was set up around the outside of the block and set into its score. This held the pin in place and attached the block to the line of rigging it served; several blocks from *La Belle* were still stropped when excavated (fig. 3).

Fig. 3. Block 3419.8 from *La Belle* was still attached to a thimble and hook when excavated. (A. Borgens)

The scoring, which circumscribes the shell of the block, is not complete at the crown where the line of running rigging would have run through the feed. This is the top of the block where the splice in the strap is set up.

Block 3326, a single block, is unique in that its scoring is not complete at the base. Instead, the outer shell is essentially symmetrical as though it has two crowns (fig. 4). The interior of the shell, however, has a distinct feed indicated by its rounded channel to accommodate rope. In general this block appears somewhat more crudely made than the others, so its lack of a base could indicate carelessness or a mistake. It does not seem likely that it is merely incomplete since the channel is finished with a defined feed for rope, thus determining the base and crown. However, despite its incompleteness, its presence on the ship is an indication that sub-par rigging items were not necessarily discarded.[54]

[54] See discussion of distribution of stored rigging items below.

Fig. 4. Block 3326 from *La Belle*: channel and feed (left); exterior of shell with incomplete scoring (right). (C. Corder)

Aside from varying degrees of preservation, the remaining single- and double-sheaved blocks are consistent with the diagram in figure 1. In some cases definite signs of wear are apparent (concentric scoring around the middle of some pins and worn impressions from the sheaves on the inside of the shell all indicate use at some point in the life of the block), while others appear unused.

Three fiddle blocks were recovered (11380, 11379, 11341), all of which were found together, stored in the bow of the ship (fig. 5). The fiddle block is essentially two standard single-sheave blocks set together with the larger block serving as the crown and the smaller block the base for the combined block. By adding more sheaves to a tackle, more work can be done with less effort. A fiddle block could have been used in a four- or five-part tackle if used with a single or double block.

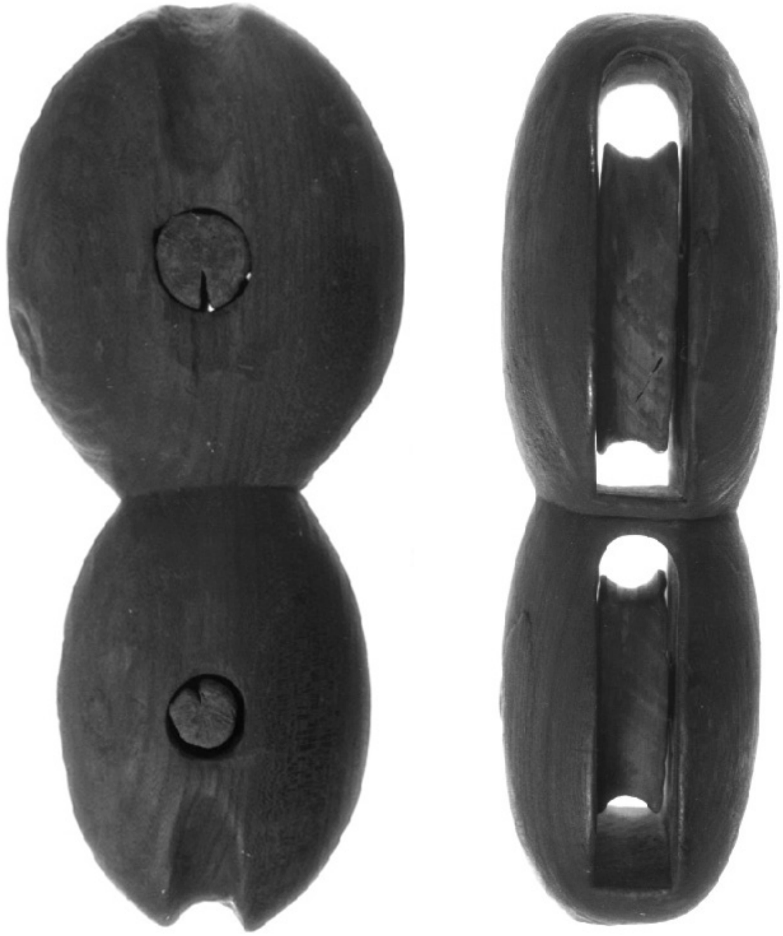


Fig. 5. Artifact 11380 from *La Belle*, one of three fiddle blocks. (C. Corder)

Most significant among the blocks excavated from *La Belle* are the Dutch lift blocks (fig. 6), and a pear-shaped pendant block. The lift blocks are unique to the 17th century, and are believed to have been used first by the Dutch exclusively on their lifts.[55] Of the known rigging assemblages, only *Vasa*'s also includes blocks of this type. However, it is well represented in 17th-century literature and ship models, and is the tell-tale sign of a continental rig during this century.

---

[55] Anderson 1994, 145-6.

Fig. 6. Artifact 3395 from *La Belle*, a Dutch lift block. (C. Corder)

The Dutch lift block is essentially a pendant block, meaning that it was designed to be suspended by a line of rigging, or pendant. A separate line of running rigging was run through the sheave of the block. In the case of the Dutch lift block, both sides of the channel are rounded and can act as the feed, making the block double-ended and therefore reversible. One side of the block would have been attached to the pendant suspended from the mast head, while the other side would have been the starting point for the line of running rigging that extended to the yard arm through a separate block and back to the sheave of the lift block, then down to a belaying point (fig. 7).

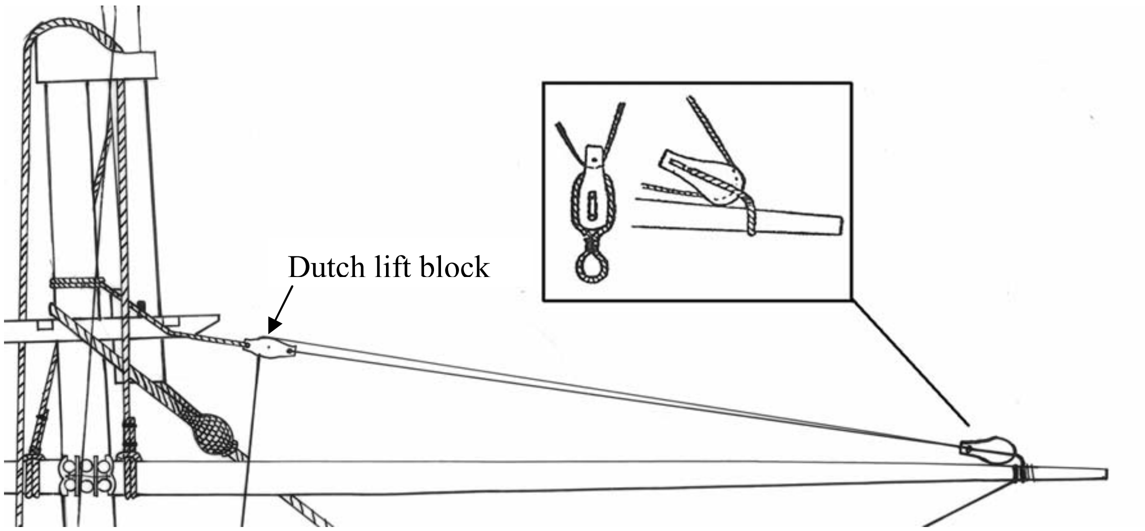


Fig. 7. Seventeenth-century Dutch design of the lower lifts with topsail sheet shown in inset. (C. Corder)

Two Dutch lift blocks were recovered from *La Belle* (3395, 12569). Block 3395 (fig. 6) is in better condition, but both are well preserved and are comparably sized. Block 3395 was found with a length of served hawser outside the port quarter, aft of the mainmast. Block 12569 was found farther astern, also outside the hull, but to the starboard side. Both blocks show signs of wear, and considering their position on the wreck site, were most likely in use on the mainmast at the time of the wreck.

The Dutch lift block was used in conjunction with a pear-shaped combination lift and topsail sheet block. This combination block had two sheaves set perpendicular to each other. The smaller sheave in the neck of the block received the lift, while the larger block received the topsail sheet (fig. 7).

Plate M from the 1691 Swedish treatise *Skeps Byggerij* by Åke Classon Rålamb (fig. 8) depicts both blocks (nos. 16, 18), identifies them as lift blocks, and links the style to medieval Holland.[56] Another block depicted in this plate (no. 15) is very similar to the

[56] Rålamb 1943, pl. M [1691]; see also Howard 1979, 136.

topsail sheet block. This block apparently lacks a sheave in the neck, having only a hole instead, and has an additional loop, apparently made of iron, in the opposite end. It is also labeled as a lift block, but there is no further explanation of its use. It is this block that looks most similar to the pear-shaped pendant block excavated from *La Belle* (artifact 3389) (fig. 9).

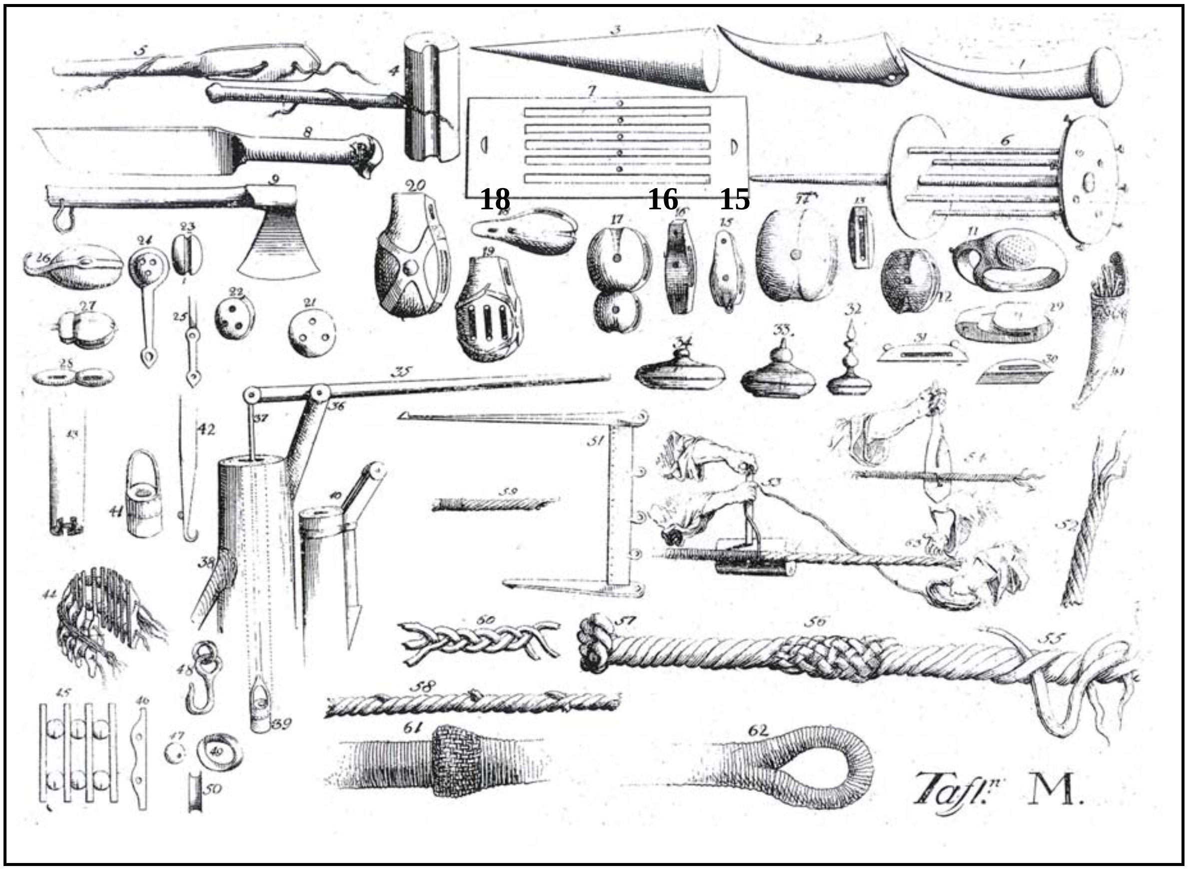


Fig. 8. Plate M from *Skeps Byggerij*, a 17th-century Swedish treatise. (Rålamb 1943, pl. M [1691])

Fig. 9. Artifact 3389 from *La Belle*, a pear-shaped pendant block. (C. Corder)

La Belle's pear-shaped block is similar in appearance to the more typical combination lift and topsail sheet block, but instead of having a second sheave perpendicular to the main sheave, it only has a hole. However, this pear-shaped block can be distinguished in form and function from the topsail sheet block because of the feed's location at the top of the block. This indicates that it is a pendant block designed to be suspended, a different configuration from the combination lift and topsail sheet block it otherwise so closely resembles.

The pear-shaped block in Rålamb's plate (no. 15) may also be a pendant block, but this can not be determined without more detail that unfortunately was not provided in the plate. The only known examples of the pear-shaped pendant block, in print or artifact, were excavated from the Swedish ship *Vasa*, where the block's function has also remained a mystery and has not been included in the reconstructed rig (fig. 10). It is significant to note that both blocks have a similar diagonal pattern of wear caused by the pendant from which they were suspended. This indicates the similar angle of the blocks in relation to their pendants.

Fig. 10. Artifact 19905 from *Vasa*, a pear-shaped pendant block.

Blocks similar in form were excavated from the Portuguese frigate *Santo Antonio de Tanna* (1697) and from the Dutch flute *Anna Maria* (1709) (fig. 11). However, in the case of the pear-shaped block from *Anna Maria*, the feed is on the opposite side, revealing a different purpose than the pendant block from *La Belle*. A traditional topsail sheet block was also found among *Anna Maria*'s rigging, and Britt-Marie Petersen has suggested the same use for this pear-shaped block, but with a modified form; the hole has been used in place of the second sheave in the combination topsail sheet block, functioning as a dead block.[57]

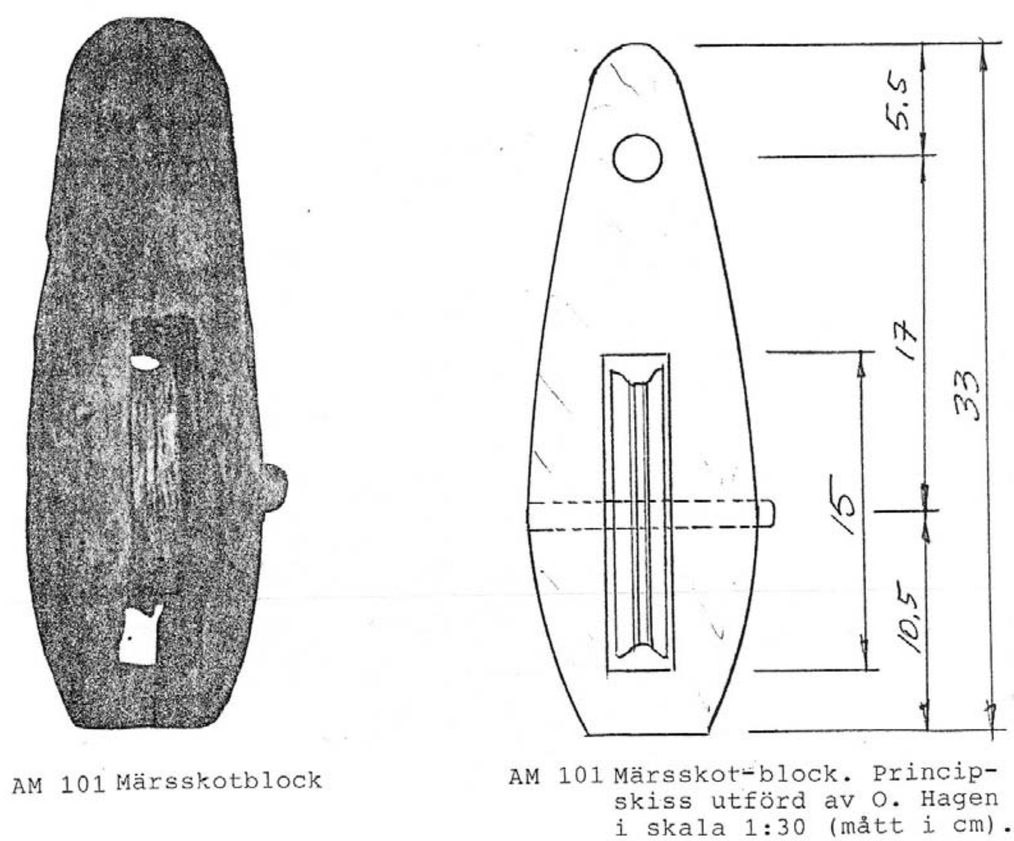


Fig. 11. The modified topsail sheet block from *Anna Maria*. (Petersen 1993)

[57] Petersen 1993, pl. 18.

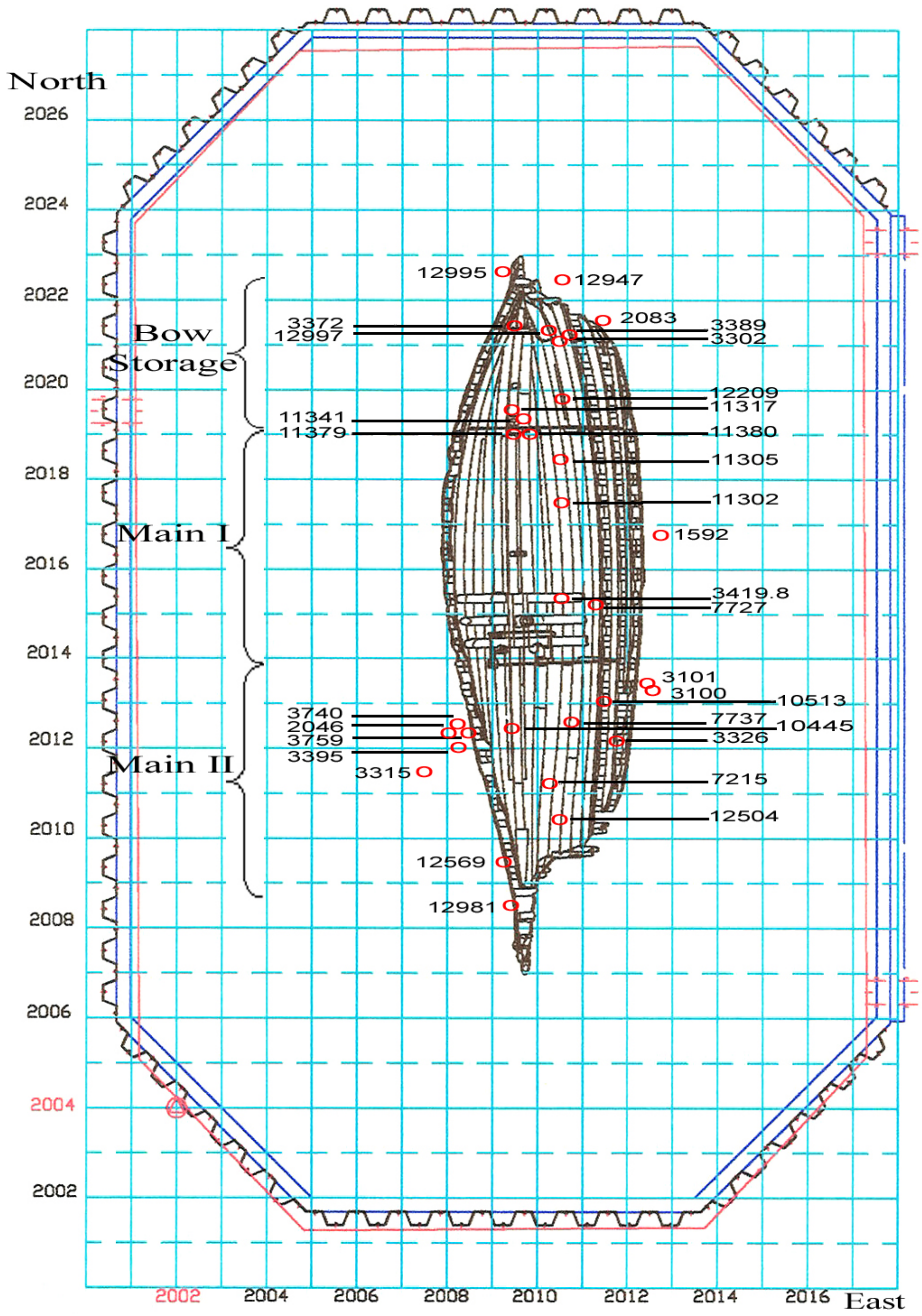


Fig. 12. *La Belle* site plan showing the distribution of blocks on the wreck site. (C. Corder)

The block from the Portuguese *Santo Antonio de Tanna* was extremely large, dwarfing even *Vasa*'s block, and was similarly declared a mystery.[58] Its feed is on the same side as the pear-shaped blocks from *La Belle* and *Vasa*, so it too must have been a pendant block and, although considerably larger, may have had a similar use. The distribution of this and all other blocks are shown in figure 12, the site plan of the wreck.

Deadeyes. Twelve deadeyes were recovered during the excavation (table 2). The majority of the deadeyes from *La Belle* had similar features (fig. 13). The standard deadeye was made from a single piece of wood, had three eyes for a lanyard, and was scored in its circumference either for a shroud or a deadeye strap. The scoring did not go entirely around the circumference of the deadeye–a base was left that corresponded either to the neck of the deadeye strap or to the splice of the shroud. If a deadeye were set up with an iron deadeye strap, the cross-section of the score was square to accept the strap, which was also square in cross-section (fig. 14). If a deadeye were stropped with a shroud, the cross-section of the score was rounded to accept rope. Deadeyes can thus be classified into two main categories, strapped and stropped, which are determined by their score.[59] Three of *La Belle*'s deadeyes were strapped. Iron corrosion product was found on deadeyes 10764 and 13009, and remains of the iron strap itself were preserved on artifact 3419.78.

Figure 13 also provides an excellent example of the standard shape of the 17th-century deadeye and the type of deadeye recovered from *La Belle*. These deadeyes were not as elongated as those from the previous century, such as the tear-drop-shaped deadeyes

[58] Thompson 1988.

[59] It is likely that deadeyes were made with a rounded score, and then an on-board carpenter or the rigger himself would have cut them to be strapped as needed (Olof Pipping, personal communication, 2002).

from *Mary Rose*.[60] In fact, their maximum height and width are typically similar, but tapering near the base recalls the tear drop shape of older deadeyes. *La Belle*'s deadeyes also have rounded faces, rather than the flat faces of early and pre-17th-century deadeyes.

Table 2. *La Belle*'s deadeyes.

Artifact N0.	Sub Type	Diameter (cm)	Thickness (cm)	Eye Diam. (cm)	Score Width (cm)
3419.2	Stropped	13.5	5.8	2.1	1.8
3419.78	Strapped	10.2	6.0	1.6	1.6
5501	Stropped	12.9	7.0	3.2	2.1
6058	Stropped	11.7	7.3	2.3	2.2
7227	Stropped	17.1	8.5	3.0	2.8
7294	Stropped	14.0	7.9	2.1	2.3
10764	Strapped	14.2	7.2	2.2	1.8
10739	Stropped	14.7	7.7	2.2	1.7
10788	Stropped	14.5	7.1	2.3	1.7
11361	Stropped	12.3	6.5	2.2	2.7
13009	Strapped	10.7	6.5	1.7	1.7
13277	Stropped	n/a	7.5	2.4	2.9

[60] Fisher 2002, 41-3; see also Rule 1982, 141-4.

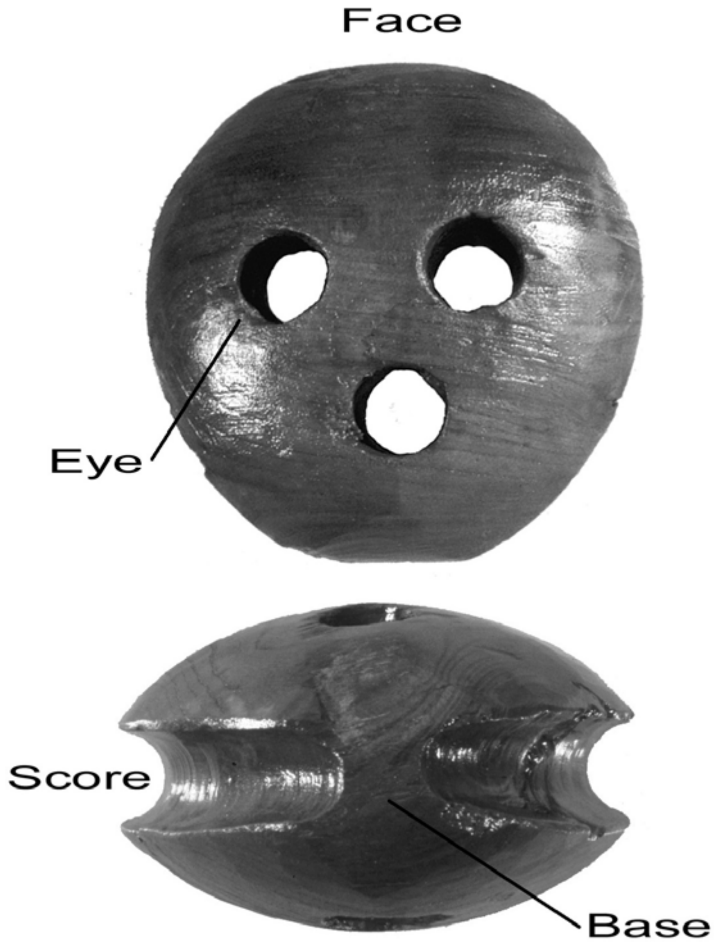


Fig. 13. Deadeye 6058 from *La Belle* shown with standard terminology for a deadeye. (C. Corder)

Fig. 14. Deadeye 13009 from *La Belle*, a strapped deadeye with score cut square in cross-section to admit a deadeye strap. (C. Corder)

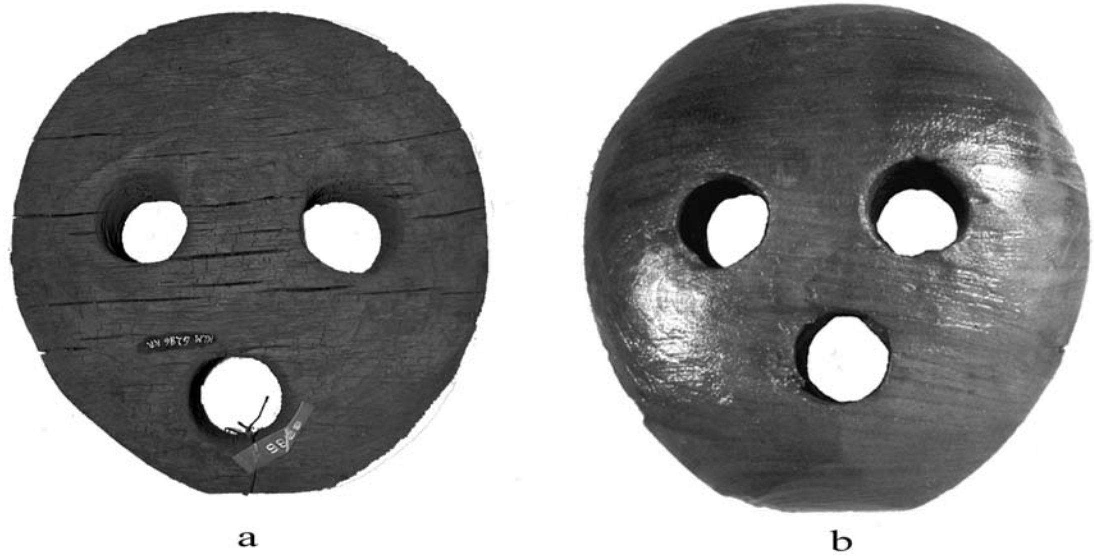


Fig. 15. Late 17th-century deadeyes: *a*, *Kronan* (1676); *b*, *La Belle* (1686). (C. Corder)

Early 17th-century deadeyes, such as those from *Vasa* (1628), had flat faces and their shape tended to be more angular, somewhere between the older tear drop shape of the 16th century and those from the late 17th century. Deadeyes from *Kronan* (1676) and the Jutholmen Wreck (1700) were almost identical to those from *La Belle*; they had rounded faces and were tapered at the base (figs. 15, 16). Later deadeyes followed the trend toward a rounder shape, and *Le Machault*'s (1760) deadeyes were entirely round in their circumference, and on their face.

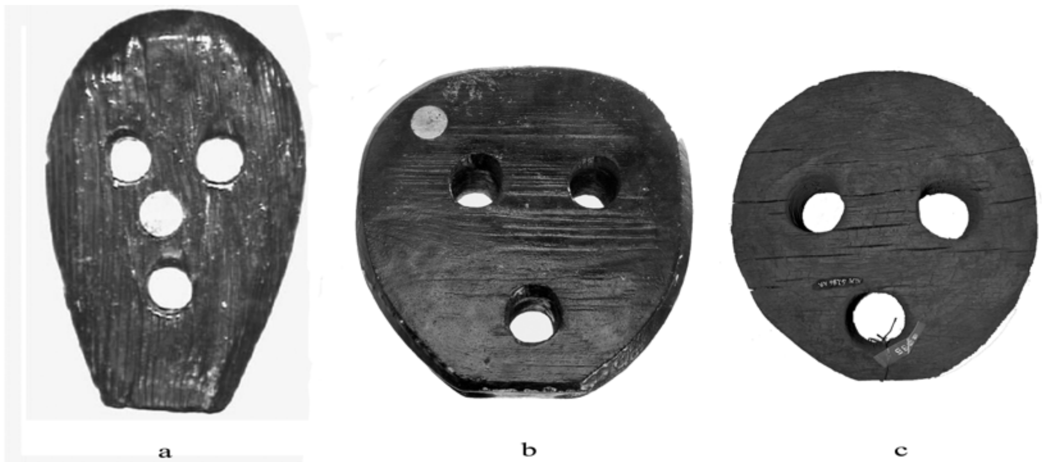


Fig. 16. Examples of the progression in deadeye shape from the 16th through the late 17th centuries: *a*, a 16th-century deadeye from *Vasa*; *b*, a standard deadeye from *Vasa* (1628); *c*, *Kronan* (1676). (C. Corder)

Two of *La Belle*'s deadeyes were entirely round in circumference, like those from *Le Machault*, but did not have bases.[61] This was not the case with the round deadeyes of the 18th century; they were round in circumference but still had a base. The reason for *La Belle*'s deadeyes not having a base is unclear. While the score could later be squared for a strap, a base could not be added, implying the incomplete channel was intentional. Furthermore, one of these round deadeyes was intended to be stropped (7294), while the other was still set into its deadeye strap (3419.78), indicating it was useful even without its base and could be fitted with a rope strop or a deadeye strap.

Of the twelve deadeyes, ten were recovered from within the hull of the ship, and so it is not likely they were in use at the time of the wreck (3419.2, 3419.78, 5501, 6058, 7227, 7294, 10739, 10764, 10788, 11361). However, six of these stored deadeyes show signs of use or were already stropped or strapped, and so had been used at some point (3419.2, 3419.78, 7294, 10739, 10764, 10788). Two of the deadeyes were too degraded to determine conclusively if they had been used (5501, 11361), and two that were in

[61] Bradley 1980-1981, 69, 76.

excellent condition showed no sign of use (6058, 7227). There were, however, few patterns in the location of these different types within the hull (fig. 17).

Two deadeyes were found in bow storage, which also held the largest portions of coiled rope and the skeleton of the one sailor whose remains were on board. Both deadeyes were found against the ceiling planking: one, which was preserved in excellent condition, on the port side of the keelson (6058); the other, on the starboard side (11361). Three deadeyes were found in Main I storage, which was the largest area below deck comprising the midships area around the mainmast step; two were within a cask (3419.2, 3419.78) and the third (5501) was found on the port side of the keelson. Four deadeyes were found in the Main II storage area abaft the mainmast step (7294, 10739, 10764, 10788). These four were all found together atop the ceiling planking and among several casks and coils of rope. All showed signs of wear and had similar dimensions. They comprised both strapped and stropped types, one of which still had lanyard rope in its eyes (10739). Deadeye 7227 probably should be identified as having been inside Main II, but was found at the extreme end of the stern where the hull was severely degraded. However, 7227 is in excellent condition, showing no sign of use, making it unlikely that it was in use when the ship wrecked.

This lack of organization indicates that a rigging storage area, common to orlop decks of larger vessels, was either not necessary on a ship the size of *La Belle* or simply was not used. It is possible that this disorganization reflects the similarly chaotic nature of La Salle's expedition at the time of *La Belle*'s loss, which followed the loss of all the other ships and most of the original colonists.

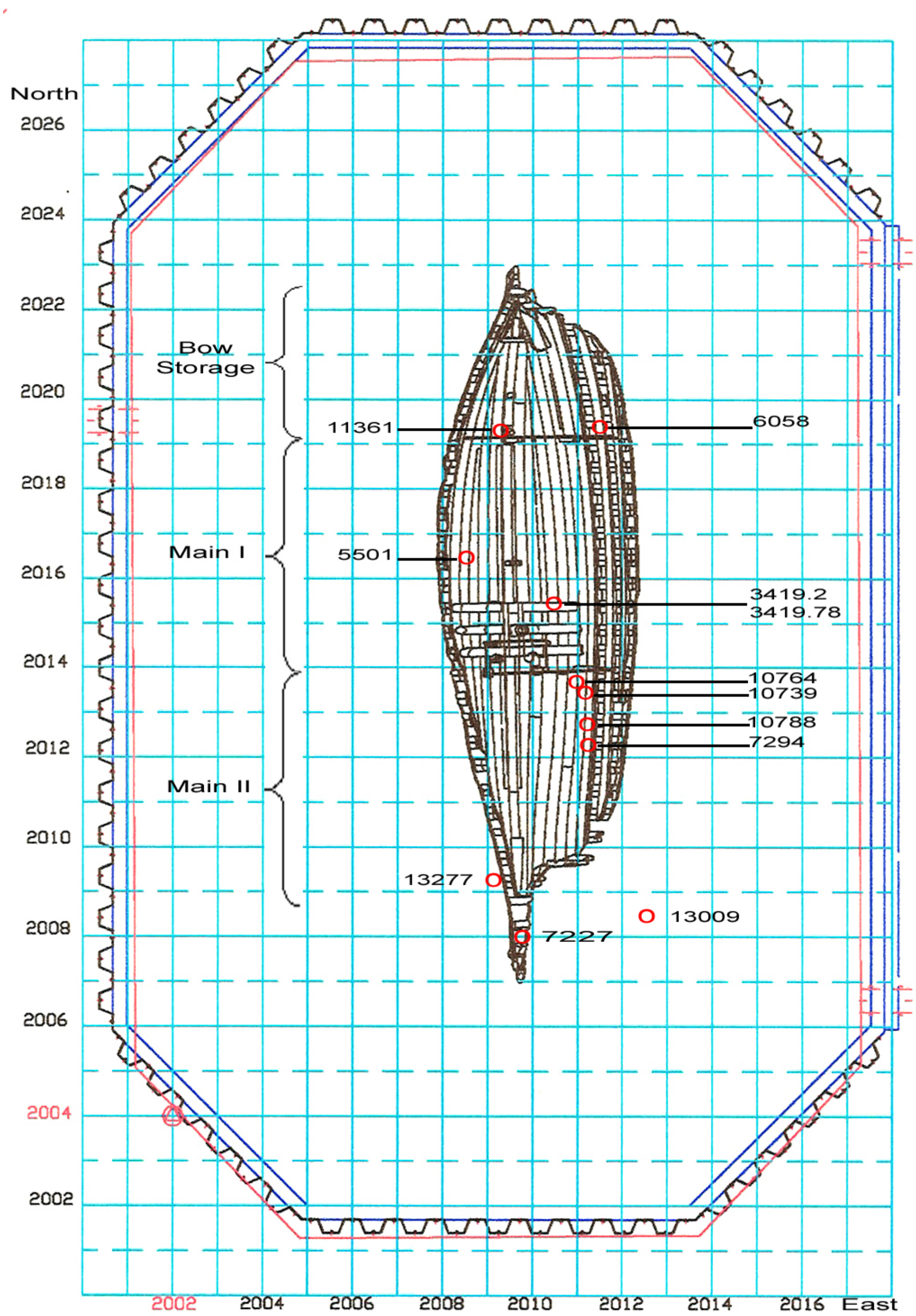


Fig. 17. *La Belle* site plan showing the distribution of deadeyes on the wreck site. (C. Corder)

However, the storage of used rigging implements may indicate thriftiness (if not neatness) among La Salle's crew, who were not unique among 17th-century sailors in this regard. Used rigging implements were also discovered among *Vasa*'s rigging stores, which included much older 16th-century deadeyes still set into their shrouds. It is significant that older used spares were part of the original stores of this well-furnished Swedish ship. These much older deadeyes no longer even resembled the contemporary deadeyes used in *Vasa*'s rigging, but apparently were considered useful for repairs and not disposable. In *La Belle*'s case, the crew is known to have salvaged as much as possible from *L'Aimable* when it was run aground, so the used rigging items may have belonged to that ship.

Two deadeyes were found outside the hull of the ship, both near the stern (13009, 13277). One was strapped, and located on the starboard side of the stern (13009), while the other was severely eroded (only one third of it remained) and located on the port side of the stern (13277). While artifact 13277 was the most poorly preserved of the deadeyes, it is one of the most significant to the reconstruction of *La Belle*'s rig. It alone still had portions of shroud set into its score. Having been found outside the hull, it was likely in use at the time of the wreck, and so confirms the type of shrouds in use on *La Belle*'s lower masts.

Trucks. Both parrel and fairlead trucks have been recovered from *La Belle*. While similar in name, they differ entirely in function. Parrel trucks together with ribs form a parrel system that works essentially like ball bearings to raise and lower the yards. A fairlead truck has a lengthwise groove on its side as well as around its circumference so it can be tied to a line of standing rigging. Another line of running rigging is drawn through the central hole in order to lead the line close to another, most often a shroud (fig. 18).

Fig. 18. A fairlead truck, artifact 4910 from *La Belle*. (C. Corder)

Parrel trucks were lathe-turned wooden "beads" drilled through the center to allow them to be strung on a rope. Together with ribs, which acted as separators for the trucks, they formed the parrel system that attached the yards to the masts and was used to raise and lower the yards as well (fig. 19). Three standard parrel trucks were recovered as well as a two-tiered parrel rib that was found in the extreme stern of the ship and may have belonged to the mizzen mast.

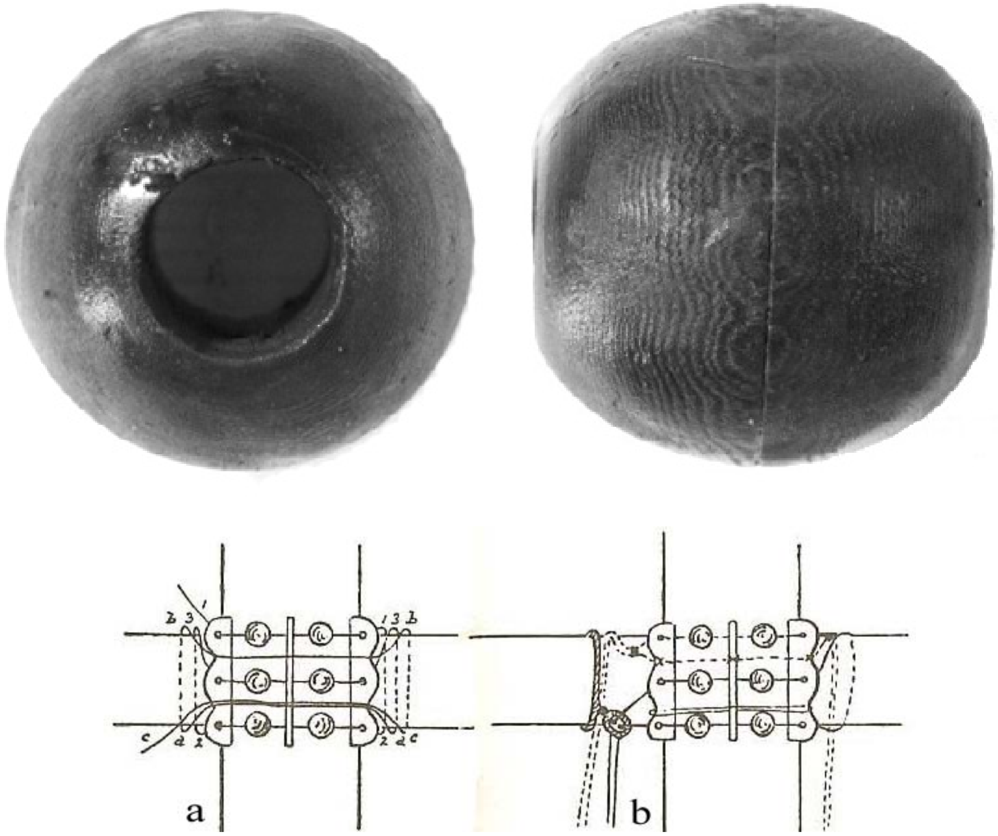


Fig. 19. A parrel truck, artifact 5152 from *La Belle.* (C. Corder) Shown with illustration of a complete parrel system: *a*, an English system of about 1625; *b*, a Dutch system of about 1680. (Anderson 1984, figs. 165, 166)

Cleats and Fairleads. Cleats were used to secure the ends of lines of running rigging, and many would have been attached to the hull of every ship. Two sizes of a standard cleat are represented in the artifact assemblage, as well as one fairlead. Two of the smaller cleats (11337, 10526) are between 27.0 and 33.4 cm long and 6.5 cm thick, while the two larger cleats (5107, 6285) are between 48.9 and 51.0 cm long and 9.0 cm thick.

A fairlead, like a fairlead truck, was used to lead a line of running rigging, but instead of being attached to a line of standing rigging, it was attached to the hull. *La Belle*'s fairlead was originally misidentified as a box handle, which is apparently a typical mistake for this type of fairlead (fig. 20). There were in fact very similar box handles in the 17th century; this is the reason the same mistake was originally made with the same type of artifact from the Swedish ship *Kronan* (1676).[62] Similar fairleads have also been excavated from the Norwegian frigate *Lossen.*[63] Fairlead 5519 from *La Belle* was located within the hull in the area called Main I, and its lead showed signs of wear. It appears to have been used at some point, if not at the time of the wreck.

Fig. 20. Artifact 5519, a fairlead, from *La Belle*. (C. Corder)

Among the standard cleats (fig. 21), only cleat 6285 was found outside the hull, and was apparently in use at the time of the wreck. It was located in association with the futtock shroud (artifact 6295) that was still attached to artifact 6013, the cross-tree and futtock plate from the fore topmast (fig. 22). This implies that this cleat may have been used with topmast rigging that was secured to the top.

[62] While visiting the rigging assemblage and artifact records from *Kronan* at the Kalmar Läns Museum in Kalmar, Sweden, I observed several fairleads of the same type as artifact 5519 from *La Belle* that were categorized as box handles; in photos without scales these items can appear to be the same type of object. In discussions with Lars Einarsson, the *Kronan* project director, it was explained that several fairleads had been originally misidentified as box handles because of their similarity.

[63] Molaug and Scheen 1983, 100.

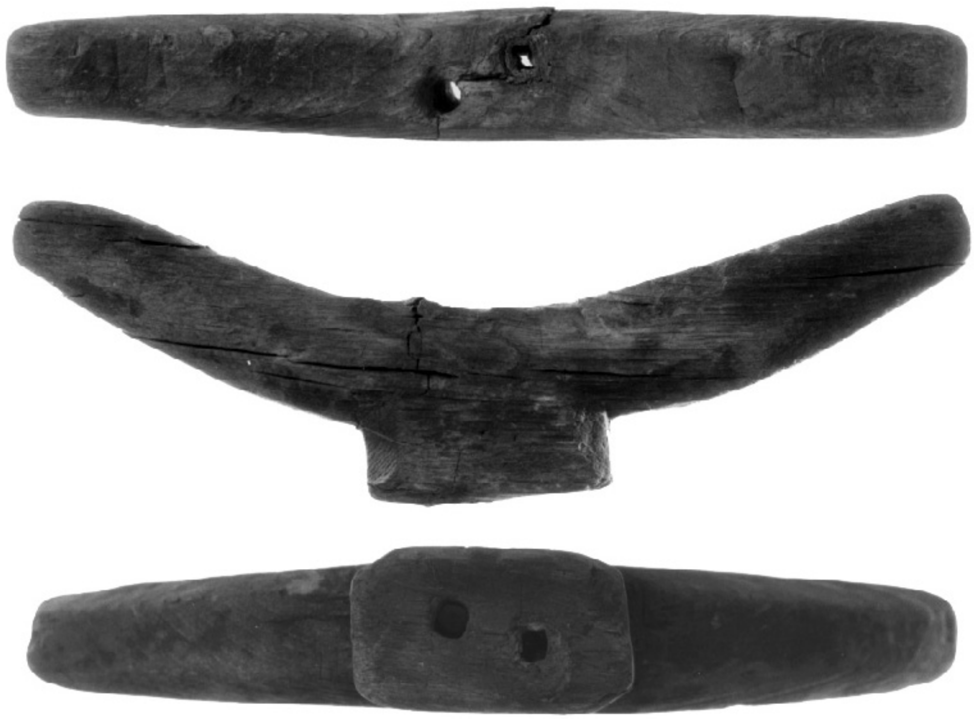


Fig. 21. A standard cleat, artifact 10526 from *La Belle.* (C. Corder)

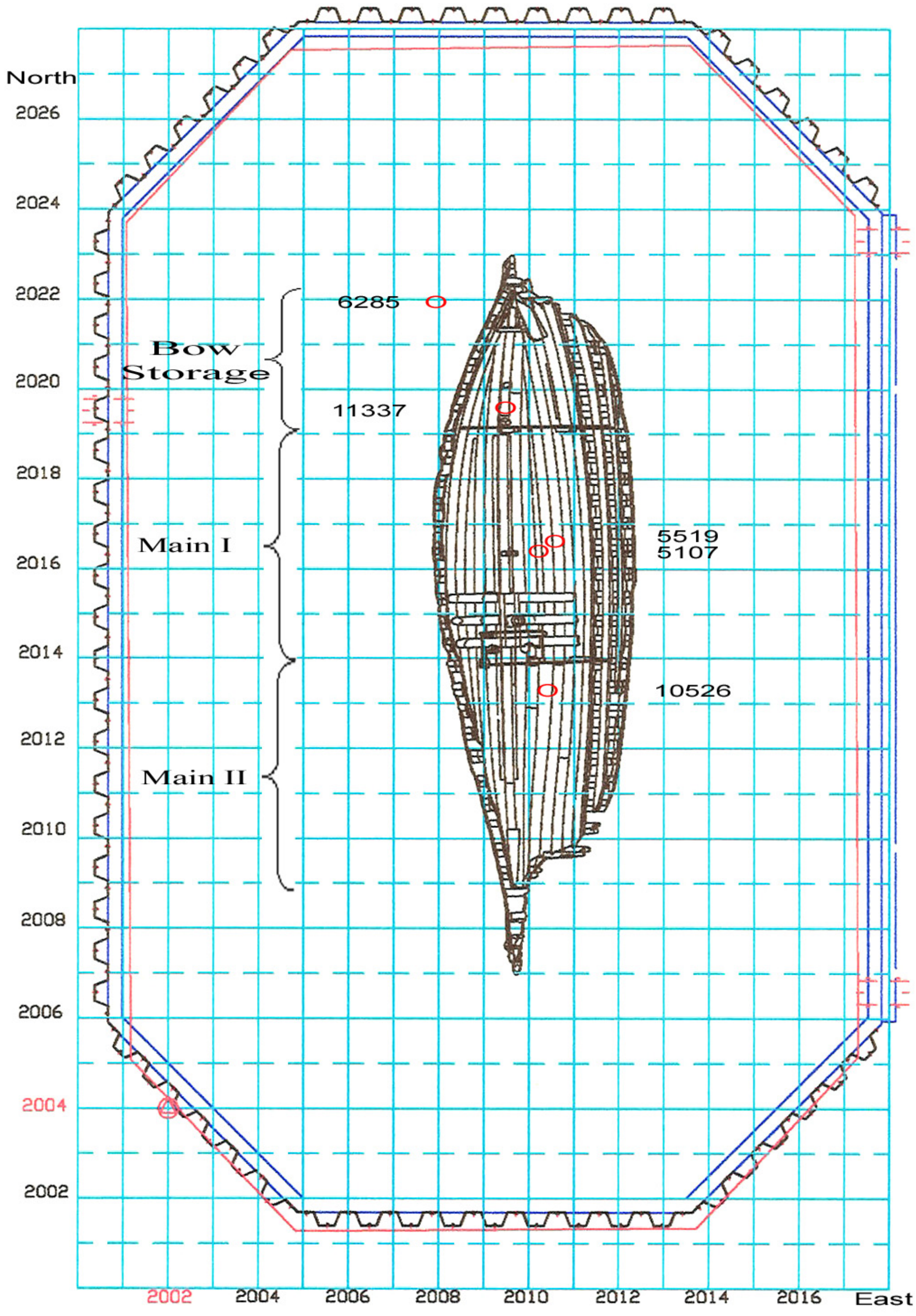


Fig. 22. *La Belle* site plan showing the distribution of cleats and fairleads on the wreck site. (C. Corder)

Topmast Rigging. Several rare examples of topmast rigging were recovered from *La Belle*: cross-trees (one with a futtock plate and deadeye strap set inside) and a topmast fid. Both the mast fid and the cross-tree were made of white oak (*Quercus alba* sp.) as was the hull.[64] This is a stronger wood than ash (*Fraxinus* sp.) or elm (*Ulmus* sp.) used for the majority of the rigging components.

One cross-tree was originally excavated with an oddly shaped concretion extending through its end (artifact 6013). An x-ray of this concretion revealed the artifact's purpose as a cross-tree with a combined futtock plate and topmast deadeye strap inserted through its end (fig. 23).

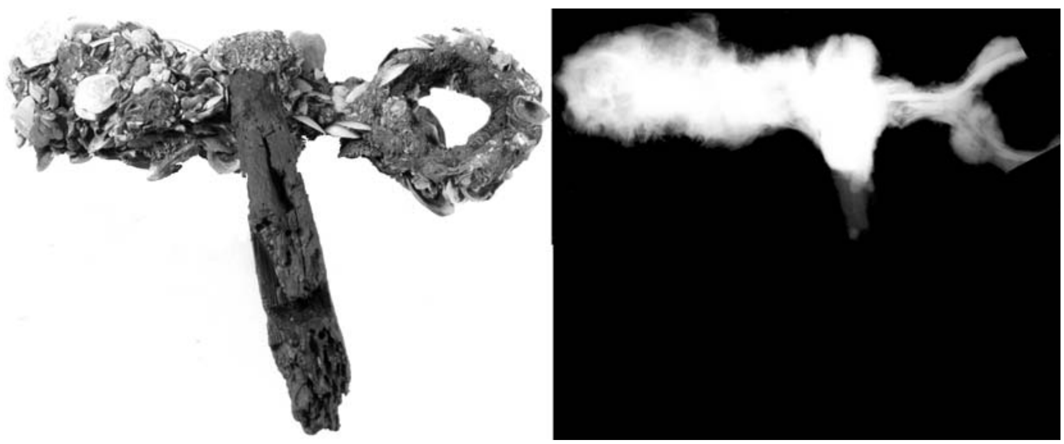


Fig. 23. Photograph and x-ray of cross-tree and futtock plate, artifact 6013 from *La Belle*. (A. Borgens)

The iron from the deadeye strap and futtock plate had entirely disintegrated, and a cast could only be made of the deadeye strap. However, the x-ray has revealed the form of the deadeye strap and futtock plate, and artifacts of the same type have been recovered as well, revealing further details of this artifact (this is discussed in the next section in more detail). The fact that the strap and futtock plate were set inside the cross-tree

---

[64] Samples from *La Belle* were analyzed by R. Bruce Hoadley, University of Massachusetts, Amherst.

presents evidence that *La Belle* did not have a top, per se, but merely cross and trestletrees (fig. 24). This is common in larger ships on the topgallant masts. *La Belle*'s topmasts were similar in size to a larger ship's topgallant masts, but this was apparently all that was necessary on the lower masts of a ship of *La Belle*'s size.

A similar cross-tree with a circular hole as if to admit a futtock plate was recovered from the Norwegian frigate *Lossen*, another rare find similar to that of *La Belle* in that it was relatively small.[65]

Fig. 24. Cross-tree, artifact 6013 from *La Belle*. (C. Corder)

One topmast fid was recovered, but unfortunately its provenance has been lost. This fid would have been inserted through the fore or main topmast to support the mast between

[65] Molaug and Scheen 1983, 91.

the trestletrees. Signs of wear suggest that it had been used at some point if not at the time of the shipwreck itself (fig. 25). Both ends are stained by tar that would have been used to protect the wood of the masts as well.

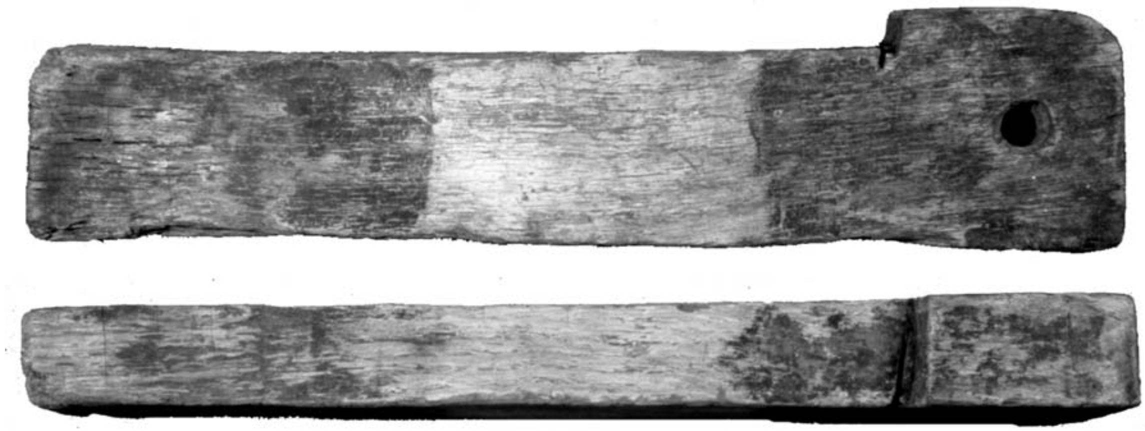


Fig. 25. Topmast fid, artifact without provenance from *La Belle*. (A. Borgens, C. Corder)

Iron Artifacts

Some of the most significant iron artifacts were actually no longer iron at all, but epoxy casts made from natural molds left inside iron concretion product. Wrecks in northern waters tend not to yield iron or concretions from which molds can be made, and while iron does not survive in warmer waters either, concretions of iron corrosion product are often formed that leave a hollow mold of the disintegrated artifact inside. An epoxy cast can be made from this mold revealing detail of an artifact long since vanished. This process has resulted in several exact replicas of deadeye straps and portions of chainplates (the iron fitting surrounding the lower deadeye from a shroud pair and connecting it to the ship's hull), providing a wealth of knowledge that would otherwise have been lost.

Deadeye Straps. The deadeye straps from *La Belle* were made of a single iron bar that was square in cross-section. The bar would have been hammered around the deadeye while still hot. The two ends of the bar met at the top of the deadeye's head in a v-shaped seam, which is still a standard join in blacksmithing. Deadeye 1586 is an excellent example of *La Belle*'s lower deadeye straps, of which five are represented in the artifact assemblage (fig. 26).

The form of these deadeye straps is not unique to French ships or the 17th century, but they are uniquely well-preserved replicas. A portion of a deadeye strap was recovered from *Amsterdam* (1749), and an intact deadeye strap with chainplate links was recovered from *Batavia* (1629).[66] Although over a hundred years apart and from different countries, they do not appear significantly different in form from each other or from *La Belle*'s deadeye straps. Given this dearth of material evidence, however, the several carefully-replicated deadeye straps and chainplates from *La Belle* make a uniquely large contribution to the body of evidence for iron hull fixtures from the late-17th century. Evidence has otherwise only been provided by contemporary ship models and paintings.

Lower deadeye straps were typically set into channels on the sides of ships. The neck of the deadeye strap was often secured by the channel itself. A strip of wood could be removed from the outer edge of the channel to free the deadeye strap for repairs or replacement (fig. 27).

---

[66] For *Amsterdam* see Marsden 1972, 89; see also Marsden 1975, 135. Detail about *Batavia* was communicated by Myra Stanbury on 6 January 2002 via email including a jpeg photograph of artifacts 8417 and 8418, a deadeye strap and chain links.

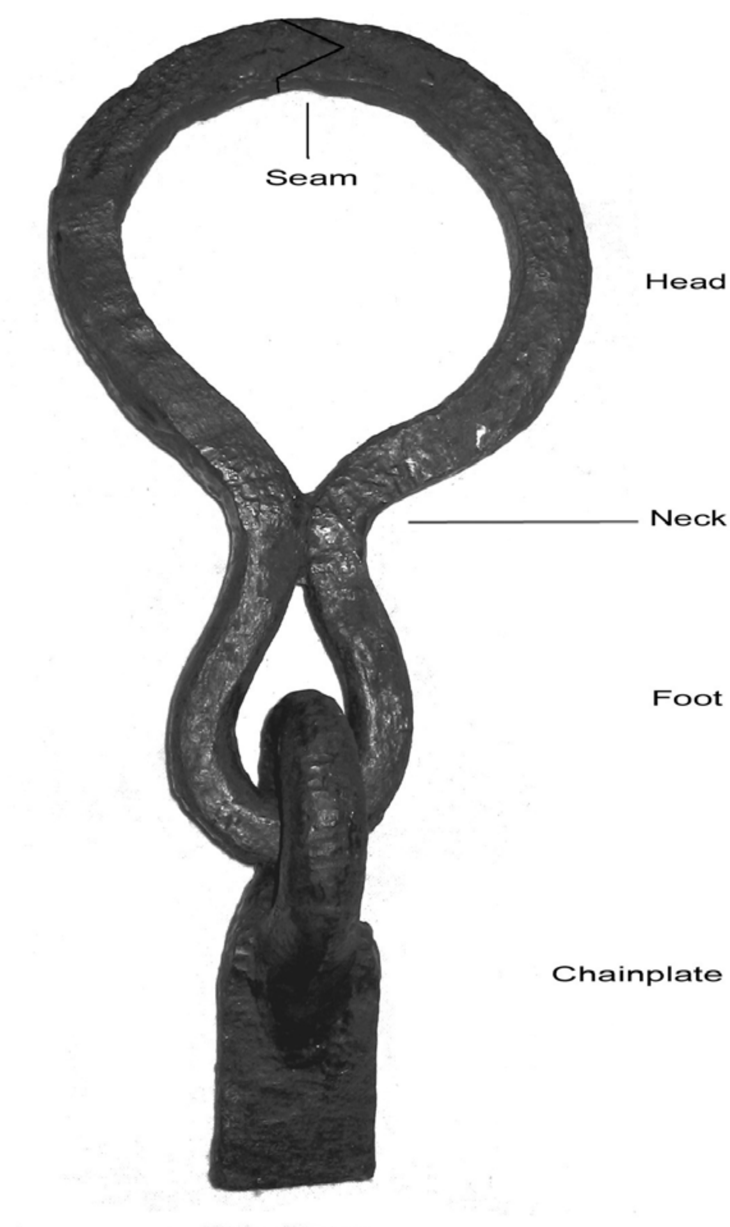


Fig. 26. Standard terminology for a lower deadeye strap, artifact 1586, from *La Belle*. The top portion of the chainplate is still attached. (C. Corder)

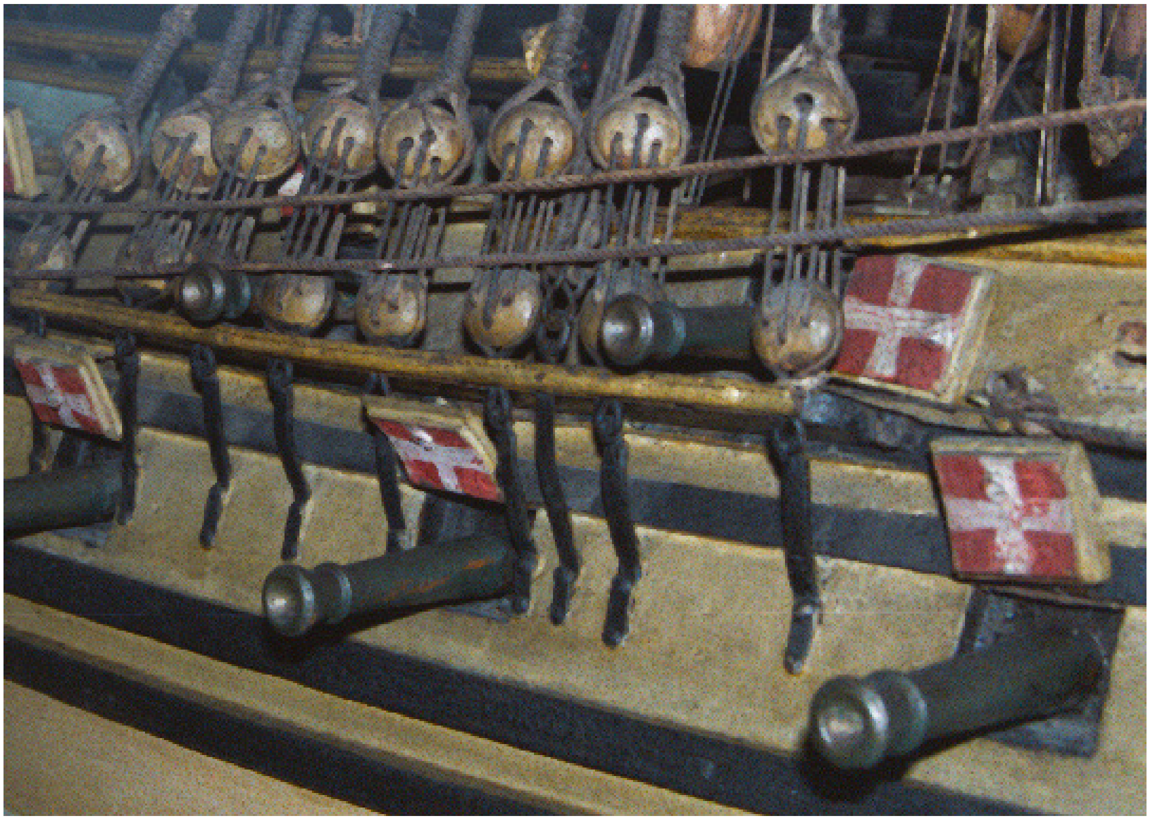


Fig. 27. Main channel of the Danish Church Model from Holmens Kirke (ca. 1680) in the Royal Danish Naval Museum (Orlogsmuseet), Copenhagen, Denmark, demonstrating the standard configuration for deadeye straps in channels. (C. Corder)

La Belle's chainplates were configured a little differently, however. Casts from two of *La Belle*'s deadeye straps revealed they were loose and had corroded after falling back on themselves once the shrouds rotted away. The concretion stopped at the point where the chainplate apparently entered the wood of the channels. The chainplate itself was thus set in the channels, and not the neck of the deadeye strap. The cast artifact also revealed that *La Belle* used flat iron straps and not lengths of chain, as was common earlier in the 17th century, and during the 18th century (fig. 28).[67]

---

[67] *Batavia*'s chainplates were chain links in 1629 when it sank (see supra no. 66).

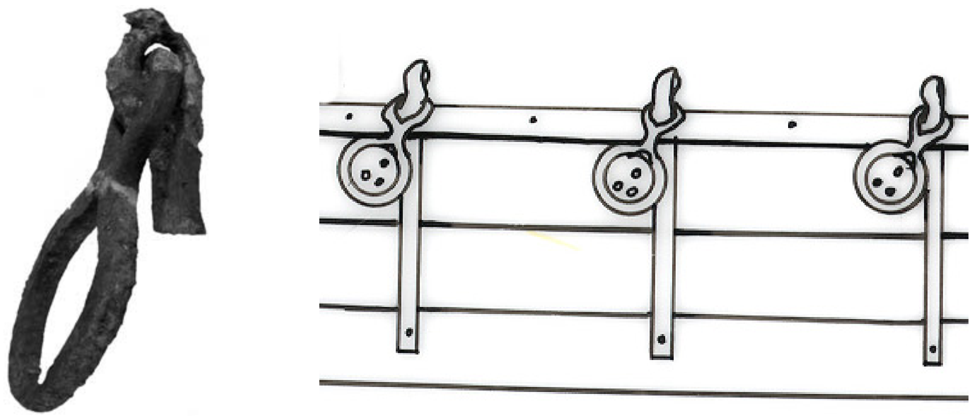


Fig. 28. Deadeye strap, artifact 1586 from *La Belle*, shown as it was configured inside its concretion, and with detail of the reconstruction illustrating how the strap was set into the channel. (C. Corder)

This loose configuration is not common throughout England, but has been seen in continental models and paintings from the 17th century. The model of the Danish *Norske Løve,* or Norwegian Lion, of 1654 has similarly strapped deadeyes.[68] *Vasa* has been reconstructed with this sort of chainplate as well, but this was not based on material evidence because very little iron was preserved from *Vasa*. *Vasa*'s modern-day riggers took this feature from contemporary ship models such as *Norske Løve*.[69]

Topmast Deadeye Straps and Futtock Plates. Portions from the topmasts' rigging—a rare find in shipwreck sites—have also been recovered from *La Belle*. As previously noted, a cross-tree was found with a topmast deadeye strap and futtock plate still inserted through it (artifact 6013) (figs. 23, 24). This is a variation on a common system for attaching the topmast's shrouds to the top itself. The bottom deadeye of the topmast shroud pair was strapped in the same way as the lower masts, but rather than having a foot, the neck of the deadeye strap became a futtock plate. Often, the futtock plate was a flat plate (thus the term) to which the futtock shrouds were attached in order to direct the force from the topmast shrouds to the lower shrouds. The futtock plates on *La Belle*

[68] This model is housed in Rosenborg Castle, Copenhagen (see infra fig. 51).

[69] Olof Pipping, who directed the reconstruction of *Vasa*'s rig at the *Vasa* Museum in Stockholm, communicated this to me when I visited the museum in January, 2002.

were apparently not plates, however, but rounded eyebolts. A partial topmast deadeye strap from *La Belle* shows how the strap, which is square in cross-section, becomes round at the neck (fig. 29). The rounded portion originally was curved around at the bottom like an eyebolt to form a loop to which the futtock strap could be attached. Deadeye strap 6013 was made the same way, and is pictured below with a partial futtock strap (artifact 2004) that demonstrates how the bottom half of the artifact would have appeared (fig. 30).

Fig. 29. A topmast deadeye strap and partial futtock plate, artifact 12576 from *La Belle,* demonstrating the visible seam at the deadeye strap's neck as it transitions from square to round in cross-section. (C. Corder)

Unlike the standard eyebolt that would have been used with a ring called a ringbolt as a belaying point, the eye of the futtock plate is not complete. The lower end of the strap would have been inserted through the cross-tree, and only then curved around to form the eye (fig. 30).

Fig. 30. A futtock plate (left, 2004), and topmast deadeye strap (right, 6013) from *La Belle*. Futtock plate 2004 demonstrates the type that was once attached to the deadeye strap at right. (C. Corder)

Unlike the lower deadeye straps, these examples of topmast deadeye straps are unique in form. The Dutch treatise, *L'Art de batir* (1719), shows a similar futtock plate (fig. 31).[70] It is also paralleled in a Spanish treatise originally published in 1719, *Architectura naval antigua y moderna*, in which plates 52 and 69 illustrate the deadeye strap both alone and set up with futtock shrouds (fig. 32).[71] However, both of these representations imply a curvature to the futtock strap, and this is not the case with the artifacts from *La Belle*. Aside from these examples in print, the material evidence from artifact collections and

[70] Anonymous 1719, pl. 6, no. 3.
[71] Victoria 1756, pls. 52, 69.

contemporary ship models is silent about this form. *La Belle* demonstrates, however, that the style was not unique to the Spanish or the Dutch, and was known at least from the late-17th into the mid-18th centuries.

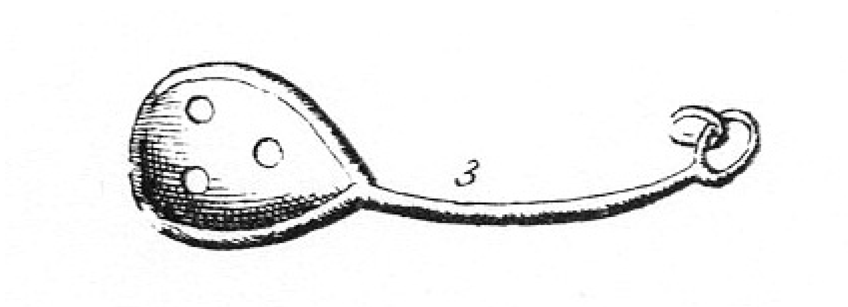


Fig. 31. Deadeye strap from *L'Art de batir les vaisseaux*. (Anonymous 1719, pl. 6, no. 3)

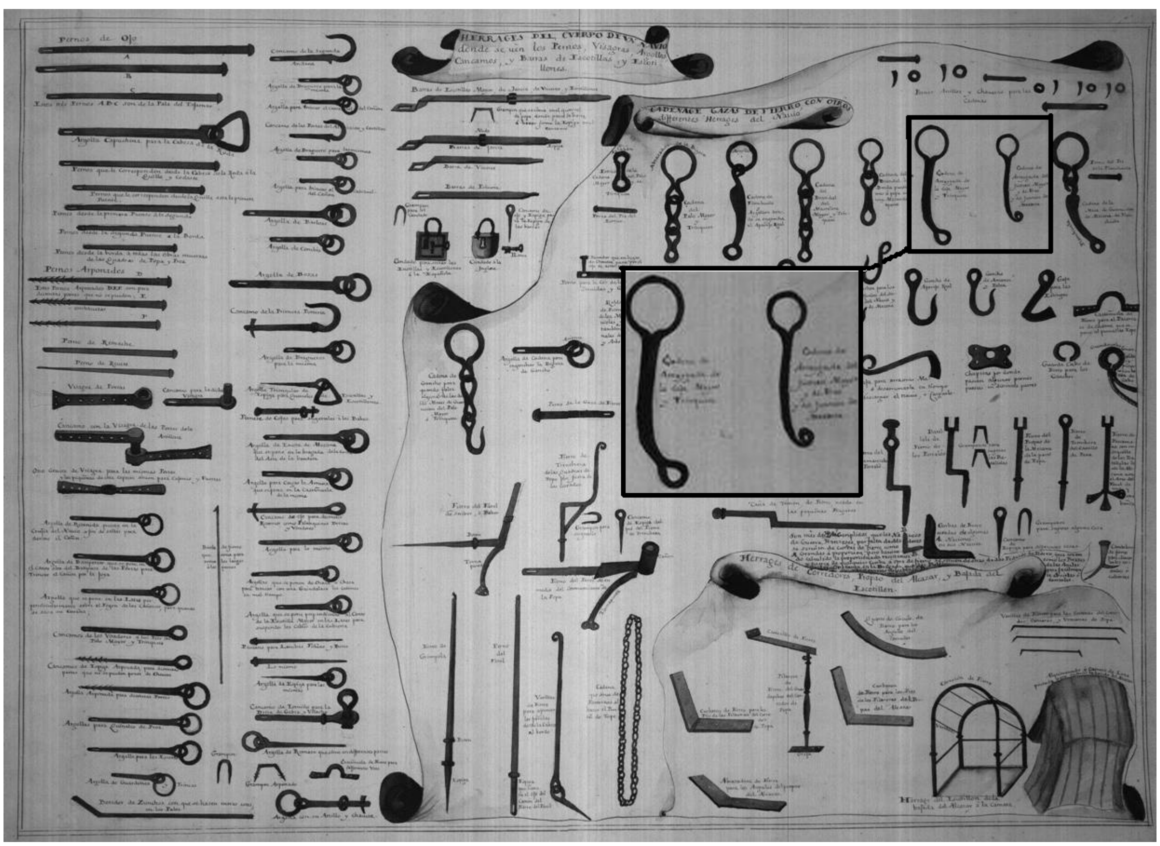


Fig. 32. Plate 52 from *Architectura naval antigua y moderna*. (Victoria 1756)

Rope Artifacts

Hundreds of individual lengths of rope were recovered from *La Belle*. Like the wooden artifacts, the rope was treated with silicone oil. This has preserved the cellular structure of the fibers, resulting in intact and pliable lengths of rope. Although several large coils were recovered intact, most of the catalogued finds represent short lengths of hawser or shroud-laid rope, but among these, several can be identified as to their function in the rig (bolt rope, portions of a lower shroud and a futtock shroud, sheet and clew garnet strops, and a tack).[72]

Hawser is comprised of strands, which are in turn made of many short rope yarns that are set up left-handed (i.e., the yarns of the strands appear to angle down from left to right).[73] Three strands are set up right-handed to create hawser (i.e., the strands of the rope appear to angle down from right to left). Four strands that are set up right-handed create a shroud-laid rope. Three hawsers or three shroud-laid ropes can be set up left-handed to create a cable. These different types of lines were employed for different tasks throughout the rig, but not consistently by all naval traditions. The term "shroud-laid", for instance, implies that the use for a four-stranded right-handed rope was a shroud, but this English term is not necessarily appropriate for all other rigging traditions. In France in 1677, Dassié wrote that "the main shrouds, the fore shrouds, and the others, ought to be of three strands."[74]

Rope that was likely to be long-exposed to weather or extended chafing was occasionally wormed, parceled, or served. Worming (the filling of the division between

---

[72] Alternately spelled clewgarnet, clew-garnet, cluegarnet, clue-garnet, and clue garnet. A clew line, with these same spelling derivations, referred to sails other than the main and fore courses in the 18th century, while clew garnet seems to have referred only to the main course in the 17th century, when clewe was also an accepted spelling (Manwayring 1972, 26 [1644]).

[73] In other archaeological contexts, this is referred to as s-twist (left-handed) and z-twist (right-handed).

[74] Dassié 1994, 53 [1695]. The 1677 edition was reprinted in 1695.

strands by passing yarn along them) and parceling (wrapping tarred canvas around rope) are not seen among the rope recovered from *La Belle*. They are not described in the French sources consulted here, either, but neither is serving (wrapping strands around rope) and yet it is prevalent among the recovered samples from *La Belle*. Wormed and parceled rope may have existed among *La Belle*'s artifacts, but did not survive.

Worming strengthened rope and created a smooth surface for parceling, which protected the rope from weather and abrasion. Some portions of rigging were commonly wormed and parceled because they were more subject to such abrasion. If a rope were both wormed and parceled, it could finally be served to further protect the rope and secure the parceling; however, *La Belle*'s rope was only served, and neither wormed nor parceled. Serving was generally an easier task than either worming or parceling, so the lack of these features on *La Belle*'s rig may reveal a "cheaper" product because it was faster for the rigger. However, when *La Belle* was discovered a year after it wrecked by Enríquez Barroto, a Spanish sea Captain, Barroto himself described its tackle as "very fine, new, and mostly of four strands."[75] Barroto also described gathering up "some cordage that still might be serviceable… and some 30 fathoms of 8-inch cable."[76] It is therefore also possible that the better (or at least better-preserved) cordage was scavenged by the Spanish in 1687.

<u>Bolt Rope</u>. Bolt rope (fig. 33) is a general term for rope attached to the edge of a sail. Thirteen individual lengths of identifiable bolt rope (12 hawser-laid and one shroud-laid) were recovered from *La Belle*. Many of these have remnants of the marlin hitching used to secure the sail to the rope; the hitchings were spaced approximately every 2.5 cm, or between each strand. Most bolt rope fragments cannot be associated with a particular sail, but at least two of them(3101.13, 3101.19) can be identified as probably having been attached to the main sail. The associated blocks, 3100 and 3101, were a sheet

---

[75] Weddle 1987, 171.
[76] Weddle 1987, 172.

block and a clew garnet block, respectively, recovered with large portions of the sheet, clew garnet strop, tack, and the clew of the sail. The entire assemblage was outside the ship's hull, amidships on the starboard side (fig. 12). Rope fragments 3101.13 and 3101.19, although no longer attached to the assemblage, were portions of this sail's bolt rope.

Fig. 33. Detail of bolt rope, artifact 2002 from *La Belle* (A. Borgens).

Shroud-Laid Rope. Eight artifact groups represent 13 lengths of shroud-laid rope that were recovered from among *La Belle*'s artifacts. This shroud-laid rope can be divided into two sub-types, those with a heart (a wick of rope yarns through the center) (2266.4, 3392, 13277) and those without (2725.4, 3147, 3162, 12995, 13287). Dassié described this in his treatise as "quatre cordons, et une méche au milieu, appellée *l'Ame*."[77] The heart presumably was used to keep shroud-laid rope round but apparently was not necessary, as several examples of shroud-laid rope from *La Belle* lack a heart.

Some lengths of rope from each sub-type can be identified as to their purpose. Artifact 3147, which lacks a heart, represents four lengths identifiable as bolt rope because

[77] Dassié 1994, 52 [1695].

remnants of sail are still attached. Artifacts 3392 and 13277, which have hearts, are portions of lower shrouds and are discussed in the following section.

Lower Shrouds. A portion of the lower shroud (artifact 3392)was identifiable by its seizing, which suggests *La Belle*'s shrouds were in fact made of shroud-laid rope with a rope-yarn heart (fig. 34). A far less well-preserved length of rope (artifact 13277), found still set around the remnants of a deadeye, confirmed this discovery. Although only the base and the bottom of two eyes remained of the deadeye—one of the poorest-preserved deadeyes in the assemblage—artifact 13277 has ironically proven to be among the most significant artifacts because of the short length of shroud still set into its score. Like the better-preserved 3392, artifact 13277 is shroud-laid and has a heart at its center as well. Dassié described this in his treatise, as was quoted above in the discussion of shroud-laid rope: "quatre cordons, et une méche au milieu, appellée *l'Ame*."[78] However, he was describing the mainstay, not the shrouds, which he had suggested be a simple three-strand hawser.[79] Therefore, in this instance, *La Belle* has proven not to have employed techniques described by sources from its time and country.

[78] Dassié 1994, 52 [1695].
[79] Dassié 1994, 53 [1695].

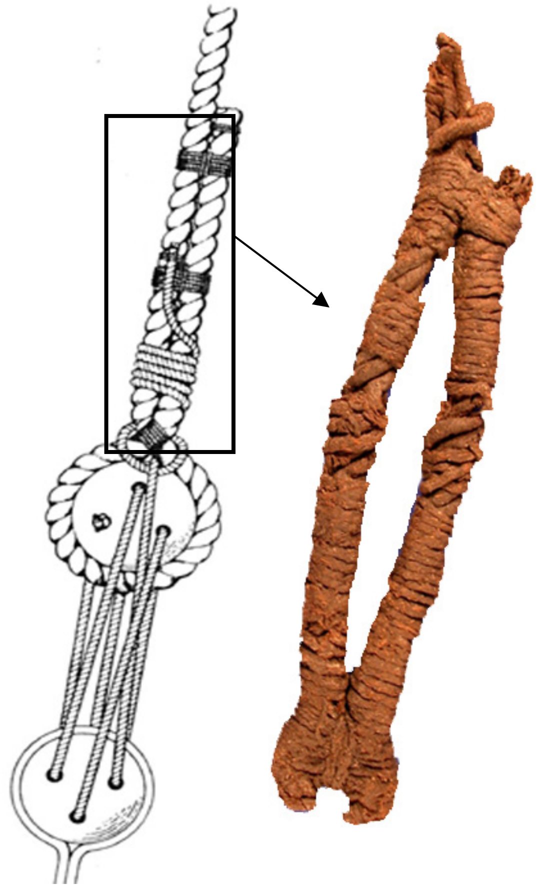


Fig. 34. Artifact 3392, a lower shroud from *La Belle*, shown with a representation of a lower shroud set up with shroud-laid rope. Artifact 3392 is also an example of served rope that is not wormed or parceled. (Modified from Lees 1984, 42)

Futtock Shrouds. Artifact 6295 was excavated as part of cross-tree assemblage 6013, which consisted of a cross-tree, upper deadeye strap, and futtock plate. Just as the deadeye strap and futtock plate were poorly preserved, yet provided significant information, artifact 6295 was also poorly preserved compared to other examples of *La Belle*'s hawsers, but can be positively identified as having been a futtock shroud. Thus, a clearer picture of the detail of *La Belle*'s rig is achieved: the lower shrouds were shroud-laid, the futtock shrouds were hawser-laid.

Tacks, Sheets, and Clew Garnets. One of the most complete rigging artifact assemblages consists of the clew, clew garnet block and strop, sheet block and strop, and tack of one of the courses, which was located just under the starboard quarter of the wreck abaft of midships (artifacts 3100 and 3101). All of the rope in the assemblage is hawser-laid, except for the tack, which is shroud-laid, and all is served.

The lower corners, or clews, of a square sail were controlled by the tacks (hauled down and forward), sheets (hauled down and aft), and clews (hauled up for furling). The bolt rope of the courses was seized at the clews to form an eye (eye seizing) through which the blocks and strops for these lines of rigging were secured to the sail. Typically the clew was inserted through the clew garnet block strop, and the clew garnet block was brought back up through the clew to be held upright by the clew garnet. The clew garnet originated at the yard arm; it was fed through the clew garnet block on the bottom corner of the sail and returned to a block on the yardarm before falling down to deck where it

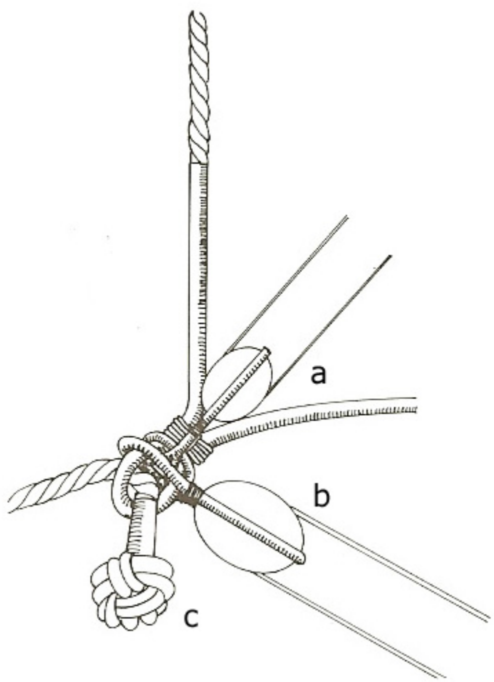


Fig. 35. Typical 17th-century configuration for the sheet, clew garnet and tack on the main and fore courses: *a*, clew garnet; *b*, sheet; *c*, tack. (modified from Marquardt 1986, fig. 153 (f)).

could be hauled upon to furl the sail. The eye of the clew was then inserted through the sheet block strop, which was held in place by the knot of the tack, which was inserted through the eye of the clew (fig. 35).

The configuration apparently used on *La Belle* differs from this traditional system (fig. 36). *La Belle*'s artifacts 3100 and 3101, which are comprised of the sheet and clew garnet blocks and strops as well as the tack and clew of the corresponding sail, reveal that the clew garnet strop was secured to the sheet strop rather than the clew of the sail itself. The tack and sheet block strop were lashed together with shroud knots that were inserted into the sail's clew to secure the entire assemblage.

While this configuration seems at first glance to be more complicated than the traditional method, it is remarkably moveable; the entire set of running rigging associated with the clews of the courses could be removed together in one motion. R. C. Anderson observed that an easily moveable clew, sheet, and tack assemblage would have been used if a bonnet (a detachable portion at the foot of the sail) were employed. Bonnets fell out of favor with the English after 1680, and with the Dutch after 1660 on mainsails but not on foresails, which retained their bonnets much later than on English ships.[80] The Danish Church Model (ca. 1680), housed in the Royal Danish Naval Museum in Copenhagen, has just such a moveable set with its bonnet on the foresail, but no bonnet on the mainsail (fig. 37). It is possible, therefore, that artifacts 3100 and 3101 represent *La Belle*'s fore course and suggest the use of a bonnet.

[80] Anderson 1994, 158.

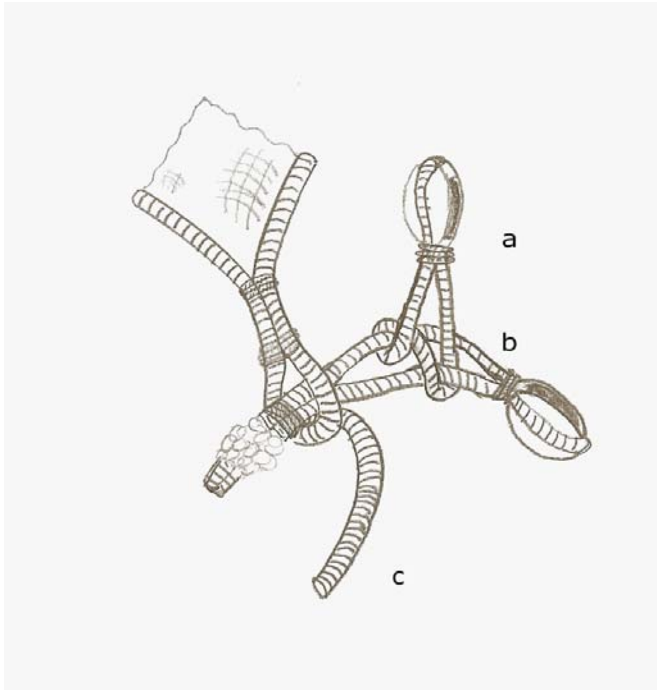


Fig. 36. Representation of artifact assemblage 3100 and 3101 from *La Belle*: *a*, clew garnet; *b*, sheet; *c*, tack. (T. Oertling, C. Corder)

Fig. 37. Sheet, clew garnet, and tack on the forecourse bonnet of the Danish Church Model (ca. 1680) in Orlogsmuseet. (C. Corder)

CHAPTER III

RECONSTRUCTING THE MASTS AND SPARS

Establishing the rig of an 18th-century ship would be greatly helped by knowing the ship's type, which determined rig during that century. *La Belle*'s ship type, however, cannot be considered in the same way to determine its rig because, unlike the 18th-century definitions of "bark" and "frigate", which indicated a specific rig, ship type did not refer to rig in the 17th century. However, these terms were still meaningful to the 17th-century seafarer. Jean-Baptiste Minet, an engineer among La Salle's crew, recorded that "the frigate *La Belle*" was given to La Salle by the king "instead of the little bark that was requested."[81] He clearly saw a distinction between these terms, and continued to refer to *La Belle* as a "frigate" or "little frigate" throughout his journal. Henri Joutel, who served as La Salle's post commander for two years at Fort St. Louis and shared the same journey as Minet, used the term "frigate" throughout his journal.[82] However, the archival records kept at Rochefort shipyard where *La Belle* was constructed report that *La Belle* was a bark of 40 to 45 tons.[83]

These discrepancies reflect some inconsistency in the designation of ship type during this century. Unlike their better-known 18th-century definitions, the terms "bark" and "frigate" in the 17th century appear to refer to function rather than hull or rig type. Barks were often smaller merchantmen, whereas the term frigate generally referred to a relatively larger naval vessel often described only as swift and nimble, or in other, similar terms. In 1702, Aubin, a Dutch author, defined "frigate" as a class comprising lightly built vessels of war which ordinarily had two decks, but he offers eight definitions for the term "bark", suggesting multiple purposes for ships of this type,

---

[81] Weddle 1987, 84.
[82] Warren 1998.
[83] Rochefort Royal Shipyard Archives 1684.

among them water ship, advice boat, lighter, and supply boat. Specifically, he stated that a bark was a boat of one deck, with three masts, which did not surpass 100 tons.[84] William Falconer, an English author, did little to change the definition of "frigate" in 1769 when he published a naval dictionary that defined "frigate" as a light nimble craft mounting from 20 to 38 guns. He also defined "bark" as a general name given to small ships, and "peculiarly appropriated by seamen to [ships that carried] three masts without a mizzen topsail."[85]

Falconer's and Aubin's definitions of a bark are very nearly represented in a collection of prints published by Jean Jouve, a French author, in 1679. In these prints of French ships, small merchantmen with various rigs all seem to be lumped together as "barks". The only common features are that they are on average around 40 tons and do not exceed 100 tons.[86] The frigates depicted by Jouve are 100- to 200-ton vessels that could fit both Aubin's and Falconer's definitions and include far more cannon than *La Belle* could have carried.[87]

Given this, it is probably more accurate to consider a ship's purpose (and therefore the conditions it faced) and its size rather than type when determining an appropriate rig for a 17th-century ship. *La Belle* was not initially intended to sail the Atlantic. Originally, *La Belle* was stored disassembled in the hold of *Le Joly*, and was meant for assembly once the expedition reached the Mississippi River. This sort of do-it-yourself ship construction was referred to as "en fagot" at this time in France. Each of *La Belle*'s frames still bears the mark indicating its intended position along the keel as an aid for those assembling her. However, more storage within *Le Joly* became a priority, and *La*

---

[84] Aubin 1702, 67-8, 431.

[85] Falconer 1776. There are no page numbers in Falconer's dictionary, but the terms can be found alphabetically.

[86] Jouve 1971, pls. 4, 6, 8, 9, 15, 16, 18, 21, 22d [1679].

[87] Jouve 1971, pl. 12 [1679].

Belle was assembled in France and sailed to the New World.[88] So, whatever its initial purpose, its rig ultimately would have been appropriate for crossing the Atlantic.

The majority of Jouve's ships that are designed for the open ocean are square-rigged with a mizzen topsail and spritsail topsail.[89] Most of these are termed flutes and pinasses, however, and are considerably larger than *La Belle.* Only one is similar in tonnage to *La Belle*.[90] Among the barks in Jouve's prints that are similar in tonnage to *La Belle*, some have mizzen and spritsail topsails, while others do not.[91] However, this is also the case with larger barks (fig. 38).[92] In 1660, Edward Hayward listed the sail complement for *Nichodemus*, a sixth rate, in *The Sizes and Length of Riggings for All His Majesties Ships and Frigats. Nichodemus*, which was designed for open-ocean passages, was square-rigged and carried main and fore courses, topsails, a spritsail and mizzen sail, but no spritsail topsail or mizzen topsail.[93]

Boudriot included a picture of a little frigate in his *History of the French Frigate* that appears very similar to *La Belle* and carries a spritsail topsail (fig. 39). However, the mistaken inclusion of a crossjack yard without a mizzen topsail casts doubt on the reliability of this picture as a source upon which to base *La Belle*'s rig.

---

[88] Boudriot 2000; see also Bruseth and Turner 2005, 81; Weddle 2001, 100.
[89] Jouve 1971, pls. 6, 7, 8, 10, 11, 12, 19, 20 [1679].
[90] Jouve 1971, pl. 6 [1679].
[91] Jouve 1971, pls. 4, 6, 14 [1679]; plate 6 shows ships with a spritsail topsail, while plates 4 and 14 do not.
[92] Jouve 1971, pls. 8, 9 [1679]; plate 8 shows both mizzen and spritsail topsails, plate 9 does not.
[93] Hayward 1660, 3-12, 16.

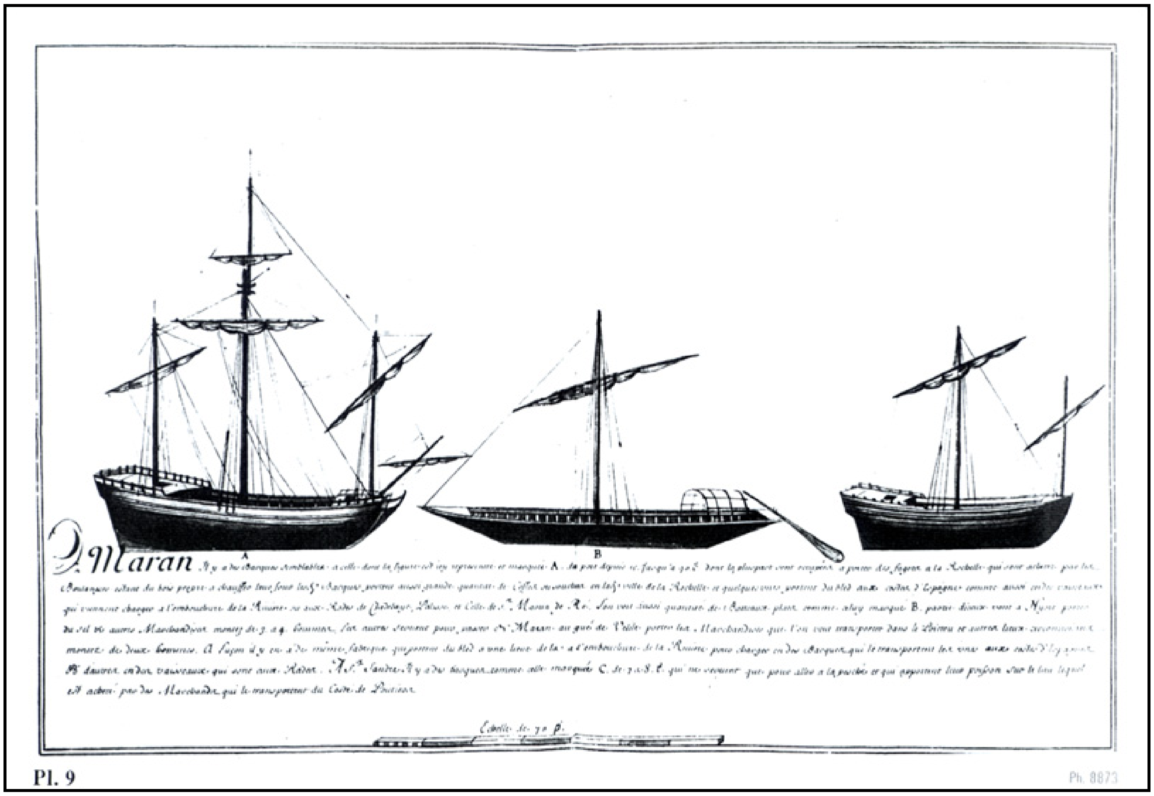


Fig. 38. A variety of hulls and rigs all labeled “Barque” in a 1679 print ascribed to Jean Jouve. (Jouve 1971, pl. 9 [1679])

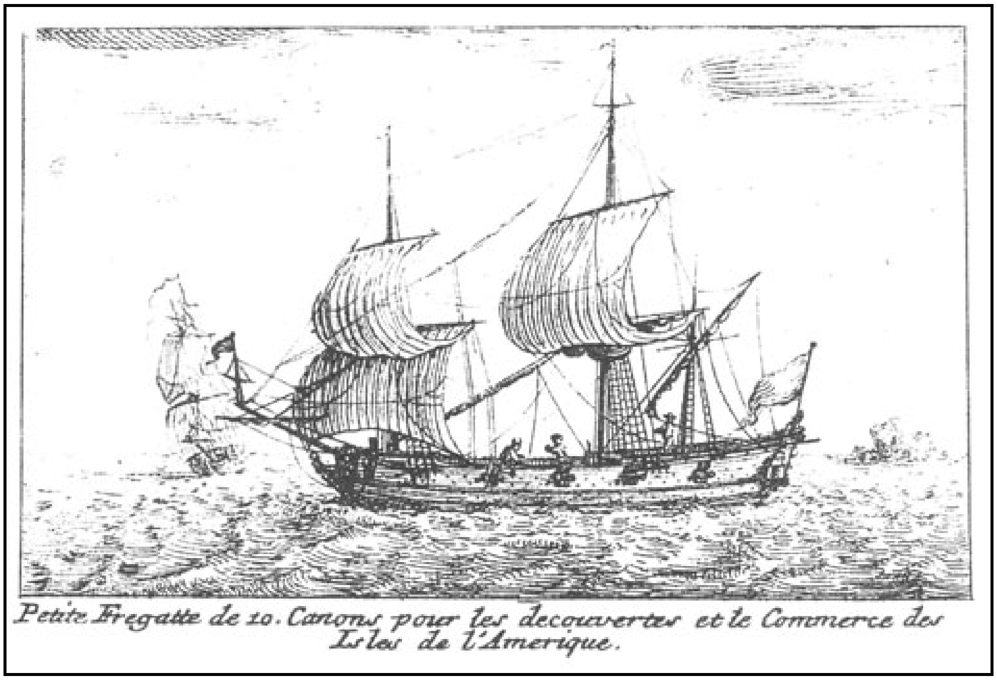


Fig. 39. *Petite Fregatte de 10 cannons pour les descouvertes et le commerce de Isles de l'Amerique*, 1710 (from *History of the French Frigate*). (Boudriot 1993, 58)

According to proportions used to determine all the other masts on board *La Belle*, the spritsail topsail yard would most likely have ranged between 4.07 and 4.56 m (12.50 and 14.00 Fr ft), and would have been only a few inches thick. However, while *La Belle*'s purpose would seem to prescribe a square rig, inclusion of mizzen and spritsail topsails is not clearly indicated by this evidence or by merely considering the ship's purpose. This variety in sail plans is illustrated within Sir Anthony Dean's 1670 list of all the ships in the Royal Navy. The list included sixth rates, sloops, and yachts similar in size and tonnage to *La Belle*, but despite this similarity, their crews, sail complements, and rigging stores varied widely.[94] Unfortunately, this evidence leaves only a basic expectation for the type of rig *La Belle* may have carried: a three-masted square-rigged ship. Fortunately, however, material evidence and primary accounts of *La Belle* have confirmed these expectations.

---

[94] Dean 1981, 112 [1670].

We know from the hull remains and artifacts, as well as journals kept by members of La Salle's expedition, that *La Belle*'s basic rig fit within these expectations. The hull remains contained the well-preserved mainmast step as well as portions of the foremast step, and the unique Dutch lift blocks discussed above could only have been employed in the lifts of a square rig. Journal accounts have gone further, giving evidence for the mizzen mast through discussion of an event on 17 December 1684. This incident was included in both Henri Joutel's and M. Minet's diaries. Minet recorded that *La Belle* "was [driven upon her anchor] and struck *L'Aimable,* breaking the main yard. *La Belle* discovered that her mizzen mast and main topsail yard were broken."[95] Joutel's description of the accident with *L'Aimable* differs slightly, but not significantly. He explained that *La Belle* lost its mizzen, and that *L'Aimable* lost its bowsprit yard and topgallant sail.[96] *La Belle* was therefore a three-masted, square-rigged ship, whose mizzen must have been stepped on a deck higher than the preserved portion of the hull. The question that remains is whether to provide mizzen or spritsail topsails to a vessel its size.

Although *L'Aimable* apparently carried a spritsail topsail, it cannot be assumed *La Belle* did as well. *L'Aimable* was a flute and a much larger ship, as evidenced by Minet's discussion of its entrance to Matagorda Bay, which was too shallow for its draft and so it was run aground and thus lost. *La Belle*, however, was able to enter the bay without incident.[97] And so, because the printed evidence from the 17th century is fairly evenly split between ships of similar tonnage to *La Belle* with and without these topsails, it appears that either explanation could be reasonable. The material evidence from *La Belle* herself is unfortunately silent on the matter, but many of its artifacts point to a remarkably simple rig. Thus, because of the danger of over-masting a small ship, and in

---

[95] Weddle 1987, 92.
[96] Warren 1998, 64.
[97] Weddle 1987, 108.

an attempt to reconstruct a consistently simple rig, this reconstruction has not included a mizzen or spritsail topsail. Ultimately, this would probably be best determined through a calculation of the center of effort because this could indicate a reasonable distribution of sail area relative to the hull. The research requirements for this undertaking are discussed in the conclusions, and are an important consideration for further study of this ship.

Mast Proportions

Nearly all proportions used to reconstruct *La Belle*'s masts and spars can be traced back to the ship's beam measurement, which is known (15 Fr ft, 4.88 m). In the 17th century, the lengths and diameters of a ship's masts and spars were determined by proportion to the ship's beam, and sometimes length of the hull and its depth of hold. Interestingly, one contemporary author of a rigging manuscript stipulated that he would not use his own masting proportions;[98] others wrote that no set of rules could summarize the art of rigging,[99] and another author even said that he did "not pretend to know the right rules for masting of ships."[100] In the 17th century, rigging a ship was not merely a process of mathematical equation. In fact, little complex math was used; instead, dimensions were based on basic hull proportions, or proportions to other masts. It is clear from these simple guidelines and the warnings from experienced sailors that rigging was a skill perfected over time through trial and error; it was not an exact science. This in part informed the decision to use a scale reconstruction of *La Belle* in order to determine its most likely rig. Some problems arise, in the process of attempting a clear illustration, that may not have otherwise presented themselves, and in the case of rigging, a picture is worth quite literally a thousand words.

---

[98] Miller 1957, 2 [1667].
[99] Smith 1970, 20 [1627]; see also Romme 1778, 27.
[100] Davis 1985, 6-7 [1711].

Because the ship's basic dimensions were known, it was most useful and probably most accurate to determine the sizes of its masts and spars using formulae that would have been available to contemporary riggers. Appendix B lists the sources consulted for each mast and spar in chronological order, showing each source, its formulae for the lengths and diameters of all masts and spars, and the results when applied to *La Belle*'s dimensions. Appendix B also offers the proportions between certain masts and spars; readers may find it useful to refer to this appendix throughout the mast and spar discussion.

These sources consist of various contemporary naval dictionaries and treatises, the most significant of which for *La Belle* are the manuscript SH 144 (1670) and the treatise by Dassié (1677, 1695) because they are both French and date from roughly the same time *La Belle* was constructed.

With calculations from English treatises, *La Belle*'s beam was measured using Imperial measurements (4.88 m, 16.00 En ft). However, the French foot was approximately ten percent longer than the English foot during the 17th century, so a conversion factor of 2.71 centimeters to the French inch was used.[101] Therefore, when French sources were consulted, *La Belle*'s beam was measured in French feet (4.88 m, 15.00 Fr ft). The Amsterdam foot was smaller than the English foot during this century, and when a Dutch source was used, the beam was measured using this foot (2.36 centimeters to the Dutch inch) (4.88 m, 17.23 Du ft).[102]

Specifically regarding the manuscript SH 144, the beam in these equations does not include the frames, but is taken inside the frame.[103] While many treatises' mainmast calculations use the beam, it is traditionally measured outside the frames. Because of

---

[101] Boudriot 1993, 10.
[102] Hoving 1994, 58.
[103] Boudriot 1993, 342 [SH 144 (1670)].

this, in Appendix B where the mast and spar calculations are recorded for each treatise, the beam measurement used for the mainmast calculation from SH 144 does not include the frames (14 Fr ft, 4.55 m). However, for purposes of comparison of the mainmast-to-beam proportion, the mainmast length from SH 144 (which resulted from an equation using the shorter beam measurement) was compared to the traditional beam measurement, like all the other sources.

The manuscript SH 144 is unique for indicating that the measurement of the ship's beam ought to be taken inside the frames for use in its mast and spar calculations. *La Belle*'s beam was recorded on 15 December 1684 at Rochefort in La Rochelle, France, after having been constructed there the preceding May and June. The Rochefort archive shows a 14-foot beam. The beam of the actual ship, determined by its hull remains, was 15 French feet when measured outside the frames, but 14 French feet when measured inside. This could be a coincidence or an error, considering the lapse of time between the ship's construction and when the record was made. However, the agreement between the archival record of the ship's beam and the actual beam when measured inside the frames has introduced the interesting question of whether at any point the French measured the beam inside the frames. While there is no further evidence to answer this question positively, it has been recorded here in order that it may be included in further research.

Some details of the rig depended on the reconstruction of *La Belle*'s hull that was used in this reconstruction of the rig. The hull reconstruction relied on here was determined by Glenn Grieco, who built a large-scale model (1:12) of *La Belle*, and Taras Pevney, whose research revealed the design of *La Belle*'s hull and contributed significantly to Mr. Greico's model. The bowsprit proportions are partially dependent upon the height and projection of the beak head, which was not preserved from the ship. This determined, in part, the angle of incline of the bowsprit (steeve), as well as the point inboard at which it was stepped. Mr. Grieco's model reconstructed the aft bulkhead and stern cabin as well. Based in part on the hull remains, this research determined the position of the mizzen mast relative to the ship's overall length, and the height of the mizzen mast step.[104]

Mainmast. Throughout the 17th century, the proportion between mainmast and ship's beam of large English ships was generally 2.4 to 2.5.[105] However, small ships would have required a proportion greater than these. Sir Anthony Dean's (1670) complex formula, which allowed for small and large ships, suggested the mainmast be 2.6 times the beam for large ships, and 3.0 for small ships.[106] *The Seaman's* Vade Mecum (1707) similarly suggested that small ships have a mainmast 3.0 times the beam.[107] The *Lion's Whelps* (185 tons), ten small ships built in 1628, are an example of such small ships, and had mainmasts three times the length of their beams.[108] In 1705, James Love published a range between 2.84 and 2.93, both of which were intended for relatively small ships (73-75 ft, or 22.25-22.86 m long; 25.0-28.5 ft or 7.62-8.69 m in beam).[109] In 1711, John Davis published proportions between 2.54 and 2.67 for a ship that was 84 feet long and 28 feet in beam,[110] while *Marine Architecture* (1748) included with its suggested proportions (2.4 to 2.5) an example of a much larger 150-foot (45.72 m) ship with a 40-foot (12.19 m) beam.[111] Based on these possibilities, a proportion between 2.5 and 3.0 was probably accurate for small English vessels through the beginning of the 18th century, and something between 2.4 and 2.6 would have been accurate for large English ships well into the 18th century.

During the 18th century, however, the length-to-beam ratio of ships was changing: ships were becoming beamier. This was a solution to problems of stability that persisted

---

[104] Grieco 2003b.
[105] Manwayring 1972, 67 [1644]; see also Miller 1957, 3 [1667]; Smith 1970, 18 [1627].
[106] Dean 1981, 82 [1670].
[107] Anonymous 1707, 131-3.
[108] Howard 1979, 126.
[109] Love 1705, 40, 75.
[110] Davis 1985, 6-7 [1711].
[111] Anonymous 1748, 49, 51.

throughout the 17th century and were complicated by the addition of more guns to ships during the 18th century.[112] For this reason, it is problematic to apply masting proportions from 18th-century treatises to a 17th-century ship that had a narrower beam.

Continental 17th-century ships carried slightly longer mainmasts in proportion to their beams. The French specifically appear to have had longer mainmasts relative to beam in the 17th century, but in the 18th century their proportions are similar to the English. SH 144 (1670) and Dassié (1677, 1695) both suggest proportions larger than contemporary English counterparts: 2.60 and 2.83.[113] However, 18th-century French sources offer proportions similar to English sources from that century. Forfait (1788) includes proportions between 2.3 and 2.5 for a variety of sizes of ships, and Bouguer (1746) and Romme (1778) both suggest the same proportion of 2.5 times the beam.[114]

The Dutch carried the longest mainmasts relative to their beams among this group. The treatise *L'Art de batir* (1719) from the early 18th century suggested the largest of these proportions for a large ship, 3.0. This Dutch formula (two times the sum of the beam and depth of hold) is also published by Witsen (1671).[115] Witsen used an example of a 134-foot (37.95 m) ship that was 29 feet (8.21 m) in beam, and had a 13-foot (3.68 m) depth of hold. Using his suggested formula, an 84-foot (23.79 m) mast, which is 2.9 times the beam, would have resulted. However, referencing the same 134-foot (37.95 m) ship, Witsen suggested an 80-foot (22.66 m) mast, which was nearly 2.8 times the beam. Witsen later gave the example of a ship with the same beam (29 ft, 8.21 m) but a 12-foot (3.40 m) depth of hold that carried an 82-foot (23.22 m) mast. This does adhere to his formula, but also results in a mainmast-to-beam proportion of 2.8 due to the smaller depth of hold.[116] Despite these discrepancies, which serve to illustrate the

---

[112] Anderson 1994, 16; see also Gardiner 1992a, 121; Howard 1979, 180.
[113] Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994, 31 [1695].
[114] Bouguer 1746; see also Forfait 1788, 106-15; Romme 1778, 14.
[115] Anonymous 1719, 25; see also Witsen 1671, 129.
[116] Witsen 1671, 129.

warnings in other treatises, discussed above, against too strict an adherence to the rules, a general trend toward a larger mainmast-to-beam ratio among these Dutch sources is evident.

Bouguer observed these differences in the 18th century when he wrote that French ships carried masts a little longer than the English, but a little shorter than the Dutch.[117] To more easily visualize this distribution, figure 40 shows the mainmast-to-beam ratio suggested by these 17th- and 18th-century sources.

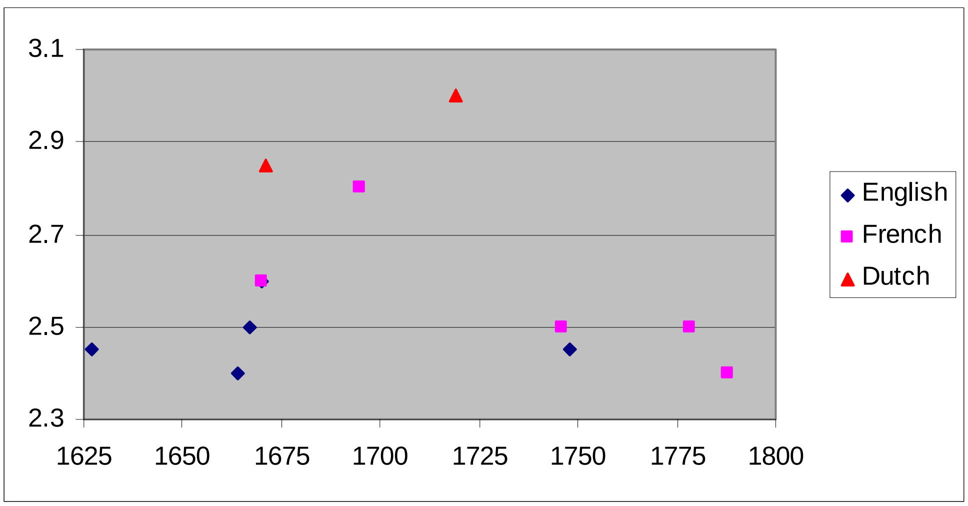


Fig. 40. Mainmast-to-Beam Ratios.

Comparison of proportions between French, English, and Dutch mainmasts is an informative exercise, but French sources were ultimately used to determine the specific height of *La Belle*'s mainmast. The formulae from SH 144 (1670) and Dassié (1677, 1695) suggested it would be reasonable for *La Belle* to have stepped a mainmast between 12.68 m (39.00 Fr ft) and 13.82 m (42.50 Fr ft) in length. This narrow range is

[117] Bouguer 1746, 123.

supported by the diameter of the remaining portion of the mast's heel from which the maximum diameter can be derived and, in turn, the height.

Only 76 cm of the mainmast heel remained, the widest portion of which is 28.20 cm in diameter.[118] The diameter at the mast heel was typically about 85 percent of that at the mast partners, which would have been several feet above this preserved portion.[119] According to this formula, the mainmast was about 33.18 cm (12.24 Fr in) at the partners. This in turn indicates that the mast was between 11.94 m (36.72 Fr ft) and 13.89 m (42.72 Fr ft) tall.

This range for the mainmast height was derived by applying formulae for mast thickness from SH 144 and Dassié to the thickness derived above (33.18 cm). SH 144 calls for a mast that is $^{1}/_{36th}$ the thickness of the mainmast's height (11.94 m),[120] and Dassié suggested the mainmast's thickness be one third of an inch for every foot in height minus two inches (13.89 m).[121] Many 17th-century English sources suggested a mast be one inch in diameter for every yard in height;[122] this also results in a mast 11.94 m (39.18 ft) tall.

The dimensions for height (11.94-13.89 m) and for diameter (33.18 cm), derived from the remaining portion of the mast, are compatible with the ranges offered by Dassié and SH 144 that were derived from the ship's beam (12.68-13.82 m tall; 32.98-35.23 cm thick). Based on this, the mainmast has been reconstructed to stand 12.85 m tall (39.50 Fr ft) with a maximum diameter of 33.20 cm (12.25 Fr in)

---

[118] Meide 1997, 995.
[119] Mondfeld 1989, 218.
[120] Boudriot 1993, 342 [SH 144 (1670)].
[121] Dassié 1994, 32 [1695].
[122] Love 1705, 39, 77; see also Manwayring 1972, 67 [1644]; Smith 1970, 18 [1627].

Foremast. Seventeenth-century authors offered a wide variety of formulae for calculating the foremast. However, the resulting proportions between main and foremasts are relatively consistent throughout the 17th and 18th centuries. Smith (1627) and Manwayring (1644), from the first half of the 17th century, suggested the smallest proportion, 0.80 of the mainmast, while Dean (1670) suggested the largest, 0.90 of the mainmast. The majority of contemporary sources, however, suggested a proportion 0.89 of the mainmast.[123]

The difference between the early 17th-century proportions and those from the following hundred years reflects an increase in foremast height. R. C. Anderson observed that the increase in foremast height compensated for stepping the foremast further down the curve of the stem as the century progressed.[124] A general lengthening would have served to maintain the proportion between the tops that was so common. This relationship between mast tops and caps is, then, a more reliable way to determine the heights of masts since one does not always know where along the stem a foremast may be stepped. Anderson observed that both English and continental ships shared a common relationship between mastheads and tops, although the French tended toward shorter foremasts. He also observed that the cap of the mizzen mast generally came to a point halfway up the foremast head, which in turn stood about halfway up the mainmast head.[125] Prints by Romme and Lescallier, who published in the late 18th century, reflect this relationship (figs. 41, 42).[126]

[123] Miller 1957 [1667]; see also Love 1705; Davis 1985 [1711]; Anonymous 1748; Mountaine 1756.

[124] Anderson 1994, 17.

[125] Anderson 1994, 17-8.

[126] Lescallier 1791, pls. 5, 7, 11, 12, 18, 19; see also Romme 1778, 66, fig. 3.

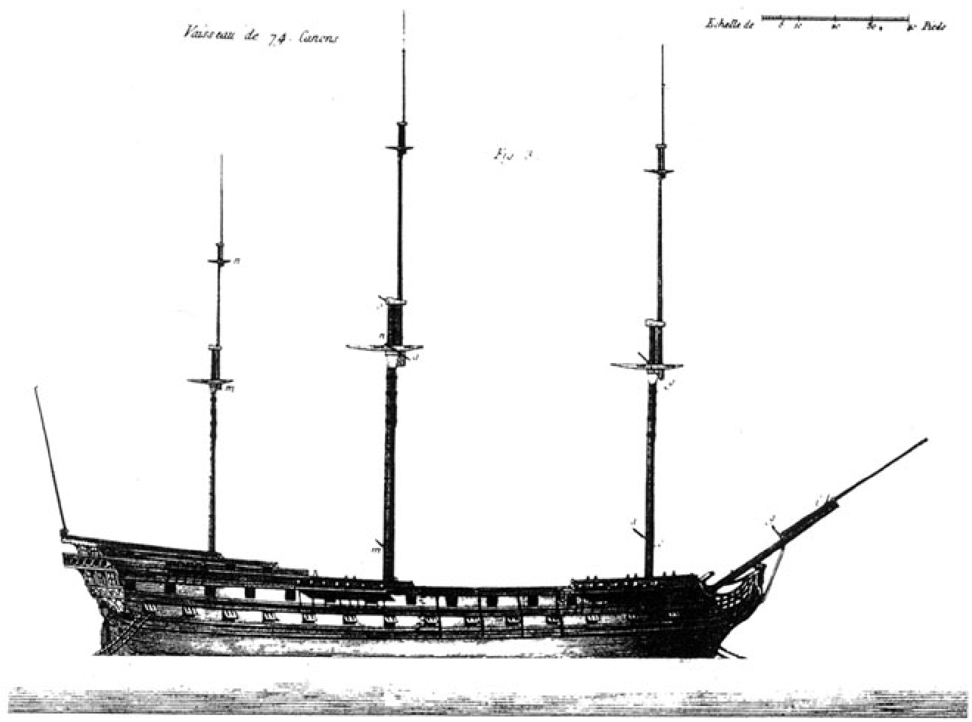


Fig. 41. French 18th-century foremast caps came halfway up the mainmast head. (Romme 1778, fig. 3)

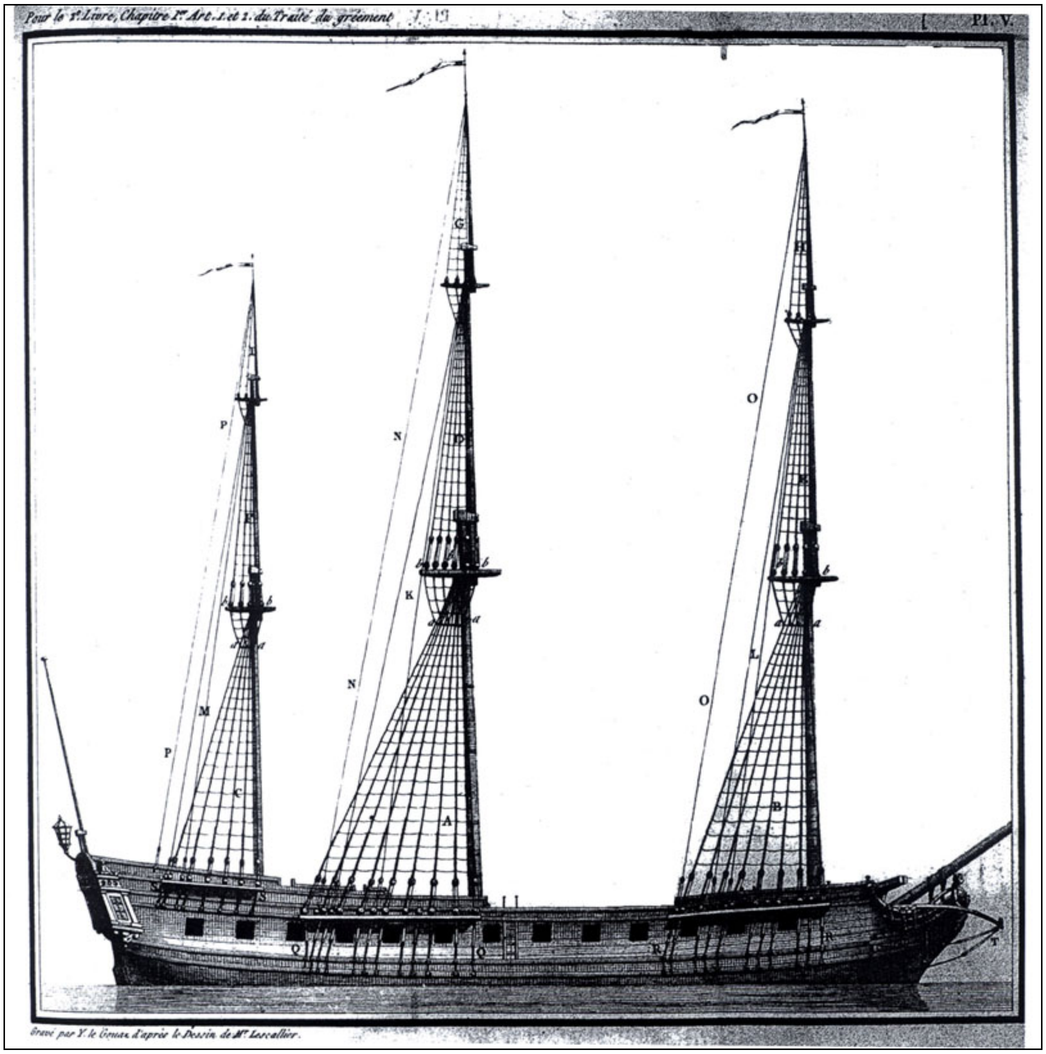


Fig. 42. French 18th-century masthead proportions. (Lescallier 1791, pl. 5)

However, 17th-century representations by Jouve (1679) and in *Album de Colbert* (1670) show the foremast cap reaching only the approximate level of the mainmast top rather than halfway up its masthead (figs. 43, 44).[127]

---

[127] Jouve 1971, pls. 3, 7, 8, 19A [1679]; see also Berti 1988, pls. 39, 42, 47, 48, 50 [1670]).

Fig. 43. French 17th-century foremast caps reached the level of the mainmast top. (Jouve 1971, pl. 8 [1679])

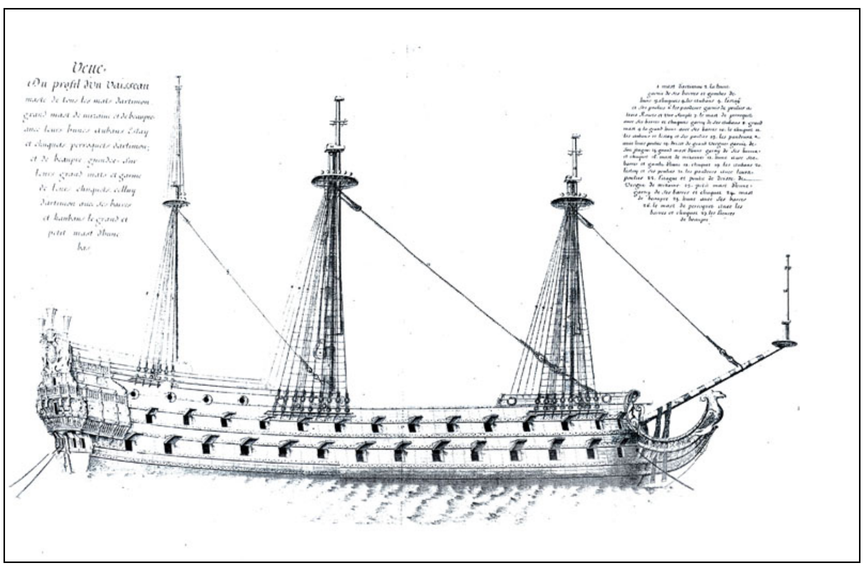


Fig. 44. French 17th-century masthead proportions (from *Album de Colbert*). (Berti 1988, pl. 39 [1670])

A sail plan of *La Couronne*, constructed in 1636 at Roche Bernard, also includes a foremast cap coming only to the height of the mainmast top (fig. 45). This relationship has been considered representative of early 17th-century ship rigs, but as the evidence here indicates, appears to have been maintained on French ships throughout the 17th century.

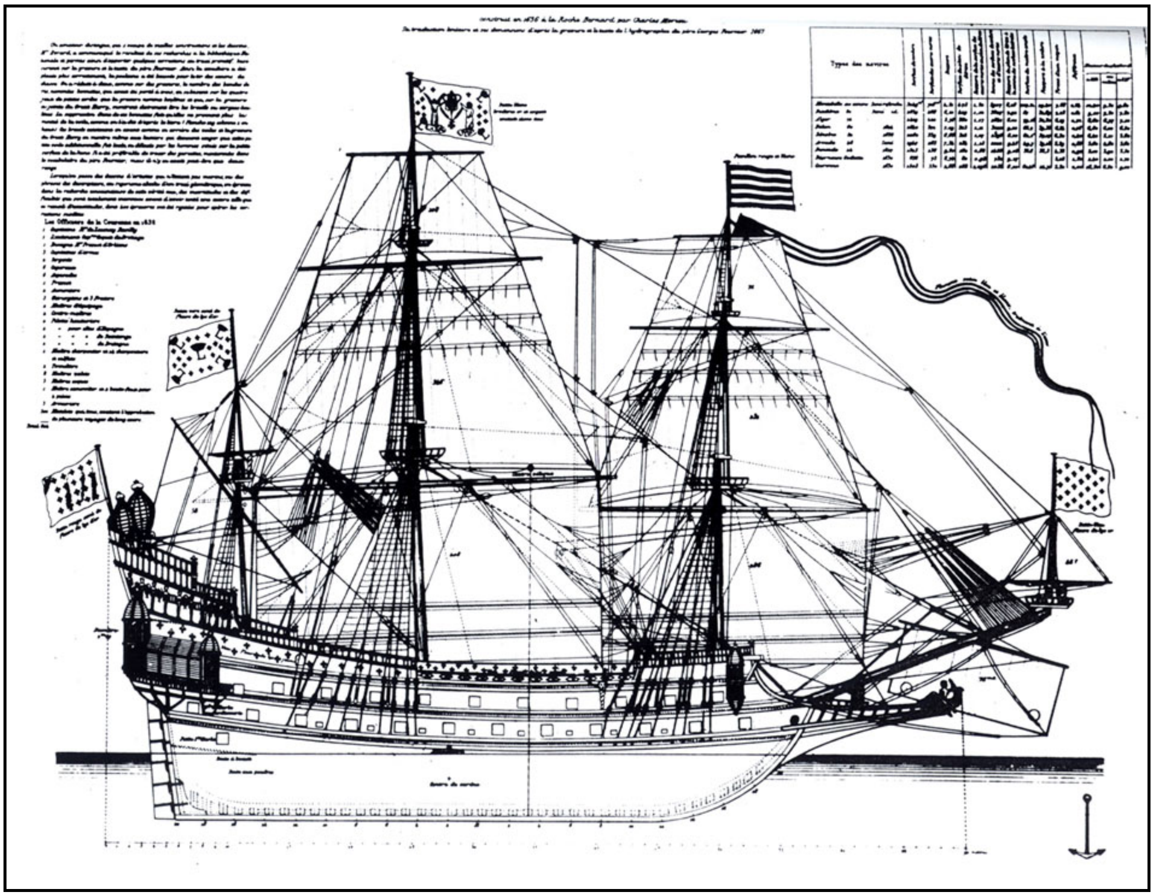


Fig. 45. *La Couronne* (1636), and an early 17th-century French sail plan. (Hancock 1973, fig. 2)

Seventeenth-century French treatises are consistent with these observations. SH 144 (1670) suggests a proportion only 0.84 times the mainmast, as compared to the very common 0.89 used by English sources.[128] Dassié (1677, 1695) clearly explained that the foremast was to be the height of the mainmast minus the masthead.[129] One can assume here that it is not the total length of the mast but its height over the deck to which Dassié was referring. Therefore, the common relationship between main and foremasts in 17th-century French ships had the foremast cap at approximately the level of the mainmast top.

La Belle's foremast has been reconstructed to reflect this common French proportion between mast caps and tops, so the foremast comes only to the height of the mainmast top. Because the foremast step was preserved on *La Belle*, its specific position along the stem was known, resulting in a mast 11.07 m tall (34.00 Fr ft). The diameter of this mast was calculated based on the formulae offered by Dassié and in SH 144, which suggested the thickness be either the same as the mainmast, or two inches less; this reconstruction shows the foremast two inches less thick than the mainmast (27.78 cm, 10.25 Fr in).

Mizzen Mast. The mizzen mast presents more of a problem because its position is a matter of judgment. The ship modeler Thomas Miller said as much in 1667: "Now in placing your missen-mast, your judgment must be better there, [than] about any mast: because there is no just Rule to be given, but only your eye must be your best rule."[130]

Ultimately, a large range of heights was offered by the treatises consulted and listed in Appendix B (5.86 m to 15.30 m). This wide range can be attributed to the variety of decks on which the mizzen may have been stepped, and to the lengthening of the mizzen in the latter half of the 17th century. Smith (1627), Manwayring (1644), and Miller (1667) all suggested the mizzen be half the height of the mainmast.[131] This is

---

[128] Boudriot 1993, 342 [SH 144 (1670)].
[129] Dassié 1994, 32 [1695].
[130] Miller 1957, 5 [1667].
[131] Smith 1970, 19 [1627]; see also Manwayring 1972, 67 [1644], Miller 1957, 2 [1667].

considerably shorter than proportions offered later in the century, which ranged between 0.70 and 0.85 of the mainmast.

Some authors offered a formula for each deck on which the mizzen could have been stepped.[132] Others did not specify where they intended the mizzen to be stepped, but the mizzen mast's proportion relative to the mainmast can indicate this. For example, in 1670, Dean specifically stated that the mizzen should be $^{25}/_{27}$ of the mainmast, which is 0.93.[133] This suggests that Dean intended the mizzen to be stepped on a lower deck or in the hold. Davis's treatise from 1711 was clearer about this. He offered three formulae that ranged between 0.78 and 0.91 of the mainmast. The largest proportion (0.91), which was similar to Dean's, was specifically for a mast stepped in the hold.[134]

While Miller was referring to the mizzen mast's position along the length of the ship, his statement holds equally true in determining the height of the mast, which is best determined by relationship to the other masts' caps and tops rather than strict proportions. Anderson observed that on 17th-century ships the English mizzen cap usually came to a point halfway up the foremast head, but that French mizzen masts were generally shorter during this century, and came no higher than the mainmast top.[135] The Jouve prints reflect this relationship, as do the plates found in *Album de Colbert* (figs. 43, 44).[136] This relationship can also be seen in the early 17th-century sail plan of *La Couronne* (fig. 45) and in plates from the 18th-century treatises by Lescallier (fig. 42) and Romme (fig. 41).[137] Thus, it is ultimately the mainmast that should determine the height of the mizzen mast, which in 17th-century French ships reached approximately to the point of the mainmast top (fig. 46).

---

[132] Davis 1985, 7 [1711]; see also Love 1705, 39, 68; Anonymous 1748, 50.
[133] Dean 1981, 82 [1670].
[134] Davis 1985, 7 [1711].
[135] Anderson 1994, 17.
[136] Jouve 1971, pls. 2, 3, 4, [1679]; see also Berti 1988, pls. 39, 42, 47, 50 [1670].
[137] See supra no. 125.

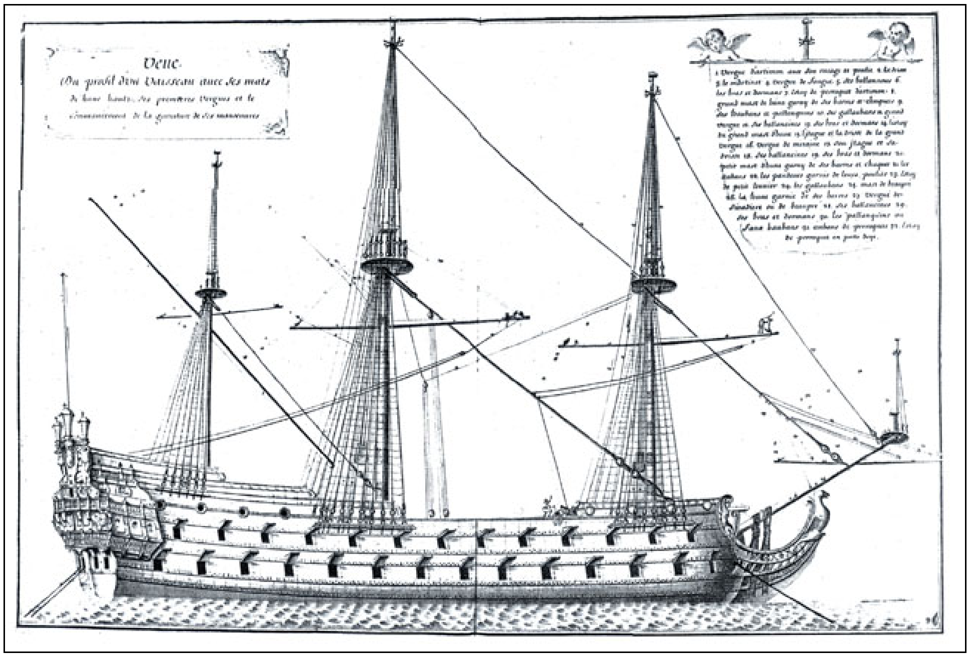


Fig. 46. The mizzen mast cap reached only to the level of the mainmast top, reflecting a common 17th-century French proportion (from *Album de Colbert*). (Berti 1988, pl. 42 [1670])

In the case of *La Belle*, no mizzen topsail has been included because of the danger of over-masting the ship, which could drive its bow into the water or compromise its stability in strong winds, and in an attempt to remain consistent with the many simple features of its rig as revealed by the artifacts. The lower deck on which *La Belle*'s mizzen was stepped was not preserved, so the overall height of the mizzen mast was determined by two factors, the common proportion between mast caps and tops seen in 17th-century French rigs, and the placement of the deck, which was determined by the hull reconstruction by Taras Pevney and Glenn Greico. Whatever the actual height of *La Belle*'s mizzen, this reconstruction shows the uniquely French practice of having the mizzen cap level with the height of the mainmast top. As currently reconstructed, the mizzen stands 10.49 m tall (32.25 Fr ft), and is 21.68 cm in diamter (8.00 Fr in).

Mast Rake. Nearly every combination of aft- and fore-raking masts can be found in contemporary rigging plans, paintings, and models. It is possible to observe some generalities between nations, however. An early English painting of the ship *Sovereign* (1637) shows an aft-raking main and mizzen mast, and a nearly vertical or slightly forward-raking foremast.[138] Many 16th-century and early 17th-century ship models exaggerate this relationship between the masts. Church models are not precise in their dimensions, but the exaggeration of the rake of the masts clearly demonstrates this relationship. Two Flemish church models dating to the end of the 16th century are among these (fig. 47).

Fig. 47. These church models exaggerate the forward-raking foremast and aft-raking mizzen mast common to the 16th and early 17th centuries. (Nance 2000, pls. 9, 10)

[138] Anderson 1994, pl. 7.

Mid-to-late-17th-century English representations either tended to show a vertical main and foremast with an aft-raking mizzen mast, or all three masts appeared nearly vertical (fig. 48). Dean clearly showed vertical fore and mainmasts with only the mizzen raked.[139] However, it is common for technical sail plans not to show rake, as is the case with the sail plans by Miller from 1667.[140] English models of two fifty-gun ships (1695 and 1690-1700) and of a fourth-rate ship (1719) all have vertical masts, none of which has a clear rake.[141] However, a model of *Royal William* in its re-built 1719 form (the actual ship was built first in 1682 but rebuilt twice, in 1692 and 1719) has the vertical foremast and aft-raking main and mizzen indicative of English ship representations.[142]

Representations of Dutch rigging stand in contrast to English rigging. While a very early Dutch painting (1594) showed the same forward-raking foremast and aft-raking main, mizzen, and bonaventure masts as early English representations, later 17th-century Dutch representations showed all three masts raking aft. Furttenbach included a Dutch ship from 1629 with aft-raking fore, main, and mizzen masts.[143] A Dutch model of 1665 and a Dutch rigging plan from about 1700 also showed this relationship between the masts (fig. 49). The model of a Dutch two-decker from Berlin (*The Holländische Zweidecker* 1660-1670) had aft-raking masts, as did *Vasa* (1628), which was rigged in a Dutch fashion.[144] *L'Art de batir* of 1719 shows all three masts raking aft.[145] However, a plate in the second volume of this manuscript shows a nearly vertical foremast.[146] Other Dutch representations with vertical foremasts can be found, but the prevalence of three aft-raking masts among a wide variety of Dutch models, sketches and paintings is

---

[139] Dean 1981, 75, 92, 94, 96, 98, 100 [1670].
[140] Miller 1957, pls. D, B [1667]).
[141] Nance 2000, pls. 43, 54, 71.
[142] Nance 2000, pl. 73.
[143] Furttenbach 1975, pl. 10 [1629].
[144] Winter 1967, pl. IV.
[145] Anonymous 1719, 1.
[146] Anonymous 1719, 37.

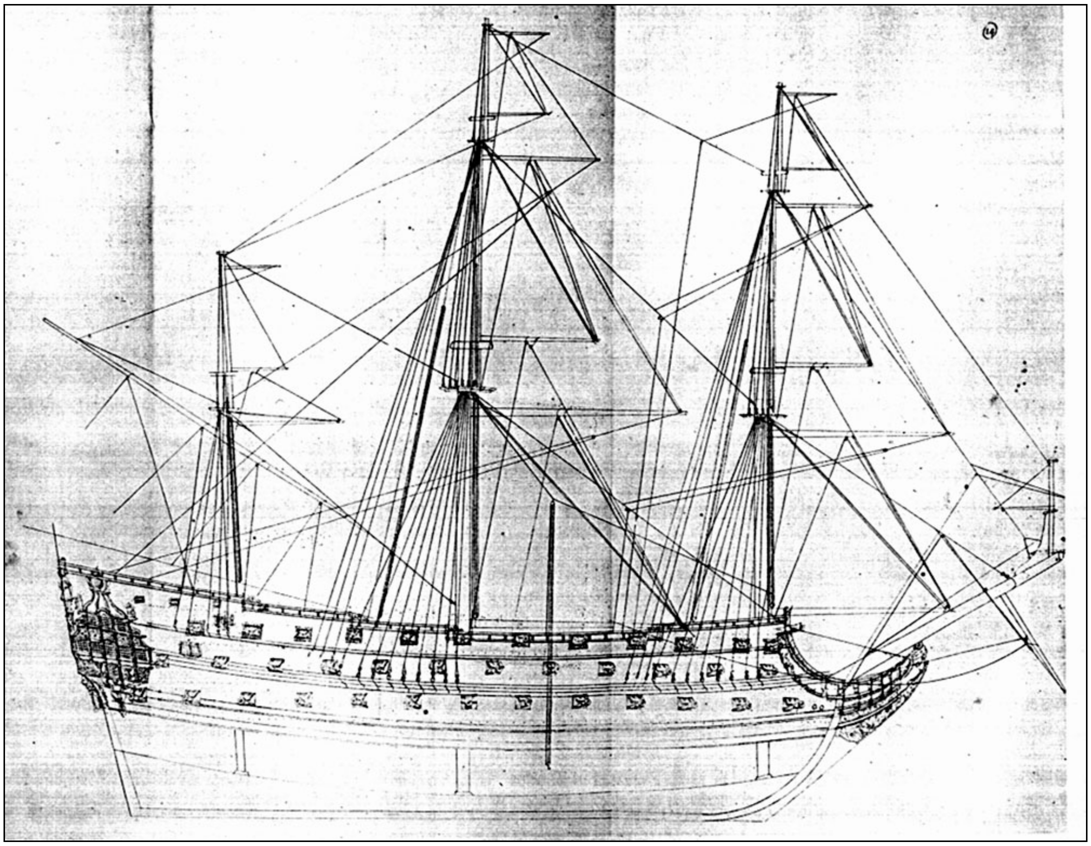
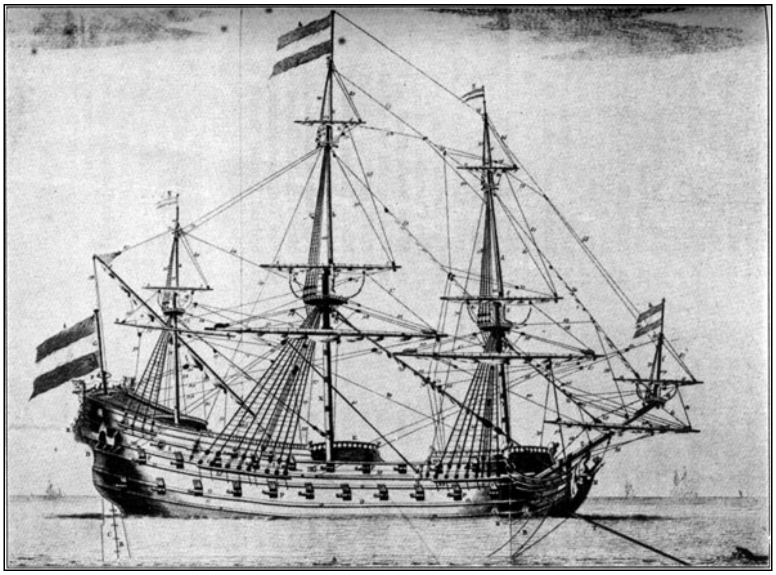


Fig. 48. The sail plan of an English second rate from *Dean's Doctrine* has vertical main and foremasts and an aft-raking mizzen mast, as is common among 17th-century English ship representations. (Dean 1981, 100 [1670])

significant.[147] Manwayring offered a possible explanation for this in 1644: "The [Dutch] stay their masts much aft, because else their ships being lofty ships would never keep a wind… [G]enerally the more aft the masts hang, the more a ship will keep in the wind."[148]

147 Anderson 1994, pl. 10.
148 Manwayring 1972, 101 [1644].



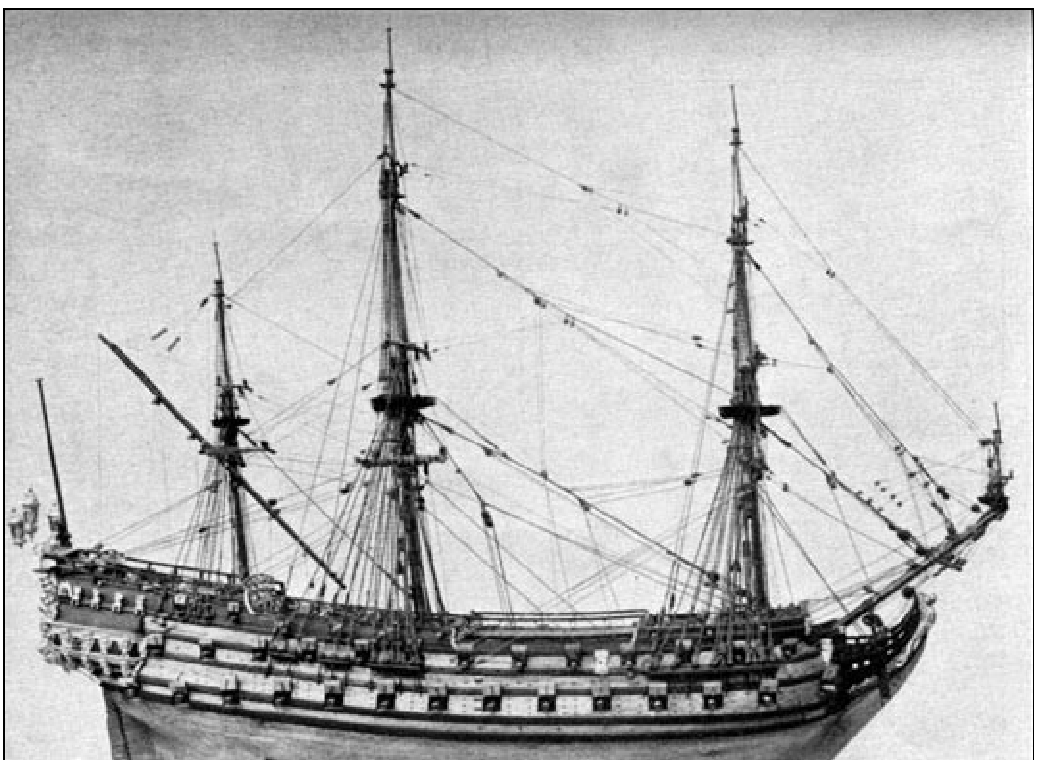


Fig. 49. A Dutch rigging plan from about 1700 (top) (from Aubin, *Dictionaire de marine*, 1702) and a model of a Dutch man-of-war ,1665, (bottom) (in the Science Museum, South Kensington) show all three masts raking aft. (Anderson 1994, pls. 11, 21)

Early representations of French rigging, however, have more similarity to English than to Dutch trends with respect to rake. Drawings of *La Couronne* (1628) and a print from 1626 of a French man-of-war show aft-raking main and mizzen masts, while the foremast is nearly vertical.[149] However, mid-to-late-17th-century French rigging representations show three vertical masts: the plates in *Album de Colbert* (1670), Jouve's plates (1679), the 1685-1690 painting of a French man-of-war ascribed to Puget (fig. 50), and Dassié's representations (1677, 1695).[150] Eighteenth-century French works continued to show three vertical masts.[151]

The field crew who excavated the mainmast step attempted to calculate the rake of *La Belle*'s mast as it sat in the mast step at the time of excavation. This may not be accurate, however, because the majority of the mast had eroded, leaving nothing to support the mast heel or its angle other than the mast step itself. The field crew recorded a change of 1 over 76 (3 mm over 23 cm), which is so slight a rake as to be unnoticeable.[152]

Considering that the preponderance of evidence from the mid-to-late-17th century showed French ships without significant rake to their masts, it seems most accurate to be conservative with this characteristic. Anderson observed rakes between 1 in 12 and 1 in 28 on various models. He observed that Dean used a rake of about 1 in 16 on his mizzen masts, and that the same rake was used on the mainmast of the *William Rex* model (1698), which had a slightly more raked mizzen.[153] Based on Anderson's observations of rake on several models, 1 in 16 is conservative. Therefore, both the main and mizzen

---

[149] Hancock 1973, figs. 1, 2; see also Anderson 1994, pl. 6.
[150] Berti 1988, 39, 42, 47, 50 [1670]; see also Jouve 1971, pls. 3, 6, 7 [1679]; Dassié 1994, 73 [1695].
[151] Romme 1778, figs. 3, 11, 66; see also Lescallier 1791, pls. 5, 7, 11, 12.
[152] Hedrick 1997, 811.
[153] Anderson 1994, 14.

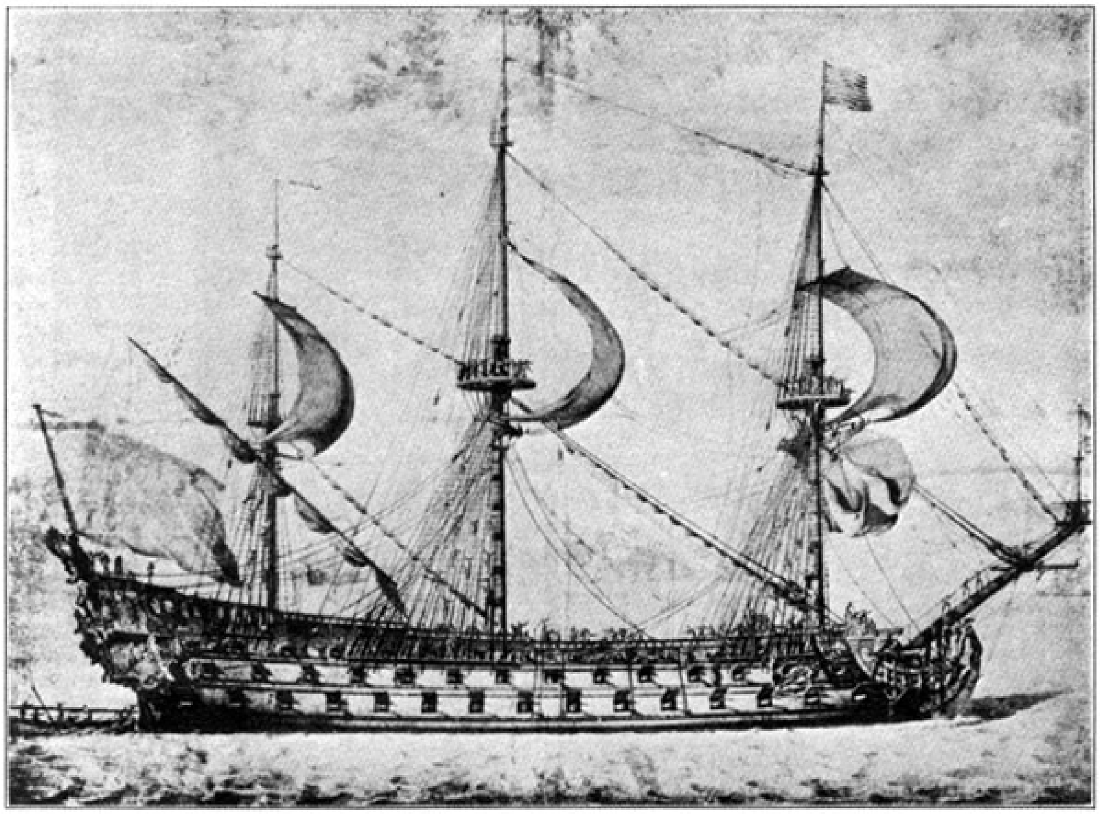


Fig. 50. A drawing of a French man-of-war (1685-1690) ascribed to Puget shows three vertical masts (in the Naval Museum at the Louvre, Paris). (Anderson 1994, pl. 16)

masts from *La Belle* have been reconstructed using this degree of rake, and the foremast is vertical.

Bowsprit. The bowsprit became shorter during the 17th century on English ships. It was common for the bowsprit to be as long as the foremast throughout the first half of the century, resulting in a bowsprit that was generally 0.80 to 0.89 of the mainmast (fig. 51).[154] Both the anonymous *Seaman's* Vade Mecum (1707) and Love (1705) still included this rule although all other evidence points to the bowsprit being considerably

[154] Manwayring 1972, 67 [1644]; see also Miller 1957, 2 [1667]; Smith 1970, 19 [1627].

shorter by this time.[155] This change was occurring by 1670 at the latest, when Dean directed the bowsprit to be 0.67 of the mainmast.[156]

Fig. 51. The model of *Norske Løve* (1634) shows the extremely long bowsprit common to the early 17th century (in Rosenborg Castle, Copenhagen). (C. Corder)

This proportion became standard on English ships through the remainder of the 17th century and well into the 18th.[157] Despite the suggestion found in the two early 18th-

---

[155] Anonymous 1707, 131-3; see also Love 1705, 39.
[156] Dean 1981, 82 [1670].

century treatises that the bowsprit length be equal to that of the foremast, it would be advisable to assume a rule similar to Dean's suggestion for English ships after 1670 and possibly for ships from the decade before, during which the change appears to have been taking place (fig. 52).

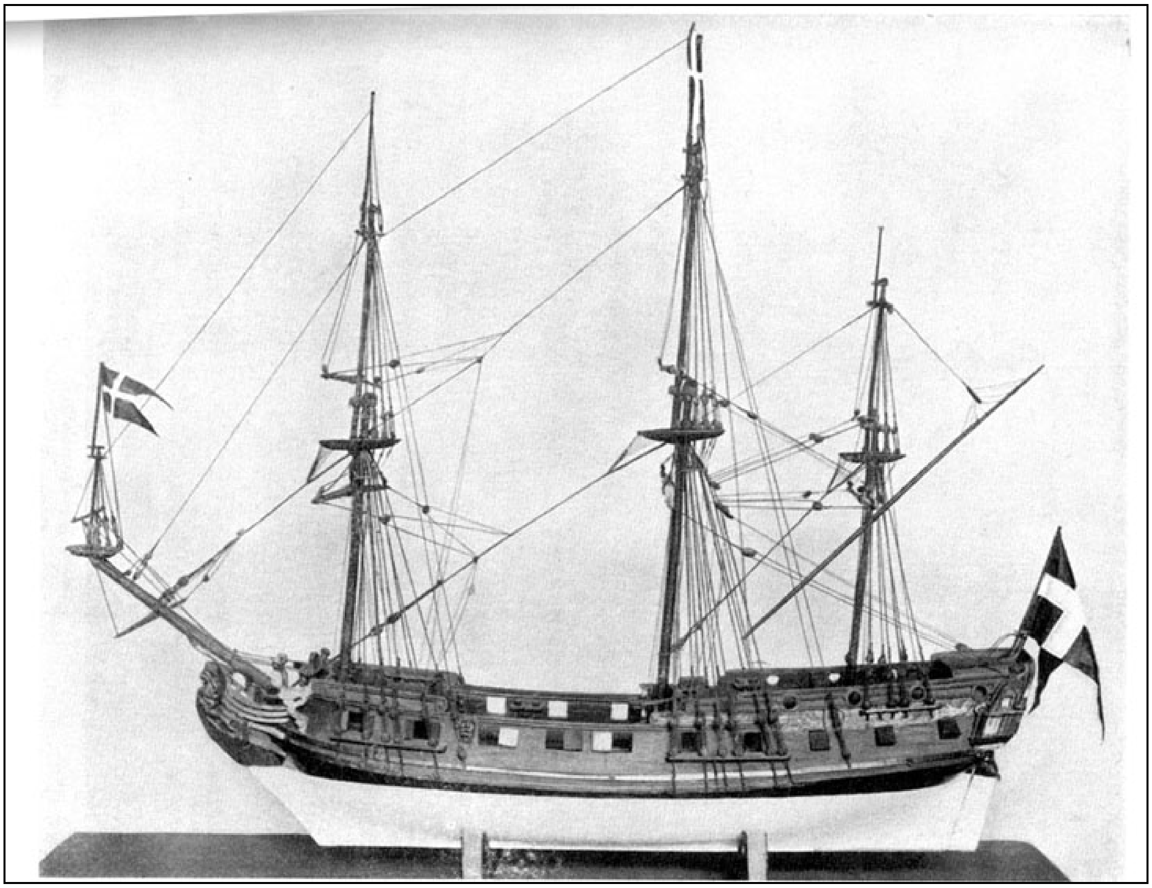


Fig. 52. This Danish frigate (1691-1720) has the proportionally shorter bowsprit of the late 17th century (in Kronborg Castle, Elsinore, Denmark). (Nance 2000, pl. 47)

There is a distinct difference between French and English sources, however. The French bowsprit was significantly shorter. Among 17th-century French treatises, the bowsprit's

---

[157] Davis 1985 [1711]; see also Anonymous 1748; Mountaine 1756. Although these sources may not specify this exact formula (0.80 to 0.89), their formulae for the bowsprit result in the same proportion relative to the bowsprit.

proportion to the mainmast was said to fall between 0.51 and 0.62.[158] During the 18th century, French proportions did not exceed the largest of these; Bouguer (1746) and Duhamel du Monceau (1752) both suggested a bowsprit be 1.5 times the ship's beam, resulting in a proportion 0.60 of the mainmast.[159]

Like the mizzen, however, it is difficult to know how far inboard the bowsprit will be stepped and, therefore, how much of these predetermined lengths will project beyond the beak head. Observing this difficulty, Anderson made a study of the bowsprit projections of several models,[160] and of the images included by Dean and Miller in their manuscripts.[161]

Anderson observed the bowsprit projection relative to the mainmast. In sources dated before 1660, this proportion was 0.60 or greater.[162] The exception to this is the Swedish *Amaranth* of 1654 that had a projection 0.50 of its mainmast. Among the English sources dating after 1670,[163] the projection varied between 0.50 and 0.54 of the mainmast, as opposed to continental sources that varied between 0.43 and 0.47 of the mainmast.[164] A plan in *Album de Colbert* from 1670 showed an extremely short projection relative to the mainmast (0.39), and Rålamb's treatise from 1691 showed a bowsprit projection similar to Anderson's models (0.46).[165] The decrease in the projection of the bowsprit after 1670 reflects the overall shortening of this mast during the 17th century, mentioned above to have begun during the 1660s. Also, the tendency

---

[158] Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994, 32 [1695].

[159] Bouguer 1746, 123; see also Marquardt 1986, 26.

[160] *Prins Willem,* 1651; *Amaranthe,* 1654; *Norske Løve,* 1654; *William Rex,* 1698; *St. George,* 1700s; and *Prince George,* 1723.

[161] Anderson 1994, 19; it is important to note that while Anderson believed *Le Royal Louis* to be a model of the actual ship, hence the name and its 1692 date, the Musée de la Marine in Paris now displays this model as a study model for young King Louis XV. Therefore, this model will be treated here as though it dates between 1720 and 1725; see also Boudriot 1973, 9-16.

[162] Miller 1957 [1667]; *Prins Willem,* 1651; *Norske Løve,* 1654.

[163] Dean 1981 [1670]; *St. George,* 1700; *Prince George,* 1723.

[164] *William Rex,* 1698; the Louis XV Model, 1720-1725.

[165] Berti 1988, pl. 47 [1670]; see also Rålamb 1943, pl. L [1691].

for the French to have shorter bowsprits is reflected in the shorter projections from continental models and treatises. Based on these sources, a 17th-century French bowsprit projection would have been between 0.39 and 0.47 of the mainmast.

While being considerably shorter than other nations' bowsprits, according to Dassié (1677, 1695) and SH 144 (1670), French bowsprits were proportionally larger in diameter. While English sources provided the same formulae for the thickness of the bowsprit as other masts (1 inch per yard in length), SH 144 and Dassié specified that the bowsprit have the same or similar diameter as the foremast, which was considerably longer than the bowsprit in French ships. Dassié suggested that the bowsprit and foremast have the same thickness while SH 144 indicated that the bowsprit should be one inch thinner than the foremast. This means that English sources suggested about one third inch (0.33) in diameter for every foot in length of the bowsprit, while French sources suggested 0.40-0.47 inch in diameter for every foot in length.[166] In the case of *La Belle*, the diameter of the bowsprit has been reconstructed at 26.42 cm (9.75 Fr in) thick.

Considering the range of proportions offered by the French and other continental sources considered here (0.51 to 0.62 of the mainmast), *La Belle* has been reconstructed with a 7.32-meter bowsprit (22.50 Fr ft) as a median within this range. The bowsprit projection should be between 0.39 and 0.47 of the mainmast according to continental sources, and so *La Belle*'s bowsprit projection is 0.43 times the length of the mainmast. This also is dictated in part by the model, but since the foremast position is known from archaeological remains, and because the maximum length of the ship between stem and sternpost was recorded in the Rochefort archives, the bowsprit projection can be determined based on material evidence.

---

[166] English sources all suggested one-third inch of thickness for every foot in height. Smith 1970 [1627]; see also Manwayring 1972 [1644]; Dean 1981 [1670]; Love 1705; Anonymous 1748. French sources recommended a thicker mast: Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994 [1695]; Bouguer 1746.

The steeve (angle of the bowsprit) is also dictated, in part, by the model. *La Belle*'s bowsprit has a steeve of 33º. This is near Anderson's observations of 35º from the *William Rex* of 1698 and the section of a Dutch two-decked ship of similar date in *L'Art de batir*, as well as Boudriot's suggestion.[167] Bouguer also suggested that the bowsprit's angle be 35º.[168]

Main and Fore Topmasts. During the first half of the 17th century, it was the rule to make topmasts half the length of their lower masts.[169] With the reintroduction of reefs in the latter half of the century, the formulae changed to allow for longer sails and therefore taller topmasts.[170] In addition to this overall lengthening after about 1655, French masts tended to be longer than English masts, and Dutch masts were in turn longer than French, as Bouguer observed in 1746.[171]

English main and fore topmasts increased their proportions to their lower masts from 0.50 to a range between 0.56 and 0.67 in the second half of the century. Dean was allowing for the re-introduction of reefs when he wrote in 1670 that topmasts should be 0.61 of their lower masts.[172] English sources continued to publish similar proportions through the remainder of the 17th century and well into the 18th. Love (1705) published a slightly smaller proportion, 0.56; Davis (1711) published a variety, 0.56 or 0.63.[173] The anonymous *Seaman's* Vade Mecum (1707) published the largest proportion among English sources, 0.67.[174] However, all of these proportions are larger than those of the first half of the century, reflecting the re-introduction of reefs.

---

167 Anderson 1994, 14-5; see also Boudriot 1993, 341 [SH 144 (1670)].
168 Bouguer 1746, 122.
169 Manwayring 1972, 67 [1644]; see also Miller 1957, 2 [1667].
170 Anderson 1994, 44; see also Brindley 1916.
171 Bouguer 1746, 123.
172 Dean 1981, 82 [1670].
173 Love 1705, 68, see also Davis 1985, 6-7 [1711]).
174 Anonymous 1707, 131-3.

French sources began publishing these larger proportions earlier than English sources, however. The manuscript SH 144 published a proportion of 0.58 in 1670, and Dassié published 0.67 in 1677 and again in 1695.[175] So during the latter half of the 17th century, French topmasts were probably longer than English in many cases. However, English ships appear to have caught up with the French in the early decades of the 18th century.

Anderson made a study of proportions from various Dutch, Swedish, and French models that also suggest a longer continental standard. The main topmast of the Swedish *Amaranthe* (1654) is 0.66 of the mainmast; *Le Royal Louis* (1720-1725) and *La Couronne* (1638) have a proportion of 0.63.[176] The plans in *Album de Colbert* (1670) also show a proportion of 0.63 between these two masts.[177]

Among the largest proportions observed by Anderson were those of Witsen (1671) and Van Yk (1697), who suggested 0.64 and 0.70, respectively.[178] The Dutch treatise *L'Art de batir* (1719) goes so far as to propose that the main topmast should be 0.88 of the mainmast, an unusually tall mast.[179] These exceed the proportions in French sources, and suggest that Dutch masts were among the tallest during the 17th and early 18th centuries. The same proportions can be applied between the fore topmast and the foremast; every source consulted used the same proportion for the fore topmast as with the main (fig. 53).

[175] Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994 [1695].
[176] Anderson 1994, 44.
[177] Berti 1988, pl. 47 [1670].
[178] Anderson 1994, 44.
[179] Anonymous 1719, 25.

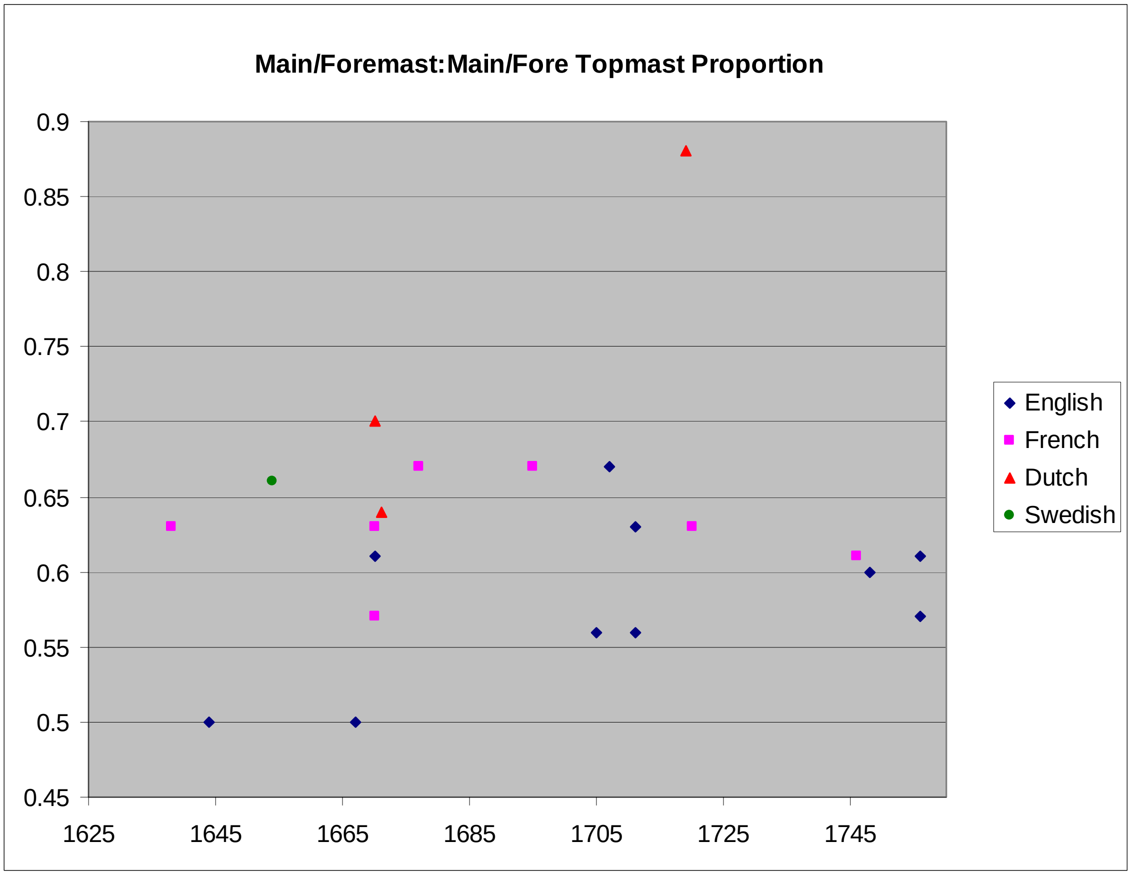


Fig. 53. Main/Foremast to Main/Fore Topmast Ratio.

La Belle would have been constructed allowing for reefs, and most likely according to the slightly longer proportions used by the French (0.57-0.67 of the mainmast). The main topmast could then reasonably have stood between 7.51 m and 8.82 m (23.09 to 27.14 Fr ft) according to these sources. Taking a near average from this, *La Belle* has been reconstructed with a main topmast of 8.02 m (24.75 Fr ft).

The same proportions can be applied between the fore topmast and the foremast. This resulted in a fore topmast within a small range, 6.40 m to 7.52 m (19.67-23.12 Fr ft). A near average results in a mast 6.83 m tall (21.00 Fr ft).

Dassié (1677, 1695) and SH 144 (1670) both suggested that the topmasts be 0.67 of their lower masts in diameter minus either $^{2}/_{3}$ of an inch or one inch.[180] Using this suggestion, the main topmast is 20.33 cm (7.50 Fr in) in diameter, and the foremast is 16.26 cm (6.00 Fr in) thick.

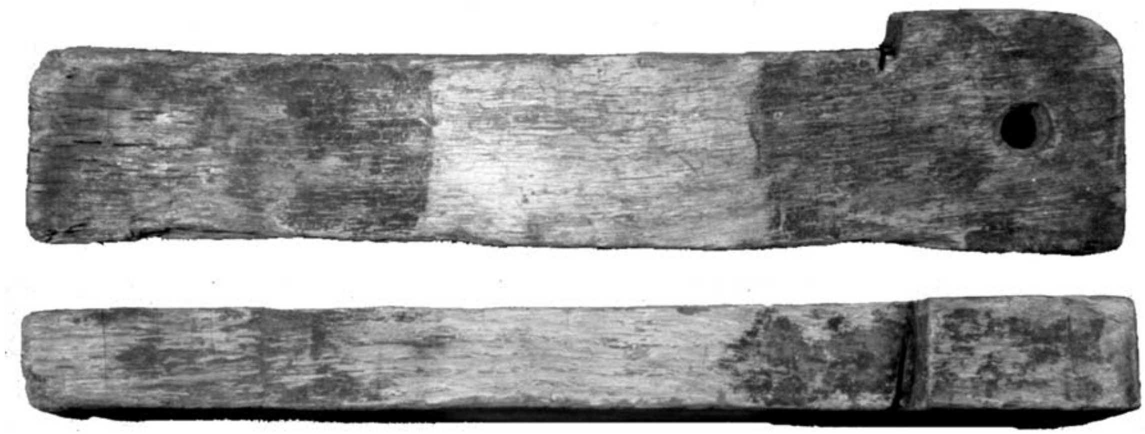


Fig. 54. Topmast fid recovered from *La Belle*. (A. Borgens, C. Corder)

These topmast diameters would also accommodate the fid recovered from the shipwreck (fig. 54). The fid measures 34.00 cm in length, 27.20 cm of which would have been inserted into a topmast heel. Anderson suggests the topmast heel at the point where the fid is inserted be 1.2 to 1.6 times the mast's maximum diameter, based on *Le Royal Louis* and *St. George*, respectively.[181] This would result in a main topmast heel between 24.40 cm and 32.53 cm (9.00 and 12.00 Fr in) on *La Belle*, and a fore topmast heel ranging between 19.51 cm and 26.02 cm (7.20 and 9.60 Fr in). The fid could fit either topmast because they are so close in size, and its dimensions lend more evidence to the reasonableness of the reconstructed topmast proportions.

---

[180] Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994, 32 [1695].
[181] Anderson 1994, 46.

Spar Proportions

Lower Yards. While Smith (1627) and Manwayring (1644) in the first half of the 17th century calculated the dimensions of their main yards based directly on keel length, later English sources based their main yard calculations on the mainmast.[182] Two early 18th-century English sources, Love (1705) and Davis (1711), also offered alternative calculations that relied on a measurement of the ship's beam, which was the basis of the formulae from the 17th- and 18th-century continental sources consulted here.[183] Among the continental treatises, the fore yard was the primary yard. This differs from English treatises, which first calculated the main yard and then derived all other yards from it. In fact, the French author Dassié clearly stated that the fore yard was the primary yard, and that it was based on an equation involving the ship's beam while the main yard was based on a proportion of the fore yard.[184] Similarly, the Dutch treatise *L'Art de batir* based the fore yard on the beam while the main yard was based on the fore yard, and the French sources SH 144 and the treatise by Bouguer based both lower yards on calculations using the ship's beam.[185]

Despite this conceptual difference between English and continental sources, all formulae show a general trend during the 17th and early 18th centuries toward shortening the lower yards relative to both the main and foremasts. Early 17th-century sources suggest main yards that are longer than the foremast by a proportion of 1.30.[186] By the middle of the century, the main yard was very nearly the same length as the foremast; Miller offered 0.96 in 1667, and Dean offered 1.00 in 1670. At this time French sources varied

---

182 Manwayring 1972, 117 [1644]; see also Smith 1970, 20 [1627].

183 Love 1705, 69; see also Davis 1985, 6 [1711]. The continental sources consulted for calculation of lower yards were Anonymous 1719, Bouguer 1746, Dassié 1994 [1695], and SH 144 [1670].

184 Dassié 1994, 33 [1695].

185 All of these equations are listed in Appendix A.

186 Manwayring 1972, 117 [1644]; see also Smith 1970, 20 [1627].

between 0.99 and 1.02, which is essentially the same proportion.[187] During the early years of the 18th century, the main yard became gradually shorter in comparison, 0.80 to 0.94.[188] This same trend holds true if the main yard is compared to the mainmast: the yard slowly shortens in relation to its mast. While early in the 17th century the main yard was very nearly the same length as the mainmast,[189] by the middle of the century and through the end, the proportion dropped to 0.86-0.90 of the mainmast. This holds true for both English and French sources.[190] Eighteenth-century sources gradually reduced this proportion further to a range between 0.71 and 0.88.[191]

Early in the 17th century, the fore yard was very nearly the same length as the foremast. In 1670, SH 144 still suggested this proportion, while Miller (1667) and Dean (1670) offered something smaller (0.86 and 0.89).[192] In 1677 and again in 1695, Dassié also offered something smaller (0.78).[193] English sources through the 18th century published even smaller proportions between the fore yard and the foremast (0.69-0.88). This discrepancy between the two French sources, SH 144 (1670) and Dassié (1677, 1695), is the result of the difference between their suggested main and fore yard proportions; while Dassié's main yard was eight feet longer than the fore yard, a fore yard from SH 144 was only half a foot shorter than the main yard. In fact, SH 144 suggests the main and fore yard should be closer to the same size than any other 17th- or 18th-century source, while Dassié's suggestions result in a main and fore yard that differ much more in length than any other source. There are thus differences between the French and English sources, as well as among the French sources themselves.

---

[187] Boudriot 1993 [SH 144 (1670)]; see also Dassié 1994 [1695].

[188] Love 1705; see also Davis 1985 [1711]; Anonymous 1707; Anonymous 1719.

[189] Smith (1970 [1627]) and Manwayring (1972 [1644]) published the proportion 1.04 for the relationship between mainmast and main yard.

[190] Miller 1957 [1667]; see also Dean 1981 [1670]; Dassié 1994 [1695], Boudriot 1993 [SH 144 (1670)].

[191] Love 1705; see also Anonymous 1707; Davis 1985 [1711]; Anonymous 1748; Anonymous 1719; Bouguer 1746.

[192] Dean 1981, 82 [1670]; see also Miller 1957, 3 [1667].

[193] Dassié 1994 [1695].

The main yard has been reconstructed at 11.07 m (34.00 Fr ft), which is the same length as the foremast, and is 0.84 of the mainmast, and 2.27 times the beam. This specifically satisfies the proportions derived from SH 144 (1670) and Dassié (1677, 1695), in which the authors assert that the main yard should be approximately the same length as the foremast, between 0.84 and 0.89 of the mainmast, and between 2.20 and 2.53 of the beam.

The fore yard has been reconstructed to reach 9.97 m (30.67 Fr ft), which is 2.04 times the beam, 0.90 of the foremast, and 0.90 of the main yard. This also specifically satisfies the proportions derived from SH 144 (1670) and Dassié (1677, 1695), in which the authors state that the fore yard should be between 0.82 of the foremast and the same length as the foremast, and between 2.00 and 2.17 of the beam. This is also a near average between the wide range of proportions indicated for the main and fore yards; 0.98 and 0.79 of the fore yard were published by SH 144 and Dassié, respectively.

Many authors agreed that the main yard should be 0.75 of an inch in diameter for every yard it was long.[194] However, Dean suggested something smaller, 0.63; Dean generally preferred thinner masts and spars than contemporary authors.[195] Love (1705) advised that the yards be as thick as the masts (one inch per yard in length), while Bouguer in 1746 suggested something in between Dean and Love (0.92).[196] Despite these variances, the preponderance of evidence supports lower yards at 0.75 of an inch in diameter for every yard in length. Therefore, when applied to *La Belle*'s main yard, this formula produced a yard that is 23.03 cm in diameter (8.50 Fr in). The fore yard is 20.77 cm in diameter (7.67 Fr in).

---

[194] Manwayring 1972, 117 [1644]; see also Smith 1970, 20 [1627]; Boudriot 1993, 342 [SH 144 (1670)]; Dassié 1994, 32 [1695].

[195] Dean 1981, 82 [1670].

[196] Love 1705, 69; see also Bouguer 1746, 125.

Topsail Yards. English topsail yards were generally half the length of their corresponding lower yards. Smith, Manwayring, Miller, Dean, and the anonymous *Seaman's* Vade Mecum all publish this proportion for the fore topsail yard.[197] For the main topsail yard, Smith (1627) and Manwayring (1644) also offer a smaller proportion (0.43), while Dean (1670) and Love (1705) suggest something longer (0.57).[198] Only Davis (1711) who, like the French, proposed formulae based on the ship's beam, offered a larger proportion (0.63 and 0.65 for the fore topsail yard, and 0.59 and 0.66 for the main topsail yard).[199] These are consistent with French sources from this period that suggest proportionally longer topsail yards. SH 144 (1670) and Dassié (1677, 1695) suggested that the fore topsail yard be 0.63 to 0.64 times the fore yard. SH 144 recommended that the main topsail yard be 0.65 the main yard, and Dassié recorded that the main topsail yard ought to be 0.61 times its lower mast.[200] Both are longer than contemporary English proportions.

Rigging plans of the 17th century support this evidence (fig. 55). Plates in *Album de Colbert* of 1670 consistently show main topsail yards that are 0.60 of the main yard and a fore topsail yard that is 0.61 of its lower yard.[201] *La Couronne* (1629) was fitted with a main topsail yard 0.67 times the length of the main yard, and plates of the rigging plan suggest that the fore topsail yard was 0.67 times its lower yard.[202]

---

[197] Smith 1970, 20 [1627]; see also Manwayring 1972, 117 [1644]; Miller 1957, 3 [1667]; Dean 1981, 82 [1670]; Anonymous 1707, 131-3.
[198] Dean 1981, 82 [1670]; see also Love 1705, 69.
[199] Davis 1985, 6-7 [1711].
[200] Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994, 32 [1695].
[201] Berti 1988, pls. 45, 48, 49 [1670].
[202] Hancock 1973, 24.

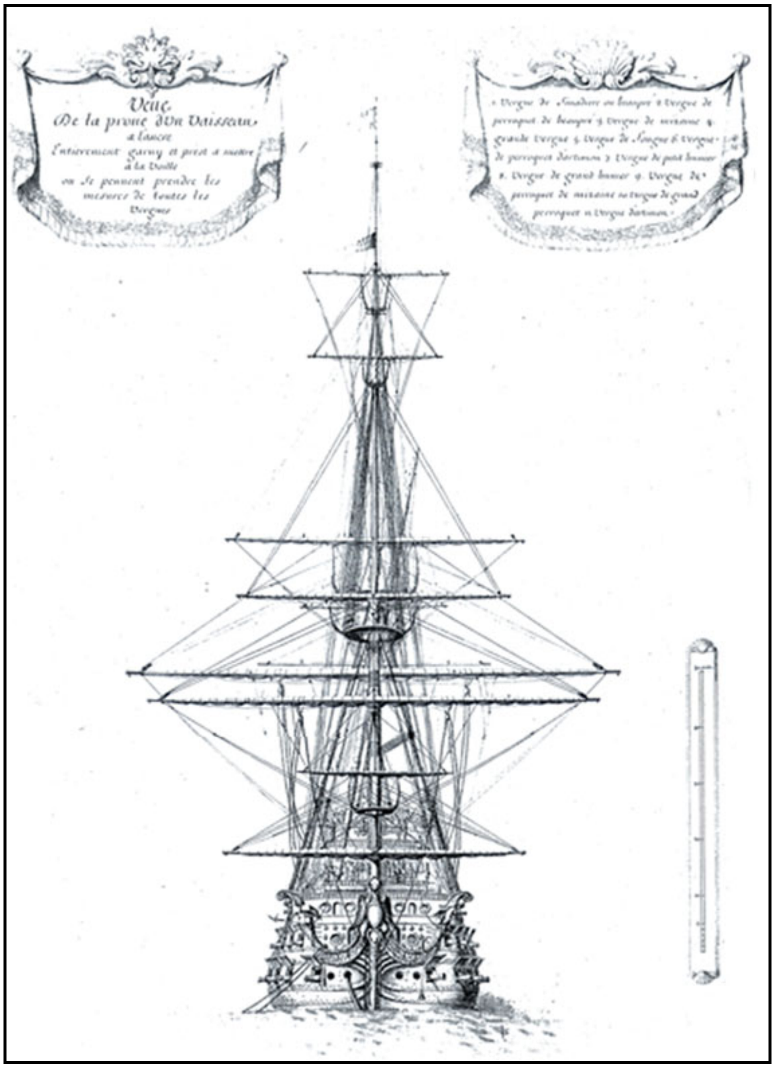


Fig. 55. French ships had longer topsail yards than the English during the 17th century (from *Album de Colbert*). (Berti 1988, Pl. 49 [1670])

In the 18th century, Bouguer (1746) suggested a smaller proportion for both top yards, 0.58, which was similar to contemporary English treatises.[203] Romme (1778), however,

---

[203] Bouguer 1746, 125; see also Anonymous 1748.

suggested that the main topsail yard be 0.60 times the main yard, and that the fore topsail yard be 0.67 times the fore yard.[204]

The Dutch, on the other hand, tended toward shorter top yards. In 1719, the Dutch treatise *L'Art de batir* recommended, like the English, that the top yards be only half the length of the lower yards.[205] *Der Holländische Zweidecker* of 1660 to 1670 reflects this shorter standard among Dutch top yards. Plates of the model show that the main topsail yards were 0.58 to 0.59 times the main yard, and that the fore topsail yards were 0.51 to 0.55 times the fore yards.[206] This may have been because Dutch ships carried long masts. Generally, a ship with longer masts had shorter yards, and a ship with shorter masts carried longer yards. In 1627, Captain John Smith warned that while there were no hard-and-fast rules for mast and yard proportions, "if your Masts be Taunt, your yards must be the shorter; if a low Mast, the longer."[207]

La Belle has been reconstructed with a fore topsail yard that is 0.64 times the lower yard, resulting in a yard that is 6.39 m long (19.67 Fr ft), and 13.31 cm in diameter (4.90 Fr in). The main topsail yard is 0.63 times the main yard (an average from French proportions), resulting in a main topsail yard 6.99 m long (21.50 Fr ft) and 14.57 cm in diameter (5.37 Fr in). These dimensions are longer than contemporary English ships' yards, and reflect a distinctly French feature in *La Belle*'s rigging.

Spritsail Yard. Smith (1627) offered a larger spritsail (1.60) yard relative to the main topsail yard as compared to later sources. This is because the main topsail yard, according to Smith, was smaller than what later sources indicate. This is not the case with Miller (1667). Miller suggested a main topsail yard similar to Smith, but a

---

[204] Romme 1778, 24-5.
[205] Anonymous 1719, 25.
[206] Winter 1967, pls. 2, 3.
[207] Smith 1970, 20 [1627].

considerably smaller spritsail yard (0.86 of the main topsail yard). Miller stands out among English and continental sources, all of which say the spritsail yard should be similar in size to the main topsail yard, if not exactly of the same size. SH 144 (1670) says the two yards should be the same size, while Dassié (1677, 1695) says four feet should be added to it, resulting in a proportion of 1.17.[208] Dean (1670), Love (1705), Davis (1711), and Bouguer (1746) all published a spritsail yard to main topsail yard ratio between 1.00 and 1.10. *The Seaman's* Vade Mecum stands out among these, having offered a formula that results in a figure 1.66 times the main topsail yard;[209] *L'Art de batir*'s suggested formula is similarly large (1.32 times the main topsail yard).[210]

Therefore, generally, a spritsail yard approximating the dimensions of the main topsail yard was common for both English and French ships. However, topsail yards were longer among the French, resulting in a French spritsail yard that was longer than the English yard. This relationship can by seen by comparing the spritsail yard to the bowsprit itself. In this relationship, the French treatises offered proportions that stood out among the others as being some of the largest between the spritsail yard and bowsprit.

The wide variety of proportions observed between the different sources is unique among all the other yards. There is an equally wide variety of formulae offered by each source, and no apparent patterns. Formulae were based on the main yard, the crossjack yard, the mizzen yard, the main topsail yard, the fore topsail yard, the main yard, the bowsprit, the beam, and the fore yard; practically every source based its formula for the spritsail yard on a different part of the ship or rigging. It can be said, however, that the French were carrying among these the longest spritsail yards.

---

[208] Boudriot 1993, 342 [SH 144 (1670)]; see also Dassié 1994, 32 [1695].
[209] Anonymous 1707, 131-3.
[210] Anonymous 1719, 25.

Suggestions for the thickness of the spritsail yard vary more widely than for any other yard as well. Smith (1627) and Manwayring (1644) both advised making it half an inch thick for every yard in length.[211] Later sources advised something larger; SH 144 (1670) published 0.72 in; Dean (1670), 0.63 in; Love (1705), 1.00 in; and *L'Art de batir* (1719), 0.80 in.[212] However, there was only one suggestion from the 17th-century French sources; accordingly, SH 144 suggested that this yard be equal to the fore topsail yard in diameter.

Because there was such a wide variety of suggestions for the spritsail yard, the French manuscript SH 144 (1670) was followed to the exclusion of others. This satisfied the general trend among French sources for a longer spritsail yard. In the case of *La Belle,* the spritsail yard has been reconstructed to equal the main topsail yard, as suggested by SH 144 (1670) as well as Bouguer (1746), resulting in a spar 6.99 m long (21.50 Fr ft). Also relying upon SH 144, the only French source to offer a formula for this yard's diameter, *La Belle*'s spritsail yard has been reconstructed as 14.44 cm thick (5.33 Fr inches).

<u>Mizzen Yard</u>. The mizzen yard appears to have grown after the mid-17th century. Smith (1627) suggested that the mizzen yard be 0.63 of the fore yard, while Miller (1667) suggested it be 0.97 of the fore yard, and SH 144 (1670) said 0.86. After the time of these two sources, both English and continental sources were consistent in advising that the mizzen yard be similar, if not exactly the same length, as the fore yard. Dean (1670), Dassié (1677, 1695), Love (1705), *The Seaman's* Vade Mecum (1707), Davis (1711), *L'Art de batir* (1719), Bouguer (1746), and *Marine Architecture* (1748) all offered proportions between 0.97 and 1.08 of the fore yard, and half of them specifically stated that the mizzen yard was to be equal to the fore yard.[213] It is important to note

---

[211] Manwayring 1972, 117 [1644]; see also Smith 1970, 20 [1627].

[212] Boudriot 1993, 342 [SH 144 (1670)]; see also Love 1705, 69; Anonymous 1719, 25.

[213] Dassié 1994 [1695]; see also Dean 1981 [1670]; Anonymous 1748; *The Seaman's* Vade Mecum 1707.

that, despite the otherwise very consistent suggestions, SH 144 stands out among contemporary treatises by offering a much shorter mizzen yard relative to the fore yard (0.86 of the fore yard). Therefore, *La Belle*'s mizzen yard has been reconstructed to be the same length as the fore yard according to the majority opinion (9.97 m, 30.66 Fr ft).

Most sources suggested the mizzen yard be half an inch thick per yard in length.[214] However, three manuscripts close in date to *La Belle*, including both 17th-century French sources, suggested something much larger. SH 144's formula results in a proportion 0.88 inches per yard in length,[215] Dean suggested 0.63 inches per yard, and Dassié advised that the yard be 0.59 inches thick per yard in length.[216] For French mizzen yards, then, something larger than half an inch thick per yard in length is best. Therefore, *La Belle*'s mizzen yard has been reconstructed thicker than contemporary English yards would most likely have been, at 16.34 cm (6.00 Fr in).

[214] Smith 1970, 20 [1627]; see also Manwayring 1972, 117 [1644]; Love 1705, 69; Bouguer 1746, 125; Anonymous 1748, 49.
[215] Boudriot 1993, 342 [SH 144 (1670)].
[216] Dean 1981, 82 [1670]; see also Dassié 1994, 34 [1695].

CHAPTER IV

RECONSTRUCTING THE STANDING AND RUNNING RIGGING

Contemporary treatises not only prescribed dimensions for masts and spars but included charts of rigging sizes as well. However, rather than providing proportions with which to calculate the ropes' appropriate dimensions, 17th- and 18th-century treatises included charts listing actual sizes of rigging for masts of various diameters, or in the case of a particular Dutch treatise, by the ship's beam. Also unlike the treatment of masts and spars, which are categorized by their maximum diameter, rope is categorized by its circumference. For example, a 12-inch mast is a mast with a 12-inch diameter, while a 4-inch rope is a rope with a 4-inch circumference.

Few 17th-century treatises comprehensively address rigging proportions, and unfortunately there are no available French treatises on the subject. As a result, this reconstruction relies heavily upon the anonymous 1719 Dutch treatise, *L'Art de batir*, to calculate the sizes of specific lines of rigging, aside from those for which *La Belle*'s artifacts have provided direct evidence.[217] However, French sources continue to direct the form and style of the rig. *L'Art de batir* makes an important contribution because it indicates differences in the sizes of specific lines of rigging between the Dutch and the English, which are represented by several corroborating sources. While French sources might have indicated still more differences among the continental traditions, as was discussed above, none were available. Furthermore, as has been shown to be the case with other rigging features, *La Belle* was influenced by Dutch rigging design, and so a Dutch treatise is more appropriate than an English one for the purpose of establishing line weight. As such, *L'Art de batir* has been relied upon for determining line weight in the case of *La Belle*.

---

[217] Please see the discussion above on the rope artifacts recovered from *La Belle*.

Standing Rigging of the Main and Foremasts

Standing rigging is generally defined as any line of rigging that serves to support the masts, while running rigging moves the yards, the sails, the masts, cargo, or boats. Some items of rigging fit both categories, however. The tackle pendants, which served to support the masts and were secured to the channel near the shrouds, were called "swifters" early in the 17th century, a term that later referred to the after-most pair of shrouds.[218] These "swifters" were also used when careening a ship, to ease the ship onto its side while preventing the masts from coming out of their steps.[219] In this discussion, however, the tackle pendants will be included among the standing rigging, as will other tackle that were attached to the masts.

The pendants for these tackle were the first item of standing rigging added when "dressing" a mast. The shrouds were added in pairs after this, beginning with the forward-most pair on the starboard side, and alternating with the port side shrouds; in this fashion, the shrouds were added forward to aft (fig. 56). If the mast held an odd number of shrouds, the final shroud was single, fit with a different splice. Ratlines ran horizontally across the shrouds, keeping them taut and allowing for catharpins in larger ships as well as providing a foothold for sailors. These shrouds were set up with a lanyard that ran between a deadeye on the lower end of the shroud and a deadeye that was attached to the hull by a chainplate set in a channel, or "chainwale", as it was called during the 17th century. The chainplate was a plate of iron during the mid-to-late 17th century, although later, in the 18th century, and earlier in the 17th century, it was actually made of long chain links. The channel was bolted to a wale (a thick strake of planking) in order to better support the forces from the shrouds. The shrouds supported the mast and indirectly distributed the force of the wind in the sails onto the hull.

---

[218] Manwayring 1972, 104 [1644]; see also Anderson and Salisbury 1958, 49 [1625].
[219] Manwayring 1972, 104-5 [1644].

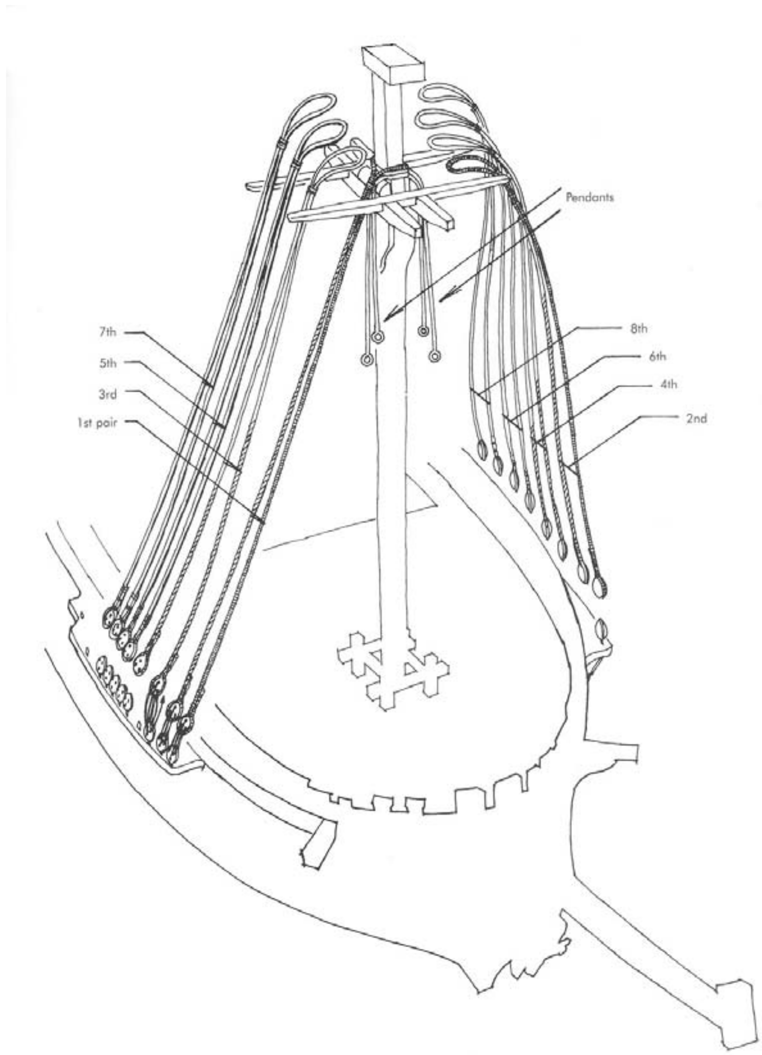


Fig. 56. Dressing a mast. (Petersson 2000, 5)

The most substantial line of standing rigging on the lower masts was the stay. The mainstay ran around or to one side of the foremast from the mainmast head and attached to the bow of the ship. The forestay attached to the bowsprit. Stays supported the masts in a forward direction, countering the backward and lateral pull of the shrouds as well as the force of an aft-raked mast. Without the stays, the masts would have been loose, and less able to direct the force of the wind to the hull (fig. 57).

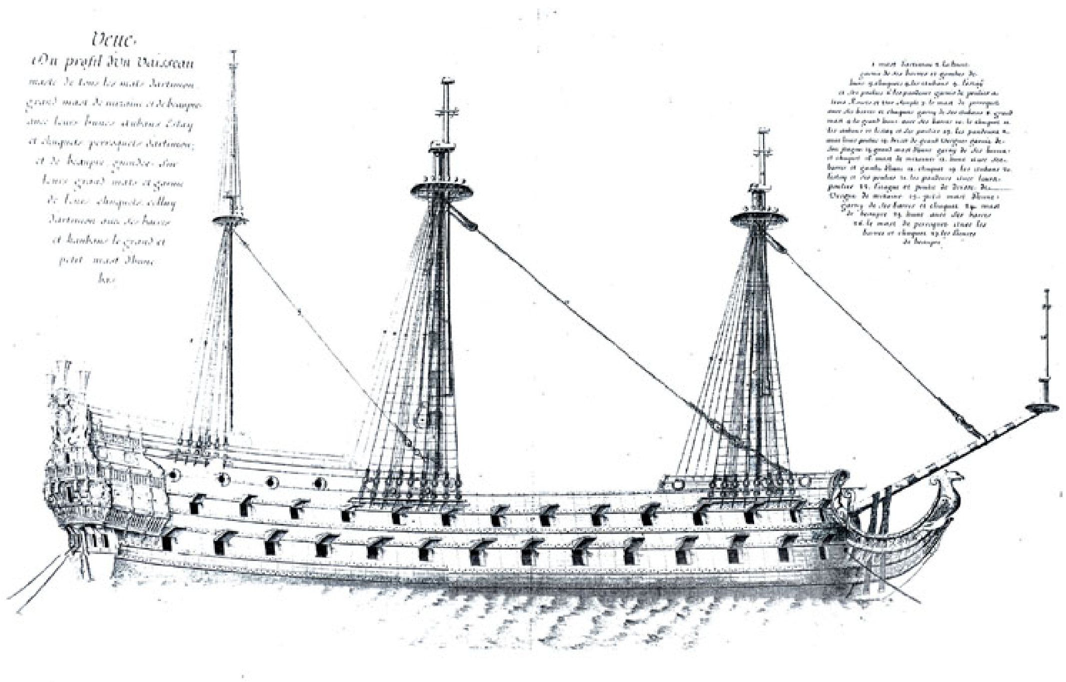


Fig. 57. Lower stays on a 17th-century French ship (from *Album de Colbert*). (Berti 1988, pl. 39 [1670])

Most ships would have had some form of mid-ship tackle for hoisting guns, ship's boats, or cargo. These are only included among the standing rigging because they are attached to the masts and are therefore distinguished from yardarm tackle. The tackle itself would have been suspended either from one line drawn from the main top and attached to the mainstay, or from two lines drawn together from the main top and fore top.

Tackle Pendants. Tackle pendants were the first line of standing rigging seized around the main and foremast head. Then, after the shrouds had been set up, the tackle would have been added to their pendants. Anderson offered two options for the tackle pendants of foreign ships, a four-part tackle of a fiddle block over a single block and a five-part tackle of two double blocks.[220] However, these are really only specific to the Dutch. In fact, the anonymous Dutch treatise, *L'Art de batir* of 1719, specifically labels fiddle

---

[220] Anderson 1994, 105, figs.106, 107,

blocks "tackle blocks", demonstrating their typical use.[221] The French, however, do not belong in Anderson's "foreign" category in this instance. *Album de Colbert* of 1670 includes detail of the tackle pendants, and instead of fiddle blocks the tackle pendants are four-part, made of a double block over a single block.[222] Dassié's treatise of 1677 and 1695 suggests the same sort of tackle pendants for the main and foremasts.[223]

English runner tackle, which are a more complicated pendant system involving a runner attached to the pendant block and a tackle attached lower down on the runner, would have been secured to the channel in two places, the runner and the tackle itself. The simple tackle used by foreign ships did not have a runner, and so was secured to the channel in only one place. *Album de Colbert* includes simple tackle pendants between the fourth and fifth, and sixth and seventh, deadeyes on the main channel, and between the third and fourth, and fifth and sixth, deadeyes on the fore channel. *Album de Colbert* also distinguishes between the forward and aft tackle, the forward tackle on each mast being labeled *pallans*, and the aft tackle, *caliornes* (fig. 58).[224] *L'Art de batir* makes the same distinction between the tackle pendants listed in its ship inventories. The names would imply by modern definitions that the aft c*aliornes* tackle was larger. But *L'Art de batir* lists the circumference of the ropes for both types of tackle, and they are the same size; however, it does not include the aft tackle in its examples of smaller (28- and 26-foot beam) ships. The Dutch treatise, *L'Art de batir*, also includes tables of rigging proportions, with four sizes of ships as examples: 37-foot, 32-foot, 28-foot, and 26-foot beam.[225]

---

221 Anonymous 1719, pl. 7 no. 2.
222 Berti 1988, pls. 42, 50 [1670].
223 Dassié 1994, 36, 57 [1695].
224 Berti 1988, pls. 42, 50 [1670].
225 Anonymous 1719, 27-32.

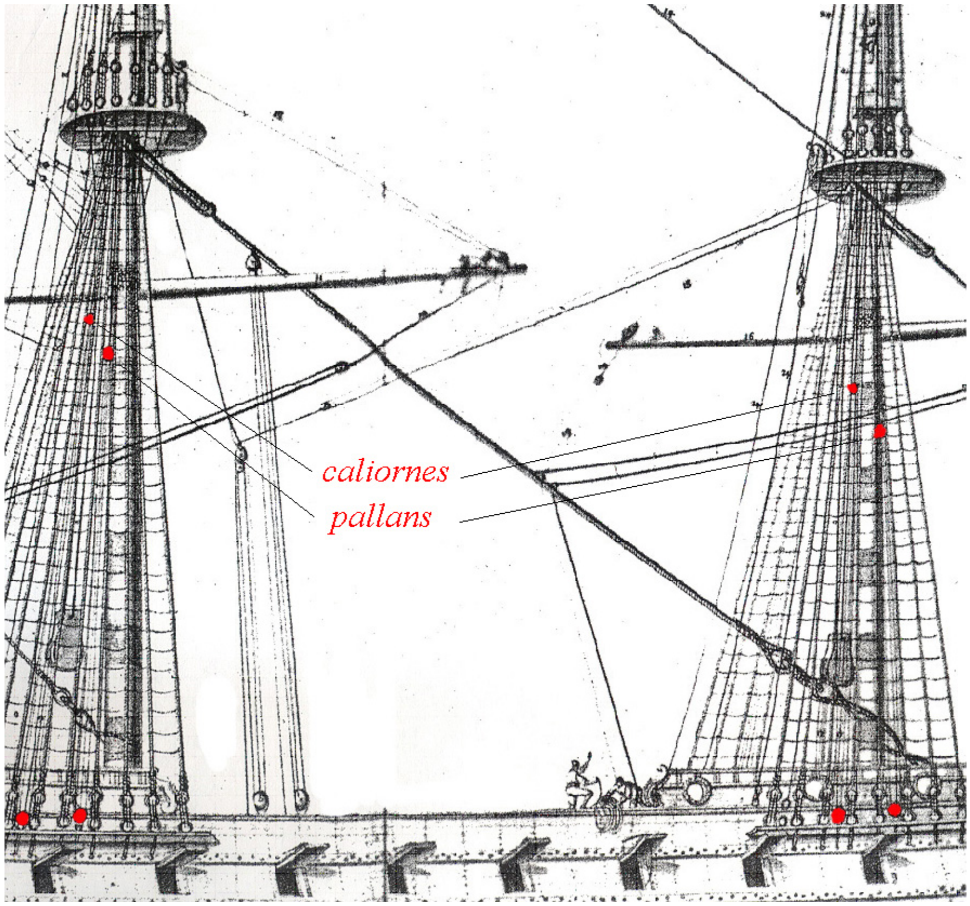


Fig. 58. Tackle pendants from *Album de Colbert*. (Berti 1988, pl. 42 [1670])

In accordance with the 17th-century French sources, *La Belle* has been reconstructed with simple tackle pendants, and because of its size, only one pair has been added to each main and foremast. The four-part tackle is made of a double over a single block, and is secured in the channel between the first and second shrouds on both the fore and mainmast.

The tackle were reconstructed slightly larger in circumference (12.74 cm, 4.7 Fr in) than the shrouds (9.49-10.84 cm, 3.5-4.0 Fr in), which are discussed below. The circumference was derived from tables of rigging proportions in the Dutch treatise, *L'Art de batir*, which includes examples from four sizes of ships: 37-foot, 32-foot, 28-foot, and

26-foot beam.[226] This treatise includes aft and fore tackle that are 0.57-0.60 of the mainstay. Derived from this narrow range of proportions are tackle slightly larger than their corresponding shrouds, as opposed to being the same size as the shrouds, which English sources indicate. The anonymous *Marine Architecture* of 1748 reproduced a table (originally published by Thomas Miller in 1667) that listed the sizes of ropes required for masts of various diameters and for their corresponding topmasts (fig. 59).[227] Proportions for tackle and shrouds derived from these sources for 12-to-13-inch (30.48-33.02 cm) lower masts match almost exactly those listed for *Nichodemus*, an English sixth rate from Edward Hayward's *The Sizes and Lengths of Rigging* published in 1660. Together, these sources indicate that English tackle were equivalent in circumference to their corresponding shrouds, unlike Dutch rigging. Because *La Belle* has been shown to have other Dutch influences upon its rig, and because of a lack of similar French rigging tables, *L'Art de batir*'s tables have been used for this reconstruction.

Shrouds. After the tackle pendants were seized over the masthead, the shrouds were added in pairs. Seventeenth-century manuscripts rarely discuss the appropriate number of shrouds for masts of particular sizes, but the number of shrouds would have depended upon the mast size, as well as the type of rope and its thickness. When numbers of shrouds are discussed, it is within secondary sources and often a large ship of the line or something similar is the subject of the discussion. However, Frank Howard observed the number of shrouds carried on small ships: between four and five foremast shrouds, and five and six mainmast shrouds.[228] This is very similar to what is found in many drawings and rigging plans from the time. Dean's fifth and sixth rates fall into these ranges,[229] and the drawing of *Le Petite Fregatte* of 1710, smaller than a standard frigate, may also be a good example; it carries four foremast shrouds, and four mainmast shrouds (fig. 39). This is similar to ships averaging 50 tons in the Jouve prints, where

[226] Anonymous 1719, 27-32.
[227] Anonymous 1748, 74-80; see also Miller 1957, 9-15 [1667].
[228] Howard 1979, 134.
[229] Dean 1981, 92, 94 [1670].

these small ships carry three to four foremast shrouds, and three to five mainmast shrouds (table 3).

Table 3. Shrouds on small ships.

	Mainmast Shrouds	Foremast Shrouds
Frank Howard	5-6	4-5
Dean's Doctrine (1670)	5-6	4-5
Le Petite Fregatte (1711)	4	4
Jean Jouve (1679)	3-5	3-4

More prevalent among 17th-century treatises were tables indicating the appropriate circumference of all lines of rigging attached to a mast of a particular size. *Marine Architecture* and Miller list the sizes of ropes required for masts of various diameters and for their corresponding topmasts (fig. 59).[230] The sizes specified by these two sources for 12-to-13-inch (30.48-33.02 cm) lower masts match almost exactly those listed for *Nichodemus*.[231] These charts indicate that the main shrouds should be about two thirds, or 0.67, of the mainstay's circumference. The fore shrouds ranged between 0.54 and 0.58 of the mainstay and 0.70 and 0.88 of the forestay. The Dutch treatise, *L'Art de batir*, also includes tables of rigging proportions, with four sizes of ship as examples: 37-foot, 32-foot, 28-foot, and 26-foot beam.[232] These tables indicate that the main shrouds were about half (0.50 to 0.55) of the mainstay's circumference, while the fore shrouds were slightly less than half of the mainstay (0.46 to 0.50) and 0.58 to 0.63 of the forestay. While the Dutch treatise appears to be calling for shrouds smaller than the English sources, shrouds calculated for *La Belle* by either source would be

[230] Anonymous 1748, 74-80; see also Miller 1957, 9-15 [1667].
[231] Hayward 1660, 1-14.
[232] Anonymous 1719, 27-32.

approximately the same because the Dutch treatise calls for proportionally larger stays.[233]

Here followeth the bigness of Ropes, for such Masts as follow.

The bigness of the Rigging for these main-masts, and main-top.masts: the fore-mast to these masts followeth in the next Page.	Masts of 34 in. 1 *inch*	Masts of 32 in. 2 *inch*	Masts of 30 in. 3 *inch*	Masts of 29 in. 4 *inch*	Masts of 28 in. 5 *inch*	Masts of 20 in. 6 *inch*	Masts of 26 in. 7 *inch*	Masts of 24 in. 8 *inch*	Masts of 23 in. 9 *inch*	Masts of 19 in. 10 *inch*	Masts of 13 in. 11 *inch*	Masts of 12 in. 12 *inch*	
Penents of Tackles	8½	8	7	6½	6	5½	5	7	6	5	4	4	*Note, There Bunt-lines are in bignes as followeth,* 3½ 3½ 3 2½ 2 2 2 2 2 2 2 1½
Runners	6	5½	5	5	4½	4	3½	5	5	4½	3½	3¼	
Falls of the Tackles	4	4	3½	3½	3	3	3	3½	3½	2½	2½		
Shrowds	8½	8	7½	7	6½	5	5	7	6	5	4	4	
Laniards	4½	4	4	3½	3	3	3	4	3½	3¼	2½	2½	
Swifters	8½	8	7½	7	6½	5	5	5½	5	4½	3¼	3¼	
Laniards	4½	4	4	3½	3½	3	2½	3½	3	3	2½		
Stay	17	16	15	14½	14	10	8	12	14½	9½	6½	6	
Collar at the Stem	16	15	13	12	11	9	8	10	10	8	6		
Laniard of the stay	6	5½	5½	5	4	4	3½	4	4	3½	2½	3	
Lifts	4½	4	3½	3½	3	3	2½	3	3	2½	2½	2	
Lacks	9½	9	8½	8	6½	6	5	6½	6	5½	4	4	
Sheates	6½	6½	6	6	5	4½	4	4½	4½	3½	2½	3	
Bowlines	5½	5	4½	4½	4	4	3	3	3	2½	2½	2½	
Bridles	4½	4½	4	4	3½	3½	3	3	3	2½	2		
Penents fore-brases	4	4	3¼	3½	3	3	2¾	3	3	2½	2	2½	
Brases	3	3	3	3	2½	2½	2	2½	2½	2	1½	2	*Note, The ships that have no jeers there tye is 4 inches, and their Halliyards is 2½.*
Clew-garnets	4	3½	3	3	2½	2½	2	3	2½	2½	1½	2	
Jeers	8½	8	7	6	5½	5		6	4½	4			
Parrel Rope	6	6	5	5	4½	4	3	4½	4	3½	3	3	
Brest-rope	8	7	6	6	5								
Runner of mart-lines	2½	2½	2½	2½	2	2							
Fall of mart-lines	2½	2½	2½	2½	2	2		2½	2	2	1½		
Penent of the garnet	8½	8	7½	7	6	5	4½	6	5½	5	5	4	
Tye	6	5½	5	5	4½	4	3½	3½	3	3	3	3	
Fall of the garnet	4½	4	4	4	3½	3½	3	3	3	2¼	2	2	

Fig. 59. Rigging chart from Thomas Miller's *The Complete Modellist*, 1667, showing rope circumferences for the mainmast. (Bruzelius 1999, http://www.bruzelius.info/Nautica/Rigging/Miller(1667).html)

---

[233] English sources consulted here universally call for stays whose circumferences are half the diameter of the corresponding mast, while *L'Art de batir* has suggested a range of larger proportions (0.65 to 0.75 for masts 15.5 to 20 inches in diameter). Hayward 1660, 59; see also Miller 1957 [1667]; Anonymous 1748; Anonymous 1719, 27-32.

Two portions of lower shroud were recovered from *La Belle* (artifacts 13277, 3392). The circumference of each (9.73 cm and 3.59 Fr in, and 8.76 cm and 3.23 Fr in, respectively) corresponds to the circumferences derived by applying the formulae from the Dutch and English sources to *La Belle* for the main shrouds (10.84 cm and 4.00 Fr in) and the fore shrouds (9.49 cm and 3.5 Fr in). Because of this, *La Belle*'s main shrouds have been reconstructed as 4.0 inch rope and the fore shrouds as 3.5 inch rope.

The circumference chosen for the shrouds, or any other line of rigging for that matter, may have been due in part to the type of rope from which they were made. Shrouds were generally either cable-laid or shroud-laid. Cable-laid rope is usually made of three hawsers. Hawsers are three-stranded ropes laid up right-handed (i.e., the strands appear to angle down from right to left). Cable is made up of right-handed ropes such as hawser laid up left-handed (i.e., the ropes appear to angle down from left to right). The ropes are laid up in the opposite direction of their composite strands to counteract unraveling. A cable can also be made of three lengths of shroud-laid rope, which is made of four strands that are laid up right-handed like hawser. A cable-laid rope made of three hawsers would therefore have nine strands, and a cable-laid rope made of three shroud-laid ropes would have twelve strands (fig. 60).[234]

---

[234] Anderson 1994, 84; see also Marquardt 1986, 255.

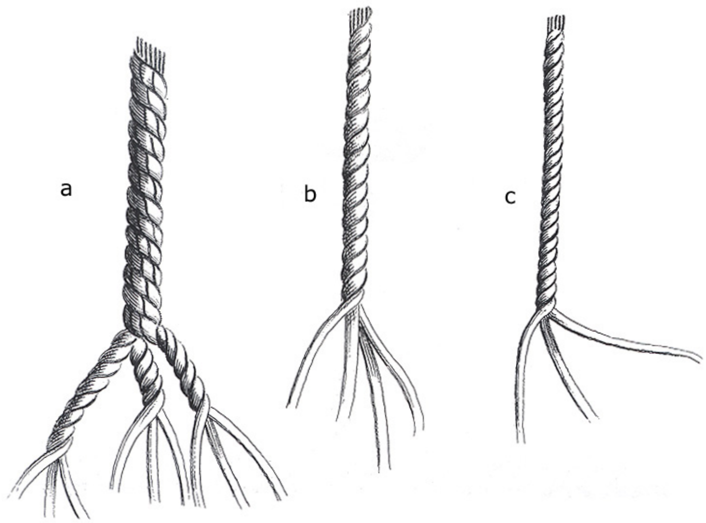


Fig. 60. Rope examples: *a*. cable-laid; *b*. shroud-laid; *c*. hawser-laid rope. (Lever 1998, figs. 1-3)

A left-handed shroud (cable-laid) wrapped under the deadeye from left to right as viewed from inboard, and was secured on the left side of the shroud. A right-handed shroud (shroud-laid) wrapped under the deadeye from right to left as viewed from inboard, and was secured on the right side of the shroud.[235]

The deadeyes were set up with a lanyard drawn between them that was used to tighten or loosen the shroud. The lanyard was generally a right-handed rope, and James Lees attests that the lanyard would have been set up differently depending on the rope used for the shroud.[236] According to Lees, the lanyard was roved through the right-handed hole of the deadeye, as viewed from outboard, when the shroud was right-handed (shroud or hawser-laid), but through the left-handed hole, as viewed from outboard, when the shroud was left-handed (cable-laid) (fig. 61).[237]

[235] Anderson 1994, 94.
[236] Anderson 1994, 95.
[237] Lees 1984, 40.

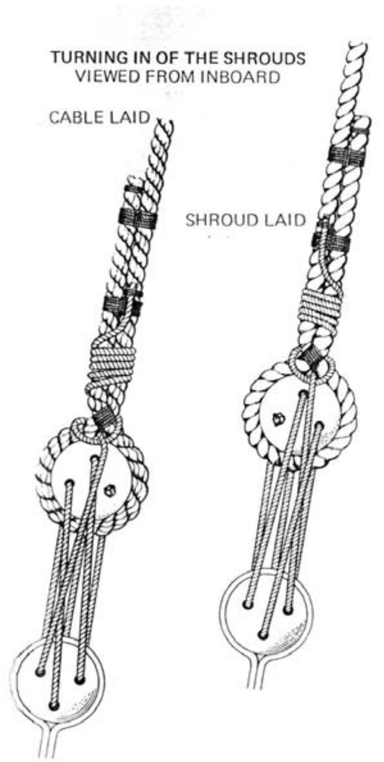


Fig. 61. Cable-laid and shroud-laid shrouds were set up differently relative to the deadeye. (Lees 1984, 42)

Some scholars believe that shrouds were most often cable-laid, while others believe they were most often shroud-laid, and only occasionally cable-laid.[238] In either case, it can be assumed that these scholars are addressing English ships. However, one scholar has specifically addressed the differences between English and mainland European tradition. Karl Heinz Marquardt specifies that cable-laid shrouds were used on English men of war, large merchantmen, and some French men of war, and that smaller merchantmen had hawser-laid shrouds, which were more common on continental ships. This last assertion was based on a statement from Röding (ca. 1793-1798), who was German; "usually the shrouds are hawser-laid, but the English also use cable-laid ropes."[239] Röding's description of German rigging resembles Dassié's (1677, 1695). Dassié said

[238] Anderson 1994, 84; see also Lees 1984, 41. Anderson believed shrouds were most often cable-laid; Lees believed shrouds were most often shroud-laid.

[239] Marquardt 1986, 61.

the main, fore, and all other shrouds ought to have been of three strands.[240] However, despite the preponderance of literary evidence that would suggest hawser-laid shrouds for continental ships and specifically for French ships of the 17th century, archaeological evidence tells us that *La Belle* apparently did not follow French tradition in this area, and carried shroud-laid shrouds.

The two portions of lower shroud recovered from *La Belle* were identifiable by an associated deadeye in one case (13277), and by its seizing in another (3392). Both lengths of shroud are shroud-laid and have a wick at their centers that Dassié described in his treatise; "quatre cordons, et une méche au milieu, appellée *l'Ame*." But he was describing the main topstay, not the shrouds.[241] Therefore in this instance, *La Belle* has proven not to have employed techniques one would expect based on contemporary French or other continental sources. The reconstruction of *La Belle* therefore shows shrouds that are right-handed to represent shroud-laid shrouds.

We can reasonably expect that shrouds were served where they were seized around the mast head and around the deadeyes (areas of chafing). Lees and Marquardt, writing about English ships of this period, say the foremost shroud on each mast was served all the way down to protect the rope from chafing by the sail. Lees also adds that the foremost shroud would have been wormed and served.[242] This would seem likely for *La Belle* as well; however, while shroud 3392 is served, there is no evidence of worming, which may be another example of a shortcut in setting up a smaller and simpler rig.

The shrouds were drawn to channels on either side of the ship in which were set iron-strapped deadeyes attached to chainplates. This, in part, transferred the force from the

---

[240] Dassié 1994, 53 [1695].
[241] Dassié 1994, 52 [1695].
[242] Lees 1984, 40; see also Marquardt 1986, 61.

masts to the hull of the ship. The chainplates would have been attached to a wale (a thick strake of planking that stiffened the hull) in order to be able to handle the force.

The majority of contemporary evidence shows that deadeye straps were set into the channel at their necks. The bottom loops, extending from underneath the channel, were attached either to long chain lengths or actual plates, both of which are called chainplates. Early in the 17th century, Smith explained that chainplates were not chains, but in fact iron plates.[243] However, *Batavia* (1629), which wrecked at about the time of Smith's publication, carried chains for chainplates.[244] By the 18th century, chainplates would almost universally be long chain lengths, but where and when this transition took place has been a difficult question to answer. While Anderson suggested that foreign ships briefly switched from plates to chains in the mid-17th century, much evidence suggests that plates were common at least throughout the second half of the century if not the first half as well, when *Batavia* carried chains.[245] The *Norske Løve* (1654) has plates, as does the Danish Church Model (ca. 1680) in the Royal Danish Naval Museum in Copenhagen, and Jouve included plates in his drawings.[246] It does seem, however, that many Dutch ship models from this century had chains like *Batavia* rather than plates; *Der Holländischer Zweidecker* (1660/1670) is an example of this. *Album de Colbert* stands out as a clear example of the French using chains during this century as well.[247]

A related and equally difficult question for the 17th century in general is how to strap the deadeyes. Because most deadeyes appear to have been set at their neck into the channel, it is easier to list the situations in which this is not the case. The *Norske Løve* (1654) has

---

[243] Smith 1970, 23 [1627].

[244] Artifacts 8417 and 8418 from *Batavia* are a chainplate with chain links still attached. Detail about *Batavia* was communicated by Myra Stanbury on 6 January 2002 via email including a jpeg photograph of the artifacts.

[245] Anderson 1994, 68.

[246] Jouve 1971, pls. 2, 10, 12 [1679].

[247] Berti 1988, pls. 38, 39, 42, 50 [1670].

loose deadeyes; the bottom loop of the strap is not set in the channel, but the chainplate itself is set in the channel so that the deadeye would fall forward were it not for the shrouds (fig. 62). Anderson observed this configuration in the print of the English warship *Sovereign* from 1637, but questioned what appeared to be the same configuration in some Dutch prints from 1625.[248] *Vasa* has been reconstructed with this sort of strapped deadeye as well, but this was not based on material evidence (few iron artifacts were preserved from *Vasa*), but on contemporary ship models such as *Norske Løve*.[249]

Fig. 62. *Norske Løve* (1654), deadeye straps in the mizzen channel. (C. Corder)

In the case of *La Belle*, several strapped deadeyes have been cast in epoxy from natural moulds left in iron concretions. Two of these have also preserved the top portion of the chainplate, providing evidence that *La Belle*'s chainplates were in fact iron plates and not chain as they were later in the 18th century. Furthermore, the deadeye strap was not

[248] Anderson 1994, 70, figs. 49, 50.

[249] Olof Pipping, who rigged *Vasa* as it stands in the *Vasa* Museum today, communicated this to me in 2002 during my visit to the museum.

set into the channel, but the chainplate itself was held in place by the channel so that the deadeyes would have fallen outward were the shrouds not attached (fig. 28).

The lower deadeye straps were all approximately 12 to 13 cm (4.43–4.80 Fr in) in diameter, which would have accommodated a deadeye about an inch larger (14.72-15.72 cm, 5.43-5.80 Fr in) and approximately the size expected for the lower masts of *La Belle*. As a general rule of thumb, deadeyes were paired to masts that were about twice their diameter in thickness.[250] Therefore, one would expect the mainmast to have carried deadeyes approximately six French inches (16.26 cm) in diameter, and the foremast, approximately five (13.55 cm). The strapped deadeyes and chainplates in the reconstruction are scaled drawings from artifact 1586, one of the best preserved of *La Belle*'s deadeyes and chainplates.

Stays. The most substantial line of rigging on a ship was the stay. Stays are sometimes seen snaked to a preventer stay (an extra stay accompanying the primary stay), but this was not common until the beginning of the 18th century. Anderson advised not fitting them on models before 1690,[251] and several continental sources support this opinion. Neither *Album de Colbert* nor Jouve showed preventer stays, nor did Dassié address them. And, while they can be found before the beginning of the 18th century, they only became common among ship models during the early decades of the 18th century.

Hearts are generally associated with English stays from the end of the 17th century, but continental ships used blocks to secure stays well into the 18th century.[252] The evidence to support blocks in the collars of most French and continental stays in the 17th century is extensive. *Album de Colbert* depicted blocks on all stays, and labeled them as such. The collars were set up before the foremast and the stay was drawn around the mast on

[250] Lees 1984, 168.
[251] Anderson 1994, 96.
[252] Anderson 1994, 99-100; see also Howard 1979, 135; Marquardt 1986, 64-5.

either side.[253] *Der Holländischer Zweidecker* (1660/1670) depicts blocks with a seizing similar to those in *Album de Colbert*.[254] *Norske Løve* (1654) and the Danish Church Model (ca. 1680) both have blocks on their stays, which are also set up before the mast, and show more clearly the type of seizing intended for the collar (fig. 63). Only Dassié suggested using deadeyes. He specifically addressed the blocks and deadeyes necessary for each line of rigging, and explicitly described deadeyes in the collar of the stays.[255] This indicates that the English practice of using deadeyes was known and used in France in the late 17th century, but the preponderance of evidence for blocks demonstrates a continued preference for blocks either for some mechanical reason or simply because of a strong inclination to maintain traditional practices. In either case, blocks have been used on this reconstruction in accordance with the vast majority of the evidence.

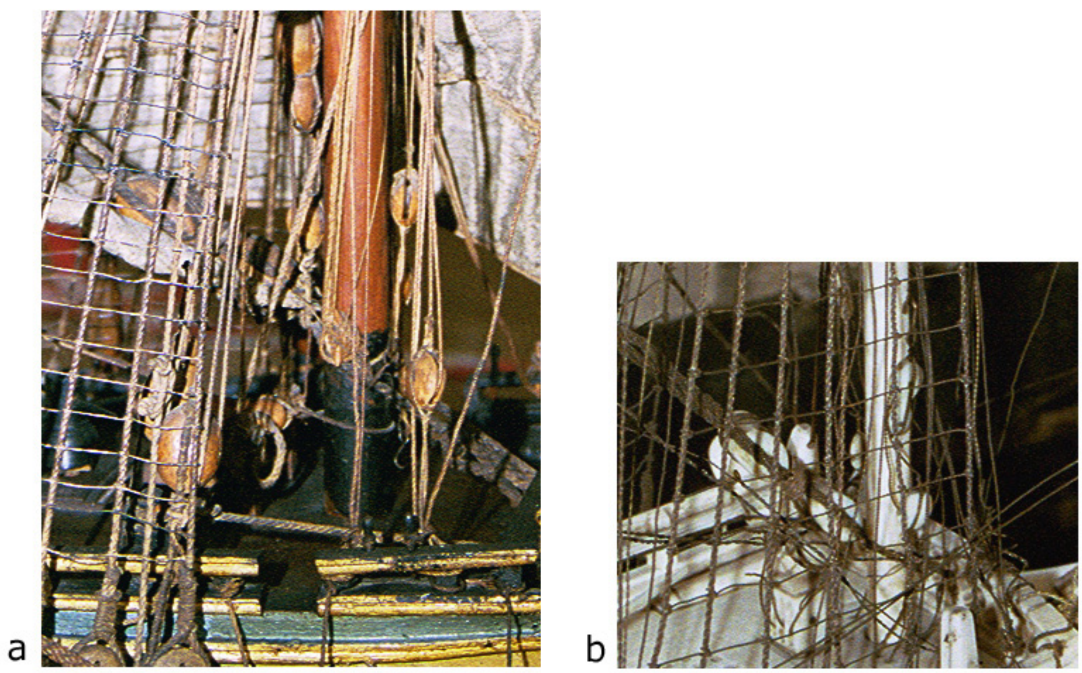


Fig. 63. Mainstay seized with blocks: *a*, Mainstay of the Danish Church Model (ca. 1680); *b*, Mainstay of *Norske Løve* (1654). (C. Corder)

---

[253] Berti 1988, pls. 39, 50 [1670].
[254] Winter 1967, table 3.
[255] Dassié 1994, 54-64 [1695].

As the most substantial line of rigging, a cable-laid rope is often suggested for the stay.[256] Marquardt specified that English forestays were most often cable-laid, made of shroud-laid rope, while continental forestays were more often cable-laid of three-stranded rope.[257] However, Dassié asserted that the main- and forestays both ought to be made of four hawsers, each of three strands, and therefore have twelve strands.[258] Unfortunately, the material record is silent on this matter as no identifiable portions of *La Belle*'s stays were recovered, and one would expect something less substantial on a ship the size of *La Belle* anyway. Furthermore, during this century, it was more common for a treatise to include discussion of the circumference of the rigging than the type of rope used. As a result, *La Belle* has been reconstructed with stays whose diameters reflect appropriate proportions, but whether they were right- or left-handed cannot be determined.

A common rule of thumb for the mainstay was to make its circumference half the thickness of the mainmast, a rule that was standardized for English ships in the second half of the 17th century.[259] The tables published by Miller and in *Marine Architecture* subscribe to this rule. The Dutch treatise *L'Art de batir* (1719), however, does not. *L'Art de batir* includes examples in which the mainstay's circumference was 0.65 to 0.75 of the mainmast's diameter; the smaller proportions belonged to examples from smaller ships and so were used for *La Belle*'s reconstruction. Similarly, according to *L'Art de batir*, the forestay was 0.80 of the mainstay, resulting in a proportionally larger stay than the English sources that called for 0.67 to 0.77 for 12-to-13-inch masts (30.48-33.02 cm).[260] This difference was addressed above because it affected the shrouds. *L'Art de batir* indicates that the shrouds were close to 0.50 of their corresponding stays,

[256] Anderson 1994, 84; see also Lees 1984, 40.
[257] Marquardt 1986, 64.
[258] Dassié 1994, 51-2 [1695].
[259] Anderson 1994, 86; see also Howard 1979, 135.
[260] Miller 1957, 9-15 [1667]; see also Anonymous 1748, 75; Hayward 1660, 10.

as opposed to the English charts that indicated something closer to 0.67. Therefore, while *L'Art de batir* directed the use of proportionally larger stays than was typical of English ships, the shrouds from both countries were approximately 0.33 of the mast. In the case of *La Belle*, the mainstay was reconstructed to reflect rope 8.0 French inches in circumference (21.68 cm) for the mainstay (0.65 of the mainmast diameter) and 6.5 French inches (17.62 cm) for the forestay (0.80 of the mainstay).

A final issue to address related to stays is where they ought to be secured. Most evidence supports a collar with blocks set up before the foremast in the case of the mainstay, and drawn around the foremast as pictured in *Album de Colbert* (1670), several of Jouve's plates (1679), in Miller (1667), and in *Der Holländische Zweidecker* (1660/1670).[261] This arrangement is also seen on the model of the *Norske Løve* (1654) and the Danish Church Model (ca. 1680) (fig. 63). Many English ships secured their mainstay through a hole in the stem.[262] However, Röding specifically observed that the French drew the mainstay around a reversed knee in the cutwater.[263] This is another feature of *La Belle*'s rigging reconstruction that is dependent upon the hull's reconstruction. Based on the evidence from continental sources such as Röding, *La Belle*'s hull was reconstructed with just such a reverse knee, and so the mainstay has been secured to it.

<u>Midship Tackle</u>. There are two types of midship tackle commonly seen on 17th-century rigging plans, the garnet tackle and the winding tackle, the basic difference being that the garnet tackle is attached to the stay while winding tackle is suspended between masts.[264] Both were used to hoist various goods in and out of the hold of the ship. Plates in *Album de Colbert* include a garnet tackle that originates at the mainstay above all the braces from the foremast. This tackle uses a double block over a single block and

---

[261] Berti 1988, pls. 39, 50 [1670]; see also Miller 1957, pls. B, D [1667]; Winter 1967, table 3.
[262] Anderson 1994, 100; see also Howard 1979, 135; Marquardt 1986, 65.
[263] Marquardt 1986, 65.
[264] Anderson 1994, 105-7.

originates below.[265] This is the same configuration Dassié described as the *bredindin* and as the smaller of the two tackle associated with the stay; this is a Spanish burton tackle by modern definition. *L'Art de batir* also lists the *bredindin* tackle for the mainmast, leaving only the two tackle pendants (*caliornes* and *palans*) for the foremast.[266]

Dassié named the second, larger tackle the "stay tackle".[267] In *Album de Colbert* this larger tackle is depicted as a pendant with a fiddle block suspended from the mainmast head. A two-part guy leads forward to the foremast top. A four-part tackle is suspended from the mast head beginning below with a single block.[268] Anderson described this as typical of French hoisting tackle of this century, and observed that *Royal Louis* had two of these, although with a double rather than a fiddle block on the pendant.[269]

One hoisting tackle was given to *La Belle* in this reconstruction following the form of *Album de Colbert*. A fiddle block on a pendant is attached to the mainmast and drawn forward to a two-part guy attached to the foremast head. The fall consists of the fiddle block over a single block.

<u>Standing Rigging of the Main and Fore Topmasts</u>

The upper masts were rigged similarly to the lower masts, although they did not have tackle like the lower masts; they consisted of shrouds, futtock shrouds, stays, and backstays. The shrouds and stays were essentially the same as the lower masts, although smaller, and the lower deadeye of a shroud pair was set into the top or a cross-tree, and futtock shrouds directed the force from the upper shrouds into the lower shrouds. These

---

[265] Berti 1988, pls. 42, 47, 50 [1670].
[266] Anonymous 1719, 28.
[267] Dassié 1994, 58-9 [1695].
[268] Berti 1988, pls. 42, 47, 50 [1670].
[269] Anderson 1994, 108.

futtock shrouds were attached at a futtock stave, which was a heavy line of rigging in place of a ratline across the top of the lower shrouds.

As with the lower masts, the most substantial lines of rigging in the upper masts were the stays. They were set up like the lower stays although smaller in circumference. The main topmast stay ran to the foremast top, and a fall led to the deck below. The fore topmast stay was attached at the bowsprit forward of the forestay.

Like the futtock shrouds, backstays were unique to the topmasts. Because the shrouds of the upper masts direct the force to the top, and not directly to the hull, backstays were added and were the only piece of rigging linking the topmasts directly to the hull. Backstays were either running (meaning they were set up as a tackle) or standing (meaning they were set up with deadeyes like shrouds).

Shrouds. The top shrouds were set up from the mast heads just like the lower shrouds, although there were generally about half as many. The table published by Miller (1667) and in *Marine Architecture* (1748) suggested that the main topmast shrouds be approximately the same size as the main topmast stay (0.92-1.00), and about 0.67 of the mainmast shrouds (0.63-0.68). *Nicodemus* carried main topmast shrouds within these ranges (equal to the topmast stay, and 0.63 of the lower shrouds). Similarly, the fore topmast shrouds were to be approximately the same size as the fore topmast stay (0.80-1.00), and 0.57 of the foremast shrouds. *Nicodemus*'s fore topmast shrouds were 0.80 of the foremast stay and were 0.57 of the foremast shrouds.[270]

L'Art de batir, however, again published slightly different proportions than these English sources. The main topmast shrouds were only 0.54 to 0.60 of the main shrouds, and the fore topmast shrouds were 0.50 to 0.58 of the foremast shrouds.[271] Because *La Belle*

[270] Hayward 1660, 1-12.
[271] Anonymous 1719, 27-32.

would be among the smallest examples within these treatises, the smaller proportions were applied to its rigging resulting in rope approximately 2 French inches (5.42 cm) in circumference for both the main and fore topmast shrouds.

Futtock Shrouds. The upper shrouds were attached to the lower shrouds by means of the futtock shrouds, which were seized to the futtock plates. Early in the 17th century the futtock 'plates' were still rope. Smith explained in 1625 that futtock plates had only recently been made of iron because the rope would wear out too easily. Throughout the rest of the 17th century, the deadeye strap extended through the top or a cross-tree, emerging as a flat plate with a hole through which the futtock shroud could be tied. This is the most common style seen among models and drawings from this century from both English and continental sources. A slight variation is included in a Spanish treatise originally published in 1719, *Architectura naval antigua y moderna*, in which plates 52 and 69 illustrate both the deadeye strap alone and set up with futtock shrouds (fig. 32, fig. 64).[272] These illustrations show a futtock plate resembling an eyebolt that has been looped around on itself at the bottom rather than a flat plate through which a round hole has been bored. This is consistent with the material evidence from *La Belle* and so the reconstruction represents this style, the particulars of which were discussed in more detail in the iron artifact section of the artifact analysis.[273]

[272] Victoria 1756, pls. 52, 69. See the above discussion of the futtock shrouds in the iron artifacts section of the artifact analysis.

[273] See also artifacts 6013, 12576, and 2004 in the artifact catalogue.

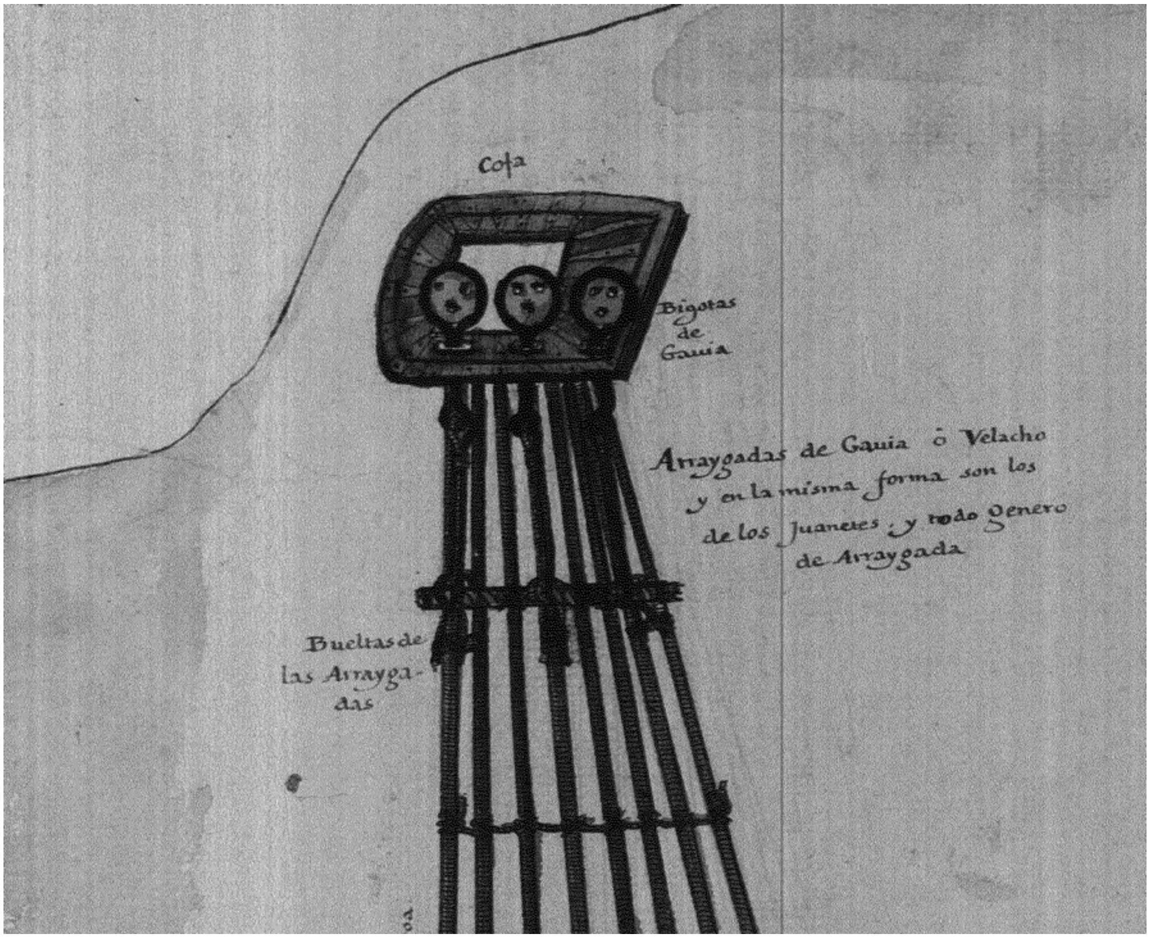


Fig. 64. Futtock plate shows set-up, from *Architectura naval antigua y moderna*. (Victoria 1756, pl.69)

Stays. The main topmast stay is quite similar to the lower stays. It extends to the foremast top through a leader block and down to the deck behind the foremast. The fore topmast stay is more complicated because of the fairly complex tackle that typically secured it to the bowsprit. There were a variety of styles, most of which used blocks; this applies to English and continental traditions alike. In this reconstruction, the forestay collar has been modeled after the Danish Church Model (ca. 1680). The Danish Church Model's fore topmast stay has a fiddle block set into its end, and is secured with a three-block tackle combination. The tackle begins at the strop of a double block secured to the bowsprit itself. This line runs through the smaller fiddle block sheave, returns to the originating block, runs through the larger fiddle block sheave, and then is drawn forward along the bowsprit to a single block secured further up the bowsprit or under the spritsail top. The line runs through the second sheave of the double block and then to deck where it is secured. A model of a Danish Frigate (1691-1725), which is housed in Ellsinore Castle in Denmark, uses the same method for its fore topmast stay collar, although the originating block is single so the fall drops directly to deck from the third block in the tackle. Some portions of this model have been repaired in modern times, but this detail of its fore topmast stay appears to be an accurate representation of its original rig since it uses some of the original lines and blocks. Its picture is included here in order to clarify the detail of the same configuration from the Danish Church Model, which is not as clear (fig. 65).

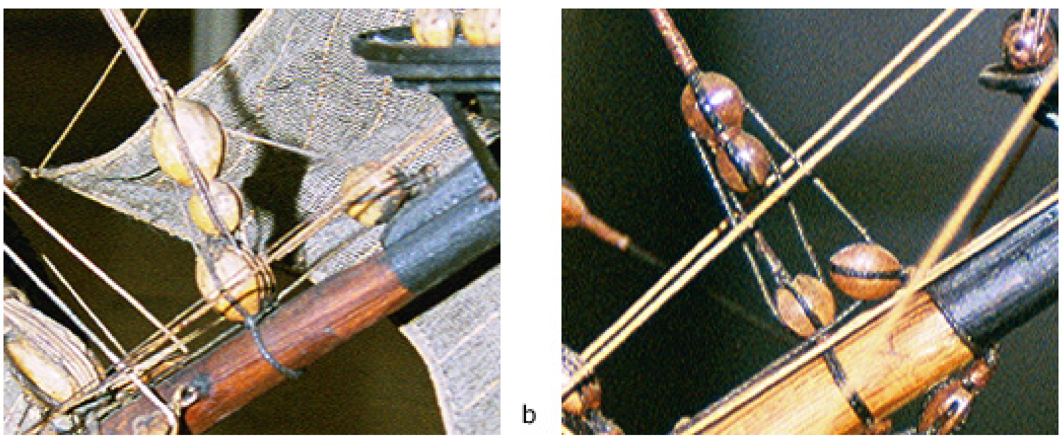


Fig. 65. The neck of the fore topmast stay: *a*, Danish Church Model (ca. 1680); *b*, Danish Frigate (1691-1720). (C. Corder)

In general, the top stays were less than half the circumference of the lower stays (0.42-0.46). However, some smaller ships had topmast forestays that were more than half of the lower forestay. *Nicodemus* carried a 4-inch (10.16 in) forestay and a 2.5-inch (6.35 cm) topmast forestay.[274] These are the same proportions suggested by Miller and in

[274] Hayward 1660, 1-12.

Marine Architecture for smaller ships.[275] These two examples result in a topmast forestay that is 0.63 of the lower forestay. This is because there comes a point when a proportionally smaller rope would not be sufficient to the task; a 2.0- to 2.5-inch (5.08-6.35 cm) rope may be the smallest rope useful to this purpose.

While French sources did not address the sizes of these lines of rigging so that proportions could be derived, Dassié did suggest that the main and fore topmast stays be shroud-laid with a wick of rope yarn in the center of the main topmast stay, as opposed to the four hawsers from which he directed the lower stays be made. This would result in upper stays that were less than half the thickness of their lower counterparts, assuming the strands were of comparable size.[276] As a result, this reconstruction has included fore and main topmast stays that are slightly less than half the circumference (8.13 cm, 3.00 Fr in) of the lower stays.

<u>Backstays</u>. The backstays were set up like shrouds and attached to the hull either at or a little above the channel. Early in the 17th century these backstays were running (set up with blocks), but after 1640 they were almost always standing (set up with deadeyes). Henry Bond's reference to standing backstays in his 1642 treatise is an early example of this transition.[277] Hayward listed both standing and running backstays for the ships on his lists originally published in 1655, while the 1670 *Album de Colbert* included only standing backstays.[278] As such, *La Belle*'s reconstruction includes standing backstays on the main and fore topmasts.

The question of how many standing backstays to include returns to the issue of ship size as do so many other questions of size and number related to *La Belle*'s rigging. Anderson observed that the Dutch used a single backstay on the lower masts before

---

275 Anonymous 1748, 74-80; see also Miller 1957, 9-15 [1667].
276 Dassié 1994, 51 [1695].
277 Anderson 1994, 118.
278 Berti 1988, Pls. 42, 50 [1670].

1650, but began using two about 1690.[279] Apparently, however, this observation about the Dutch is not also descriptive of the French at this time. *Album de Colbert*'s prints include only one standing backstay per side for the lower masts.[280] Being a smaller ship, *La Belle* would likely not have carried more backstays than the large ships in *Album de Colbert*, and thus this reconstruction includes one pair of standing backstays for the main and fore topmasts.

La Belle's backstays were likely to have been the same size as the shrouds since this seems to have been a universal rule among English and continental traditions. *L'Art de batir* advised all backstays be the same size as the shrouds.[281] This is also the case with all but one example provided in the tables published by Miller (1667) and in *Marine Architecture* (1748), as well as in the lists given by Hayward (1660).[282] Because of this, this reconstruction includes backstays that are equivalent to their corresponding shrouds (main topmast backstay, 2.2 Fr in (5.96 cm); fore topmast backstay, 2.0 Fr in (5.42 cm)).

<u>Standing Rigging of the Mizzen Mast</u>

The mizzen mast did not differ significantly from the main and foremasts. The shrouds, generally smaller and fewer than those of the main and foremasts, were set up in the mizzen channels, which were usually bolted onto a higher wale than the main and fore channels. Tackle, sometimes called burton tackle, were either drawn aft of the shrouds and set up on the rail (acting as a backstay), or extended to the channels. Burton tackle acted as backstays, or the aft-most shroud pair. The final piece of standing rigging on the mizzen was the stay, which was drawn to the base of the mainmast a few feet above deck, and set up with deadeyes or blocks.

---

279 Anderson 1994, 119.
280 Berti 1988, pls. 42, 50 [1670].
281 Anonymous 1719, 29, 32.
282 Hayward 1660, 1-12; see also Anonymous 1748, 74-80; Miller 1957, 9-15 [1667].

Burton Tackle. The first line of rigging added when dressing the mizzen mast would have been the lifts, which are part of the running rigging. Following that, the strops for the burton tackle and the falls were added.[283] These were running pendant tackle on English ships until about 1655 when Hayward listed them with larger, older ships. By 1670, Dean referred to them as "burton tackle" and showed two single blocks with a three-part fall. First published in 1677, Dassié's book also referred to them as burton tackle (by modern definition of the French term he used).[284] Anderson observed that "foreign" ships used a fiddle block over a single block on their tackle, which were led to the mizzen channel.[285] However, *Album de Colbert*'s burton tackle have a three-part fall made from two single blocks just as Dean described. These were drawn to the mizzen channel, between the middle two shrouds.[286] *La Belle*'s reconstruction follows *Album de Colbert*'s model in this regard, including one burton tackle per side that is secured to the mizzen channel between the two mizzen shrouds.

Shrouds. The shrouds were the third item of standing rigging on the mizzen mast, and would have been set up like those from the main and foremast. The mizzen shrouds were probably about half the size of the mainmast shrouds, or 2.0 Fr inches (5.42 cm) in the case of *La Belle*'s reconstruction. The tables from *L'Art de batir* (1719) agree with the tables from Miller (1667) and *Marine Architecture* (1748) on this issue.[287] And because the main shrouds in both traditions were similar, so too would have been the mizzen shrouds. Furthermore, because the 0.50 proportion results in a 2.0 Fr in rope in the case of *La Belle*, it is unlikely anything smaller could have been useful to the task.

Stay. The final item of rigging for the mizzen was the stay, which would have had about the same circumference as the mizzen shrouds, or a little larger. *L'Art de batir* and

---

283 Dassié 1994, 37 [1695].
284 Dassié 1994, 37 [1695].
285 Anderson 1994, 109.
286 Berti 1988, pl. 54, item 15 [1670].
287 Anonymous 1719, 27-32; see also Anonymous 1748, 74-80; Miller 1957, 9-15 [1667].

Hayward's tables indicate mizzen shrouds and stays that were equal in size.[288] Miller's tables, also published in *Marine Architecture*, listed mizzen shrouds that were 0.80 of the mizzen stay.[289] This seems to agree with Dassié (1677, 1695), who suggested the mizzen stay be shroud-laid while all shrouds were supposed to have been hawsers.[290] A shroud-laid rope would have been slightly larger than a hawser made of equivalent strands.

Standing Rigging of the Bowsprit

There is very little standing rigging on the bowsprit. Gammoning secured the bowsprit to the beak head, working in the opposite direction of the foremast and fore topmast stays (Fig. 66). Bobstays, which connected the underside of the bowsprit to the forward side of the beak head, were the only other item of standing rigging on this mast.

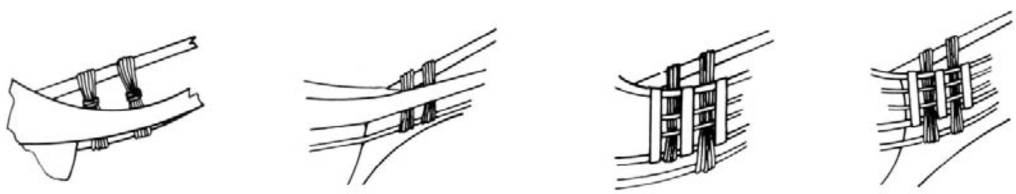


Fig. 66. 17th-century gammoning designs. (Howard 1979, fig. 189)

Gammoning. Gammoning secured the bowsprit to the beak head, working in the opposite direction of the foremast and fore topmast stays. There was very little variation in gammoning during the 17th century (Fig. 66), and there is no material evidence from the *La Belle* itself, so this reconstruction has given the ship a standard form from the period that could accompany the reconstructed beakhead.

---

288 Anonymous 1719, 27-32; see also Hayward 1660, 1-12.
289 Anonymous 1748, 74-80; see also Miller 1957, 9-15 [1667].
290 Dassié 1994, 53 [1695].

Bobstay. A bobstay was a line of rigging drawn from the underside of the bowsprit to the forward side of the beakhead; however, they were a late 17th-century development. Neither *Album de Colbert* (1670) nor Jouve (1679) included bobstays in their drawings, nor did the contemporary Danish Church Model (ca. 1680), and the *Norske Løve* model (1654). Similarly, the bowsprit shroud did not come into use until the early 18th century, and so is not seen in 17th-century sources.

Running Rigging of the Main and Fore Yards

The running rigging for the lower yards includes ties and halliards, or jeers (which were two different arrangements for raising the yards), parrels for holding the yard to the mast, lifts that moved the yard in the vertical plane, and braces for moving the yard in the horizontal plane. The other class of running rigging moved the sails directly. These lines included tacks, sheets, and bowlines for setting the sail, and clew lines, leech lines or martinets, and buntlines for hauling up the sail. This reconstruction will deal only with the running rigging lines that maneuver the spars.

Ties and Halliards. The distinction between ties and halliards and jeers is essentially one of function rather than form. Ties and halliards were used both for hoisting a yard and suspending it because the sheaves of the blocks and the yard were oriented in the same direction, allowing for movement of the tie in the sheaves as the yard was braced back and forth. A jeer was only a method for hoisting a yard, which was secured with a sling once aloft and the jeers slacked. In the case of a jeer, the blocks associated with the yard and mast cap were oriented along the length of the ship, and did not allow for the back-and-forth motion caused by the braces.[291]

[291] These observations were made by Olof Pipping, maritime historian and *Vasa* rigging expert, in a written communication of February 2002.

Differentiating between ties and halliards and jeers is not a difficult issue for French ships in the 17th century. Although jeers were in use at least by 1625 when they are described in an anonymous English treatise on rigging, and possibly as early as the 15th century, they were not common on French ships until the 18th century.[292] In 1737, Blaise Ollivier reported on English rigging techniques and compared them to French styles. He observed that the English used two halliards that replaced the tie and ramshead block common to lower yards on French ships.[293] While the system on English ships was more complex, both countries were still commonly using ties and halliards on the lowers masts. Indeed, jeers were not ubiquitous even on English ships during the 17th century. Hayward listed both ties and halliards and jeers for the main and fore yards of all the ships except the *Xth Whelp* and *Nichodemus*, which were fifth and sixth rates. For these two ships, only ties and halliards were listed for their lower yards.[294] Furthermore, the tables in Miller and *Marine Architecture* include calculations for only jeers on the lower yard of the mainmast, but ties and halliards on the foremast.[295]

In the case of continental ships, however, ties and halliards were used even on the lower masts of large ships throughout the 17th century. *Der Holländischer Zweidecker* (1660/1670), and the Danish Church Model (ca. 1680) both represent large ships and show ties and halliards in use on the lower yards. In fact, Anderson observed that a Spanish treatise from 1750 described two forms of ties and halliards and did not mention jeers, and that the French *Encyclopedia Methodique* of 1783 still described ties and halliards for the lower yards.[296] On French ships specifically, Dassié described ties and halliards for all the yards in 1695, and did not mention jeers. He indicated that the main and fore yard had a tie secured directly to the yard in two place that went over the cap,

---

[292] Anderson and Salisbury 1958, 50 [1625].
[293] Ollivier 1992, 105 [1737].
[294] Hayward 1660, 3-4, 7-8.
[295] Anonymous 1748, 74-80; see also Miller 1957, 9-15 [1667].
[296] Anderson 1994, 134.

through holes in the cap itself, descended behind the yard and through a hole in the top of the ramshead block.[297] This configuration is seen in prints from *Album de Colbert*. In this very simple configuration, the tie is actually a single line of rope that originates on the yard, goes up through holes in the cap and over its rounded top, down the backside of the mast, through the ramshead block, and back up and over the other side of the cap, and is secured to the yard next to its point of origin.[298] This reconstruction of *La Belle*, therefore, includes ties and halliards on all its yards in keeping with French ships from the late 17th century.

The ramshead block had three copper-alloy sheaves, one of which was designated for the tie, while the others were paired with sheaves in the knight's head on deck and formed the halliard. Ollivier mentioned these copper sheaves in his 1737 manuscript, as did Dassié, who specifically described three copper sheaves in the ramshead block.[299] The hole through the top of the ramshead block was oriented athwartships to accommodate the movement of the yard when braced up (Fig. 67).

---

[297] Dassié 1994, 49, 58 [1695].

[298] Berti 1988, pls 44, 45 [1670]. Interestingly, Dassié wrote that between the two ends of the tie was a double block through which passed the *franc funin*, a tackle used for hoisting cannon but also used to aid in hoisting the main yard (Dassié 1994, 58 [1695]).

[299] Dassié 1994, 49, 57 [1695]; see also Ollivier 1992, 105 [1737].

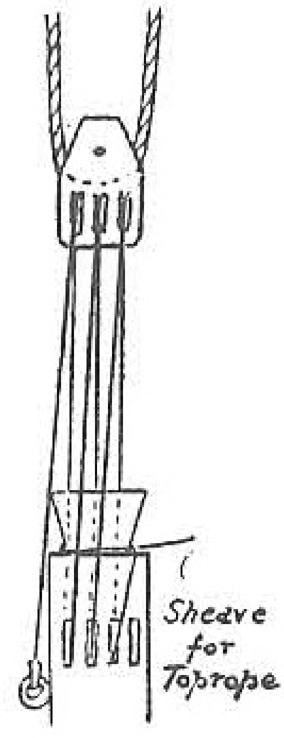


Fig. 67. Ramshead block (top) and knight (bottom) for the lower tie and halliard. (Anderson 1984, fig. 155)

The tie was about the same circumference as the shrouds in larger ships.[300] This was the case even for the mainmast of *Nichodemus,* and the foremast for 13-inch (33.02 cm) masts in the tables published in *L'Art de batir* and *Marine Architecture*, and by Miller.[301] In smaller ships this was still generally the case, but the stays and shrouds were closer in size at this level and so the tie was often similar in size to the stay as well. This was the case on *Nichodemus*'s foremast and the foremast for 12-inch (30.48 cm) masts in the tables by Miller and in *Marine Architecture*. In the case of this reconstruction, *La Belle* has been given ties that correspond to the mast's shrouds (main tie: 8.0 Fr in, 21.68 cm; fore tie: 6.5 Fr in, 17.62 cm). The halliard was generally about half the size of the tie;

---

[300] Anderson 1994, 134.
[301] Anonymous 1719, 27-8, 30-1; see also Anonymous 1748, 74-80; Miller 1957, 9-15 [1667].

this is the case in all the above-mentioned examples, and so this is also the case with this reconstruction (main halliard: 4.00 Fr in, 1084 cm; fore halliard: 3.00 Fr in, 8.13 cm).

Parrels. A yard would have been attached to a mast by means of a parrel. A parrel is a system of rope, trucks (balls acting like ball bearings), and ribs. The ribs and trucks were laced onto the rope, which was laced to the yard. The whole thing wrapped around the back side of the mast, helping the yard to roll along the mast as it was hauled up and down. Anderson observed that ribs with secondary, smaller holes, used for other permanent lacings, were Dutch in fashion.[302] Indeed, *Vasa* had trucks with these secondary holes, and *Vasa* was rigged in a Dutch fashion (*Vasa* artifacts 11760, 12455). Anderson suggested that parrel ribs ought to have three holes for the parrel rope, again presumably referring to the rigging of relatively large ships and lower masts.[303] Because large ships are most commonly represented, three-tiered parrels are most commonly seen. Prints from *Album de Colbert* show three tiers of trucks on both lower and upper masts.[304] However, two-tiered parrel ribs were recovered from *Vasa*, which was a very large ship (artifacts 19557, 18749, 19838). The drawings by Eva-Rami Stolt and the reconstruction on the rig in the *Vasa* museum show these two-tiered parrel trucks on the mizzen and upper masts.

While it stands to reason that two-tiered parrels could have been used on the lower masts of smaller ships such as *La Belle*, if the standard formula for parrel ribs (1.5 times the diameter of the yard) is applied to *La Belle*, taking also into consideration the diameters of *La Belle*'s surviving parrel trucks (6.3, 7.3, and 7.6 cm), the lower masts would have had three-tiered parrels, and so have been reconstructed as such, but with two-tiered parrels on the upper masts, which were lighter.[305] A two-tiered parrel rib, excavated from the extreme stern of the ship, was drawn and described in *La Belle*'s excavation

---

[302] Anderson 1994, 141-2.
[303] Anderson 1994, 141.
[304] Berti 1988, pl. 45 [1670].
[305] Lees 1984, 168.

records. Unfortunately, it could not be relocated in the course of conservation and so is not included in the artifact catalogue.

Lifts. Unlike the ties and halliards of the lower masts, the appropriate lift configuration for 17th-century ships varies throughout the century and regions. The principal questions to answer regarding the main and fore lifts involve the types of blocks to use, and their method of attachment, but there is a variety of conflicting options offered by contemporary sources. Two later sources use a fiddle block with the traditional continental combined topsail sheet and lift block: Lescallier and the model *Le Louis XV* (ca. 1715), housed in the *Musée de la Marine*.[306] This pear-shaped block is described by Dassié as "a large block with two sheaves, a large one of copper, and another of wood; through the copper one passes the sheet of the main top, and through the wood one, which is at the base of the block, is passed the lift of the yard."[307] In both cases, the fiddle block is spliced to an eyebolt under the cap. The lift itself begins from the yardarm where it is spliced, runs through the smaller sheave of the fiddle block, returns to the smaller sheave of the pear-shaped yardarm block, returns to the large sheave of the fiddle block, and falls to the deck.

Earlier sources, such as *Album de Colbert* (1670), show a different configuration; the lift begins (presumably) from a block under the cap (the apparent block under the cap cannot be seen in the prints), and runs to the pear-shaped topsail sheet block and back to the cap block before falling to deck.[308] The 1691 Swedish treatise by Rålamb shows this same sort of lower lift.[309]

---

[306] Lescallier 1791, pls. 2, 10. *Le Louis XV* is the model R. C. Anderson mistakenly thought was the *Royal-Louis* of 1692, but which the *Musée de la Marine* now displays as an educational tool of young Louis XV, given as a gift shortly after assuming the thrown.

[307] Dassié 1994, 58 [1695].

[308] Berti 1988, pls. 42, 45, 48, 50 [1670].

[309] Rålamb 1943 [1691]. The sail plan folds out from the back of reprints of Rålamb's treatise, and does not have a plate number.

The final configuration utilizes the continental or Dutch lift block that is unlike English lift blocks. This block is suspended on a pendant from the masthead. The lift begins from the hole in the opposite end of the block, runs to the pear-shaped topsail sheet block on the yardarm, returns to the sheave in the lift block, and falls to deck. Dassié described exactly this configuration, and emphasized that the pendants for the lifts were in fact the first item of rigging on the lower masts.[310] The Danish Church Model (ca. 1680) in Orlogsmuseet, and *Norske Løve* (1654) in Rosenborg castle both include this configuration on their lower lifts, although *Norske Løve* has a single block rather than the continental lift block.

Several observations can be made from these various lift options. In general, the upper part of the lift is attached at the top in older sources, while later it is connected at the cap. Anderson observed that blocks moved from the top to the cap about 1690 in English ships, a little earlier in French, and a little later in Dutch; the transition was complete by 1700.[311] A second observation is that despite other variations, the pear-shaped topsail sheet block on the yardarm is ubiquitous to continental lifts.

In the case of *La Belle*, it seems apparent that Dassié's description of the lower lifts would apply because of the two Dutch lift blocks that were recovered. This would seem to contradict Anderson's observation that the lift block had moved from the top to the cap in French ships some time before 1690. However, transitions such as this were never instantaneous or ubiquitous, and as was seen with the ties, halliards, and jeers, some older rigging methods remained in use longer on smaller ships or were used together with newer methods on larger ships. Whatever the case may have been with other ships of the French Navy at the time, *La Belle* appears to have used the older method of lift originating from the masthead near the top as well as the traditional continental

---

[310] Dassié 1994, 36, 57 [1695].
[311] Anderson 1994, 143.

configuration that used both the Dutch lift block and the pear-shaped combination lift and topsail sheet block.[312]

It also appears that continental ships had proportionally smaller lower lift lines than their English counterparts. The English sources on rigging proportions are in agreement that the main yard lifts ought to be one third the thickness of the mainstay, and the fore yard lifts ought to be half of the forestay.[313] *L'Art de batir*, however, shows proportionally larger lifts: 0.57 to 0.60 of the stay for the main yard lifts, and 0.60 to 0.67 of the fore yard lifts.[314] When taking into consideration that *L'Art de batir* also calls for proportionally larger stays, these proportions result in even larger lifts for the continental rigging than for the English. As such, *La Belle* has been reconstructed with the larger lifts resulting from the proportions in *L'Art de batir* (main lifts: 4.66 Fr in, 12.63 cm; fore lifts: 4.00 Fr in, 10.84 cm).

Braces. The final lines of running rigging for the lower yards are the braces, which were set up uniformly throughout the 17th century and throughout Europe. Like the lifts, which move the yard in the vertical plane, the braces move the yard in a horizontal plane, running aft from each yard arm either to a stay, or in the case of the main yard, to the quarters of the ship and sheaves set into the bulwarks, or to blocks attached there.

The fore braces began at the mainstay at a point that progressed up the stay throughout the 17th century. During the first half of the century, the braces were less than halfway up the stay, and by 1670 were about halfway up; Dutch stays may have begun this upward progression a little earlier than the English, however.[315] The brace was drawn from the stay to the yard arm and back. The fall of the fore brace would have been belayed to a cleat inside the bulwarks aft of the forward shrouds. The forward braces on

---

[312] Complete discussion of these artifacts are given above in the artifact analysis chapter.
[313] Hayward 1660, 1-2; see also Anonymous 1748, 74-80; Miller 1957, 9-15 [1667].
[314] Anonymous 1719, 27-32.
[315] Anderson 1994, 149; see also Howard 1979, 140.

this reconstruction of *La Belle* have been drawn as they can be seen in any contemporary source, starting from the mainstay, leading through a pendant block on the forward yard arms, back to leader blocks further down the mainstay, and then falling to deck.

The main braces began and ended at the ship's quarters, either at a block or sheave set in the hull; some plans show the braces disappearing behind the bulwark. Plates from *Album de Colbert* (1670) show the main braces emerging from behind the railing on the ship's quarters aft of the mizzen channel, while plans of *Royal Louis* (1692) show the braces beginning from an eyebolt high on the ship's quarters, also aft of the mizzen channel.[316] In the case of *Album de Colbert*, we cannot see how the brace is secured, but on *Royal Louis* the brace returns to a block also secured high on the quarters of the ship and the fall is led inside the ship through a small hole made for this purpose. Lescallier (1791) also showed the main braces secured aft of the mizzen channel to a block and eyebolt attached to the ship's quarters.[317] Jouve (1679) and Rålamb (1691), however, showed their main braces emerging and returning from the bulwark behind the mizzen channel. In the case of Jouve's plates, which are simplified, this could be interpreted merely as a simplification of detail. Rålamb's rigging plan is far more precise, however, and he chose to depict the ends of the main brace behind the aft- and forward-most shrouds. In the case of this reconstruction, *La Belle* has been reconstructed following the examples of *Album de Colbert*, Dassié and Rålamb, all of which depict the main braces secured somewhere behind the bulwarks aft of the mizzen.

<u>Running Rigging of the Topsail Yards</u>

<u>Ties and Halliards</u>. The main and fore top yards were rigged very similarly to the lower yards. The ties and halliards of the topmasts follow the same principle as those from the bottom masts. On larger ships the ties could have stopped at the lower masts' caps, but

---

[316] Berti 1988, pls. 42, 50 [1670]; see also Howard 1979, 132-3.
[317] Lescallier 1791, pl. 10.

there would not have been room enough to operate them on smaller ships such as *La Belle*, which lacks a top. Instead, the ties were taken to the sides of the ship in the form of a basic halliard and runner. The halliard led to one side, while the runner led to the other.[318]

Lifts. The lifts on the upper yards tended, on larger ships with topgallants, to resemble those of the mainmasts. However, on topgallants and on the upper yards of smaller ships lacking topgallants where sheet blocks were not necessary, the lifts were configured differently from the lower yards and were almost universally the same throughout the century and even among English and continental traditions. The lift either began at the side of the cap from an eyebolt, extended to a block on the yard arm, returned to a block under the top and fell to deck, or was one line that functioned on both port and starboard by passing through a lateral hole in the cap itself. Several models and plans from the 17th century depict just such a configuration: *Dutch Flight* (ca. 1645) in the Nederlandsch Historisch Scheepsvaart Museum in Amsterdam; *Amaranthe* (1654) in the Maritime Museum in Gothenburg (a replica of the original model is in the state collection in Stockholm); a Dutch man-of-war (ca. 1660) in the Hohenzollern Museum in Berlin; the Danish Church Model (ca. 1680); and *Norske Løve* (1654).[319] *La Belle*'s topmast yards are reconstructed to follow these contemporary models. A single line of rigging running laterally through the topmast caps acts as the lifts on both the port and starboard sides (Fig. 68).

---

[318] Anderson 1994, 179.
[319] Nance 2000, pls. 20, 21.

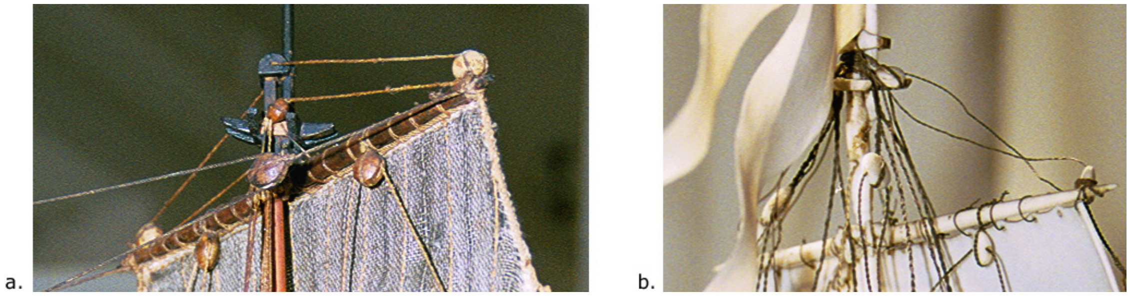


Fig. 68. Topgallant yard lifts: *a*, Danish Church Model (ca. 1680); *b*, *Norske Løve* (1654). (C. Corder)

Braces. The topsail yard braces followed the same basic principles of the lower braces, but the fore topsail braces were drawn back to the main topmast stay, and the main topsail braces were drawn back to the mizzen mast itself. Aside from these basic features, throughout the 17th century there were a variety of methods for rigging the lead of the main topsail braces. The lead may have been laced forward to a leader block in the mainmast shrouds, but the simplicity of *La Belle*'s rig implies a simpler fall straight to deck that was also seen during that century. Furthermore, this simple fall of the lead to deck complements Anderson's observation that the Dutch tended to use this method. The Danish Church Model is also rigged in this fashion. Thus, the lead of the main topsail braces in this reconstruction of *La Belle* follows the simplest method suggested by Anderson, the Danish Church Model, and found in Miller's treatise as well.[320] The brace begins from the mizzen, goes through the pendant block from the main topsail yard arm, returns a little further down the mizzen through a double block in this case (in the case of the fore braces, two single blocks were stropped to the stay), and then falls to deck.

There was more opportunity for variety among fore topsail brace leads than the main topsail brace leads. The lead of the fore topsail brace passed the main topmast stay, the mainstay and the foremast shrouds on its way to the deck, and could have run through leader blocks at any of these points. The brace began at the main topmast stay, extended

[320] Anderson 1994, 192; see also Miller 1957, pl. D [1667].

forward to a pendant block suspended from the fore topmast yard arm, and then returned to the main topmast stay where it was run through a leader block. From there, the lead may have been drawn forward to the foremast shrouds before going through a leader block on the mainstay and then falling to deck.[321] Similar to the main topsail braces, however, this reconstruction of *La Belle* has favored the simpler method of simply dropping the lead straight to deck through a leader block on the mainstay. Unfortunately, this cannot be corroborated by either Dassié or *Album de Colbert*, which does include detailed profile images of the topsail braces, but the Danish Church Model does something similar, as does *Prins Wilem*, a Dutch East Indiaman (1651) housed in the Nederlandsch Historisch Scheepsvaart Museum in Amsterdam.[322]

Running Rigging of the Mizzen Yard

Tie and Halliard. As with the upper yards, the choice between ties and halliards and jeers at the end of the 17th century was available for the mizzen yard, and just as the decision to use ties and halliards for the upper yards was clear for *La Belle*'s reconstruction, so too is a tie and halliard a clear choice for the mizzen yard. As with the upper yards, the French were later than the English in doing away with ties and halliards on the mizzen yard. Furthermore, ties and halliards on mizzen yards were retained longer on smaller ships such as *La Belle*. Therefore, a simple tackle has been added to *La Belle*'s reconstruction that resembles that of the Danish Church Model (Fig. 69).

---

[321] Anderson 1994, 191.
[322] Nance 2000, pl. 21.

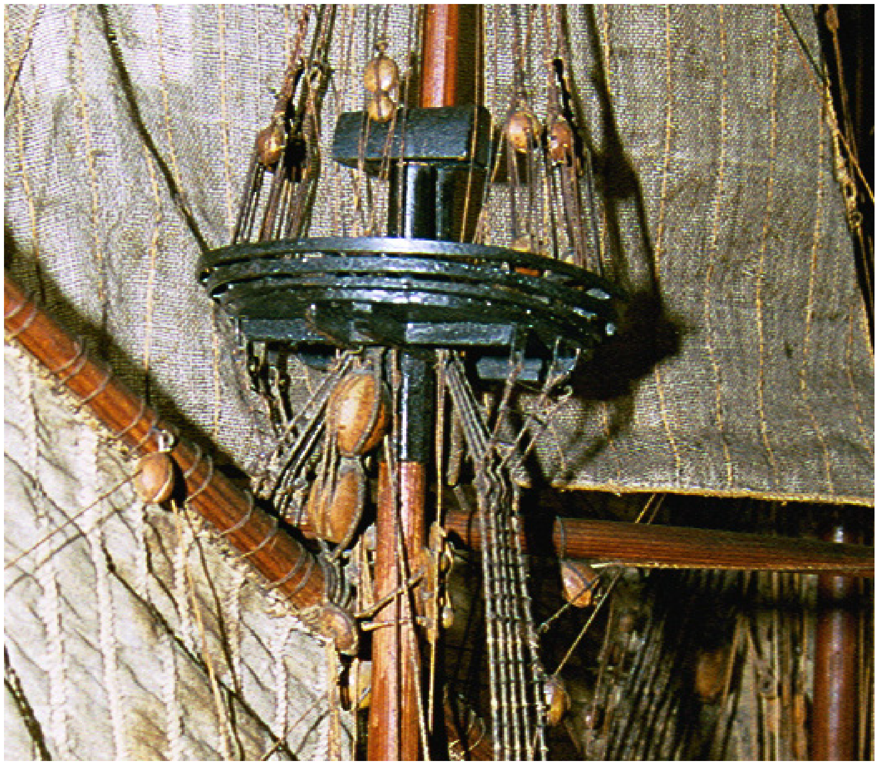


Fig. 69. Mizzen top from the Danish Church Model (ca. 1680). (C. Corder)

Parrel. The mizzen parrel follows the same principle as the other masts, but has a small two-eyed deadeye that helps connect it to the strop of the mizzen tie. The Danish Church Model demonstrates this simple solution, something similar to which could have been used on *La Belle*, and thus has been included in the reconstruction (Fig. 69).

Lift. *La Belle* was reconstructed without a mizzen topmast, but the mizzen mast still needed to accommodate the mizzen yard lift, which would have run over the mizzen itself during the latter half of the 17th century and not, as in the previous century, to the main topmast top.[323] The length of the mizzen mast was determined relative to the tops and caps of the main- and foremasts, but this was not sufficient to support the mizzen's lift. Thus, a flagstaff was added to the mizzen to support the lift. This solution has

[323] Anderson 1994, 235-6.

provided the mizzen with sufficient leverage while not risking overmasting the ship. However, it has been a difficult problem to resolve since there are so few representations of ships comparable in size to *La Belle* that lack a mizzen topsail, and those available are not very accurate.

Bowline. The bowline was attached to the forward end of the mizzen yard and functioned like a brace in order to control the angle of the yard. This reconstruction of *La Belle* has utilized the simplest form of mizzen bowline: a single line attached to the heel of the yard and belayed somewhere inboard of the main shrouds.

Running Rigging of the Bowsprit Yard

Lifts. As with the other yards, the lifts moved the spritsail yard in the same plane with the mast. While it seems that the Dutch may have used a form of standing lift in the 17th century with deadeyes instead of blocks, both *Norske Løve* and the Dutch church model employed running lifts. Furthermore, running lifts have been suggested by Anderson to be preferable for the French, although he does not cite any French sources that include such lifts.[324] As *Norske Løve* and the Dutch church model have running lifts, however, so does this reconstruction of *La Belle*, which specifically reflects the configuration used on the church model.

Braces.
On larger ships, the braces on spritsails were assisted by garnets, which also served to move the yard in the plane perpendicular to the mast; however, this seems to be unnecessary for a spar the size of *La Belle*'s, so only braces have been included. The braces originate in a pendant from the yard arm; the fall originates on the mainstay and falls to a block on the spritsail yard itself before being drawn inboard. This

---

[324] Anderson 1994, 215.

configuration can be seen on many French prints from the period: *La Couronne* (1654), the print of *L'Amiral de France* in *L'Art de batir* (1719), and in the Danish Church Model (ca. 1680).[325]

[325] For *La Couronne* see Hancock 1973.

CHAPTER V

SUMMARY OF CONCLUSIONS AND CONTRIBUTIONS

The 17th-century ship's most easily recognizable characteristic is its tell-tale spritsail topmast; however, *La Belle* has proven to be a characteristically 17th-century ship despite its probable lack of this defining sail. *La Belle*'s blocks and deadeyes have helped to define their evolution of form from the early 17th century into the 18th. Similarly, *La Belle*'s most obviously Dutch feature, the lift blocks, also places its rig decidedly in the 17th century. Thus, while the English Navy was quickly rising to the position of influence that has made its golden era the 18th century, *La Belle* gives voice to the prominent place the Dutch held in seafaring that was still so influential in the 17th century. Indeed, its Dutch lift blocks and unique topsail chainplates and futtock straps hint at this influence. Perhaps equally significant are *La Belle*'s simplified rigging features, which provide evidence for the practical use of rigging on a relatively small ship rather than the more elaborate recommendations published for significantly larger vessels. Its artifacts quite literally replace the romantic image of the sailor in the top first sighting land with the knowledge of what was required to manage the sails of the small *La Belle* above a deck only 14 French feet (4.55 m) wide as it crossed the Atlantic on what ultimately proved to be an ill-fated mission.

Seventeenth-Century Characteristics

The analysis of the blocks and deadeyes from *La Belle* in the context of the other available collections and records from this century has revealed features characteristic of late 17th-century blocks and deadeyes. Deadeyes evolved from the elongated flat-faced and tear-drop shaped deadeyes of the 16th century, characterized by *Mary Rose* examples, to the flat-faced and more angular blocks in the early 17th century, characterized by artifacts from *Vasa*, to the round-faced oval blocks of *La Belle*. This trend concluded with the completely rounded deadeyes of the mid-18th century, as characterized by *Le Machault*.

This evolution has to date not been clearly defined, but is important to note considering the apparent penchant among 17th-century sailors for recycling used rigging items as finds from *La Belle* and *Vasa* suggest. These definitions may also prove helpful if assessing the rigging assemblage from a much older ship that may have been refit and re-rigged throughout its service. Interestingly, deadeye characteristics appear to have been fairly universal among English and the various continental naval powers of the time. Other characteristics, however, while specific to the 17th century, were also specific to the French.

In order to reconstruct a likely rig for *La Belle* in those areas where material evidence was lacking, other observations of 17th-century rigging characteristics, and particularly French characteristics, were necessary. This research has revealed several specific characteristics that help to identify a 17th-century French rig. Among these are mast and spar proportions as well as specific configurations of both standing and running rigging.

When observing a 17th-century rigging plan, the proportion between the masts' tops and caps is one indicator of national origin. While in general French masts were taller than the English and shorter than the Dutch, the relative height of the masts' tops and caps are far easier to assess. The French foremast cap tended to come to about the height of the mainmast top in the 17th century, while in the 18th century it reached closer to about halfway up the mast head. Similarly, the 17th-century French mizzen cap tended to reach just below the height of the mainmast top, making it very nearly the same height as the foremast cap.

These differences in height are also reflected in the proportions published by contemporary treatises, which tended to recommend that French mainmasts be 2.6 to

2.83 times the ship's beam, while English sources recommended 2.4 to 2.5. The French bowsprit, on the other hand, tended to be shorter than the English at this time (0.51-0.62 vs. 0.67 times the foremast) and also proportionally thicker. The greater height of French masts is also reflected in the proportions offered by contemporary treatises for the top masts. French sources called for 0.58 to 0.67 in the later 17th century, a little earlier than English sources that called for something similar (0.56-0.67) in the early 18th century.

Both the French and the English tended toward shortening their yards throughout the 17th century. While the length of the main yard tended to be equal to the mainmast, and the fore yard to the foremast in the first half of the 17th century, both were reduced by the latter half (0.71 to 0.88 for the main yard, and 0.78 to 0.89 for the fore yard). When applied to the longer French masts, of course, the result was longer yards, although proportionally equal. A decidedly French characteristic of the lower yards, however, is the primacy of the fore yard in French sources as opposed to the main yard in English. This, however, is a distinction of perspective and not form, as it cannot be observed physically.

Unlike the lower yards, French topsails were proportionately longer. While the English tended toward upper yards that measured half the length of their lower counterparts, the French sources indicated a larger proportion (0.63 to 0.65 for the fore topmast yard, and 0.59 to 0.66 for the main topmast yard).

Similar to the lower yards, the French and English bowsprit yards were proportionately the same (equal to the main topsail yard); the French were still longer because their main topsail yards were longer. The same idea applies to the mizzen yard, which tended to be equal to the fore yard in both French and English ships, resulting in longer French yards because the French also had longer fore yards.

Other decidedly French features that can be observed on contemporary rigging plans pertain to the running and standing rigging. For example , the tackle pendants of French ships are more often comprised of double and single blocks, a four-part tack for instance, than fiddle blocks, which are a Dutch feature rather than French. Furthermore, while hearts are most typical on the collars of English stays, the French tended to use blocks in the 17th century. This in particular is a tell-tale sign of continental rig, if not precisely French, in the 17th century.

Dutch Influence

La Belle's artifacts have revealed several features that indicate a Dutch influence in its rig. This is not surprising for a French ship in the late 17th century. At this time, English naval power and influence had not yet been raised to its zenith as it would be in the following century, and while the influence of the Dutch Navy was in decline, it was still predominant in 1684 when *La Belle* left for the Americas.

The most significantly Dutch features are *La Belle*'s lift blocks and pear-shaped pendant block. Of the known rigging assemblages, only *Vasa*'s also includes blocks of this type; however, the type is well represented in 17th-century literature and ship models, and is the tell-tale sign of a continental rig during this century. Early 17th-century French sources show the lift originating under the cap and using the combined topsail sheet and lift block on the yard arm, while 18th-century French sources employ a fiddle block in place of the Dutch lift block. *La Belle*, however, due to the presence of the two Dutch blocks, one of which was apparently in use at the time of the wreck, appears to have used the French configuration.

While the lift blocks are widely represented in contemporary ship models and rigging plans, the pear-shaped pendant block is remarkably rare. Its closest archaeological parallel is in *Vasa*, which does not include it in its reconstructed rig either, as its purpose has yet to be determined. *Santo Antonio de Tanna* had a significantly larger block of similar form, but because of its much larger size, it is unlikely that it served the same purpose. It resembles the blocks shown in Rålamb's treatise, and may have served the same purpose as the considerably larger version excavated from *Santo Antonio de Tanna*, but its specific purpose remains a mystery and calls for further research.

La Belle's artifacts have also demonstrated unique iron rigging fixtures in the form of futtock plates that most closely resemble ring bolts. The futtock plates are not plates at all but are rounded in cross-section and were curved over on themselves at the end to form a ring for the futtock stays. No other archaeological parallels are known, but textual evidence from the Dutch treatise *L'Art de batir* suggests a possible Dutch influence.

Iron hull fixtures from the lower masts give further influence to the rig's Dutch features as well. The deadeye straps, which are so commonly seen set into the channels at their necks, appear to have been loose on *La Belle*, whose chainplates themselves were set into the channel. Concretions formed around the iron that protruded from the top of the wooden channels, revealing that the deadeye straps had fallen back on themselves when the shrouds had rotted away, and concreted in that position. This feature can be found on contemporary ship models that also employ Dutch rigging techniques, and was utilized for *Vasa*, which was rigged in a Dutch fashion as well.

<u>A Simple Rig</u>

Several of *La Belle*'s artifacts, which were shown to have been employed in the rig at the time of the wreck, give evidence for the simple solutions its rigger employed to fit out its rig. This simplicity can probably be attributed to the small size of the ship since the expedition seems to have been otherwise well outfitted and funded. So, while the rig may appear in some ways "cheap," it was likely all that was necessary.

The feature of the reconstructed rig that probably stands out first, and may seem overly simplified, is its lack of tops. The composite cross-tree, topsail deadeye strap, and futtock plate demonstrate, however, that tops were most likely not in place. The futtock strap extended directly through the cross-tree, leaving no evidence for a top structure. This was common on the topgallants of larger ships, but appears to have been the case on *La Belle*'s lower masts.

Portions of rope associated with the end of the futtock strap indicate futtock straps that were not wormed or parceled, and neither were they served. In fact, no worming or parceling was evident among the hundreds of excavated lengths of rope and cable. Serving was evident, however, on some significant lines, including the lower shrouds. Serving without worming and parceling seems to be an example of economical—at least in terms of labor—preservation of the rigging.

The most complete assemblage of rope artifacts, a lower course tack, sheet, and clew garnet, reveals another simplistic configuration, and may also reveal the use of bonnets on the fore course, another continental characteristic at this late date since the English seem to have ceased using them several decades earlier. These artifacts, which are comprised of the sheet and clew garnet blocks and strops as well as the tack and clew of the corresponding sail, reveal that the clew garnet strop was secured to the sheet strop rather than to the clew of the sail itself. The tack and sheet block strop were lashed together with shroud knots that were inserted into the sail's clew to secure the entire assemblage. In this way, the entire assemblage could be removed together in one motion, hence the likelihood of bonnets at this—by English standards—late date.

WORKS CITED

Anderson, R. C. 1994. Reprint. *The Rigging of Ships in the Days of the Spritsail Topmast, 1600-1720*. New York: Dover Publications. Original edition, Salem: The Marine Research Society, 1927.

Anderson, R. C., and W. Salisbury, eds. 1958 [1625]. *A Treatise on Shipbuilding and a Treatise on Rigging, Written About 1620-1625*. London: Society for Nautical Research.

Anonymous. 1707. *The Sea-Man's* Vade Mecum. London: James Woodward behind the Royal-Exchange.

Anonymous. 1719. *L'Art de batir les vaisseaux*. 2 vols. Amsterdam: David Mortier.

Anonymous. 1748. *Marine Architecture: Or, the Ship-Builder's Assistant*. London: William and John Mount, and Thomas Page on Tower-Hill.

Aubin. 1702. *Dictionaire de marine contenant les termes de la navigation et de l'architecture navale*. Amsterdam: Pierre Brunel.

Bax, A. and C. J. M. Martin. 1974. "A Dutch East Indiaman Lost on the Out Skerries, Shetland, in 1711." *IJNA* 3.1:81-90.

Bengtsson, S. 1975. "The Sails of the *Wasa*." *IJNA*. 4.1:27-41.

Berti, H. ed. 1988 [1670]. *Album de Colbert, 1670*. Nice: Editions Omega.

Boudriot, J. 1973. "*Les Royal Louis*." *Neptunia* 112.4:9-16.

_____. 1993. *History of the French Frigate, 1650-1850*. Translated by D. H. Roberts. Rotherfield: Boudriot Press.

_____. 2000. *Cavelier de La Salle L'Expédition de 1684: La Belle*. Rotherfield: Boudriot Press.

Bouguer, P. 1746. *Traité du navire, de sa construction, et de ses mouvemens.* Paris: Chez Jombert.

Bradley, C. 1980-1981. *The Ship's Fittings' Rigging Components and Rope Recovered from the Wreck of* Le Machault. Microfiche Report Series 192. Quebec: Parks Canada.

Brindley, H. H. 1916. "Early Reefs." *Mariner's Mirror* 6: 77-84.

Bruseth, J. E. and T. S. Turner. 2005. *From a Watery Grave: The Discovery and Excavation of La Salle's Shipwreck* La Belle. College Station: Texas A&M University Press.

Bruzelius, L. 1999. *The Maritime History Virtual Archives: Masting and Rigging:* The Complete Modellist. http://www.bruzelius.info/Nautica/Rigging/Miller(1667).html (19 August 2007).

_____. 2005. *The Maritime History Virtual Archives: Etymology:* Explication des termes de marine. http://www.bruzelius.info/Nautica/Etymology/French/Cleirac(1661).html (17 October 2007).

Bry, J. de. 1997. "Letters to the Editor" *Smithsonian.com* 6 (1997). http://www.smithsonianmagazine.com/issues/1997/june/letters_june97.php?page=2 (19 August 2007).

Cederlund, C. O. 1977. "Preliminary Report on Recording Methods Used for the Investigation of Merchant Shipwrecks at Jutholmen and Älvsnabben in 1973-74." *IJNA* 6.2: 87-99.

_____. 1982. *Vraket vid Jutholme, Fartygets byggnad*. Projekt Undervattensarkeologisk Dokumentationsteknik Rapport 16. Stockholm: Statens Sjöhistoriska Museet.

_____. 2007. *Vasa I: The Archaeology of a Swedish Royal Ship of 1628*. Edited by F. Hocker. Stockholm: Swedish State Maritime Museum.

Cederlund, C. O. and C. Ingelman-Sundberg. 1973. "The Excavation of the Jutholmen Wreck, 1970-71." *IJNA* 2.2: 301-327.

Clifford, S. A. 1993. "An Analysis of the Port Royal Shipwreck and its Role in the Maritime History of Seventeenth-Century Port Royal, Jamaica." M.A. thesis, Texas A&M University.

Dassié. 1994 [1695]. *L'Architecture navale*. Edited by G. Santi-Mazzini. Sanremo: Editrice Pharos.

Davis, J. 1985 [1711]. *The Seaman's Speculum or Compleat School-Master*. Edited by M. A. Edson, Jr. Bethesda: Nautical Research Guild.

Dean, A., Sir. 1981 [1670]. *Dean's Doctrine of Naval Architecture, 1670.* Edited by B. Lavery. Greenwich: Conway Maritime Press.

Delgado, J. P., ed. 1998. *Encyclopedia of Underwater and Maritime Archaeology*. New Haven: Yale University Press.

Eames, A. 1961. "The King's Pinnace, the *Swan* 1642-1645." *Mariner's Mirror* 47.1:49-55.

Einarsson, L. 1990. "Underwater Archaeological Excavations of a 17th-century Swedish Warship: The Nature Aims and Development of a Maritime Cultural Project." *IJNA* 19: 279-297.

_____. 2001. *Kronan*. Kalmar: Kalmar Läns Museum.

Falconer, W. 1776. *An Universal Dictionary of the Marine*. London: T. Cadell.

Fisher, J. 2002. "Blocks for the *Mary Rose*." *Ships in Scale* 13.1:41-43.

Forfait, M. 1788. *Traité élémentaire de la mâture des vaisseaux, à l'usage des élèves de la marine*. Paris: Chez Clousier.

Forster, W. A. and K. B. Higgs. 1973. "The *Kennemerland*, 1971." *IJNA* 2.2:291-300.

Franzén, A. 1989. "*Kronan*: Remnant of a Warship's Past." *National Geographic Magazine*, 175: 438-464.

Furttenbach, D. J. 1975 [1629]. Reprint. *Architectura Martialis, Architectura Navalis, Architectura Universalis.* Hildesheim: George Olms Verlag. Original edition, Ulm: Nachdr. D. Ausg., 1629.

Gardiner, R. 1992a. "Design and Construction." In *The Line of Battle: The Sailing Warship, 1650-1840*, edited by R. Gardner, 116-124. London: Conway Maritime Press.

_____. 1992b. "Sloop of War, Corvette and Brig." In *The Line of Battle: The Sailing Warship, 1650-1840*, edited by R. Gardner, 46-62. London: Conway Maritime Press.

Gawronski, J. H. G., ed. 1985. *VOC Schip* Amsterdam*, 1985*. Jaarrapport van de stitching VOC-schip *Amsterdam*. n.p.

Green, J. 1977. *The Loss of the Verenigde Oostindische Compagnie Jacht* Vergulde Draeck*, Western Australia 1656: An Historical Background and Excavation Report with an Appendix on Similar Loss of the Fluit* Lastdrager*, Part i. BAR-IS* 36(i). Oxford: British Archaeological Reports.

_____. 1986. "The Survey of the VOC Fluit *Risdam* (1727), Malaysia." *IJNA* 15.2:93-104.

_____. 1989. *The VOC ship* Batavia. *BAR-IS* 489. Oxford: British Archaeological Reports.

Grieco, G. 2003a. "The Model Reconstruction of La Salle's Ship *La Belle*." *INA Quarterly* 30.4:3-18.

_____. 2003b. "Modeling *La Belle*: A Reconstruction of Seventeenth-Century Light Frigate." M.A. thesis, Texas A&M University.

Hancock, C. H. 1973. "*La Couronne*, A French Warship of the Seventeenth Century: A Survey of Ancient and Modern Accounts of This Ship." Paper read at the 2nd Annual Conference of the Nautical Research Guild, 4 August, Baltimore. Newport News: The Mariners Museum.

Hayward, E. 1660. *The Sizes and Lengths of Riggings for all His Majesties Ships and Frigats.* Cornhill: Peter Cole.

Hedrick, L. 1997. Field Notes from the *La Belle* Excavation. Unpublished records, Austin: Texas Historical Commission.

Hoving, A. J., ed. 1994. *Nicholaes Witsens Scheeps-bouw-konst Open Getelt*. Franeker: Uitgeverij Van Wijnen.

Howard, F. 1979. *Sailing Ships of War 1400-1860*. Greenwich: Conway Maritime Press.

Ingelman-Sundberg, C. 1976. "The V.O.C. Ship *Zeewijk* 1727: Report on the 1976 Survey of the Site." *Australian Archaeology* 5:18-33.

_____. 1977. "The V.O.C. Ship *Zeewijk* Lost off the Western Australian Coast in 1727: An Interim Report on the First Survey." *IJNA* 6.3:225-231.

_____. 1978. *Relics from the Dutch East Indiaman,* Zeewijk. *Foundered in 1727.* Western Australian Museum Special Publication No. 10. Perth: Western Australian Museum.

Jouve, J. 1971. *Deux albums des batiments de L'Atlantique et de la Méditerranée by Jean Jouve (1679)*. Edited by J. Vichot. Paris: Éditions Neptunia des Amis des Musées de la Marine.

Lavery, B. 1992. The Ship of the Line. In *The Line of Battle: The Sailing Warship, 1650-1840*, edited by R. Gardner, 11-25. London: Conway Maritime Press.

Lees, J. 1984. *The Masting and Rigging of English Ships of War, 1625-1860*. London: Conway Maritime Press.

Lescallier, D. 1791. *Traité pratique du gréement des vaisseaux et autres batimens de mer*. Vol. I. Sorbonne: Chez Clousier.

Lever, D. 1998. Reprint. *The Young Officer's Sheet Anchor, or a Key to the Leading of Rigging and to Practical Seamanship*. Ontario: Dover Publications. Original edition, London: John Richardson, 1819.

L'Association Adramar. 2007. *Association pour le Développent de la Recherche en Archeologie MARitime: Le Natière (1692).* http://www.adramar.fr/index.php?id=20 (5 October 2007).

L'Hour, M. 2007. *DRASSM (Department of Underwater and Undersea Archaeological Research): The Shipwreck of the Battle of La Hogue (1692).* http://www.culture.gouv.fr/culture/archeosm/archeosom/en/houg-s.htm#retour (19 August 2007).

Love, J. 1705. *The Mariner's Jewel, or, a Companion for the Ingenious.* London: Ebenezer Tracy, at the Three Bibles on London Bridge.

Manwayring, H., Sir. 1972. Reprint. "The Seaman's Dictionary." In *English Linguistics 1500-1800, a Collection of Facsimile Reprints*, no. 328, edited by R. C. Alston, 1-118. Menston: The Scholars Press. Original edition, London: G. M. for John Bellamy, 1644.

Marquardt, K. H. 1986. *Eighteenth-Century Rigs and Rigging*. Cedarberg: Phoenix Publications.

Marsden, P. 1972. "The Wreck of the Dutch East Indiaman *Amsterdam* near Hastings, 1749." *IJNA* 1.73-96.

_____. 1975. *The Wreck of the* Amsterdam. New York: Stein and Day.

Martin, C. 1978. “The *Dartmouth*, a British frigate wrecked off Mull, 1690.” *IJNA* 7.1:29-58.

_____. 1992. The Wreck of the Dutch East-Indiaman *Adelaar* off Barra in 1728. In *People and Power in Scotland: Essays in Honor of T. C. Smout*, edited by R. Mason and N. Macdougall, 145-169. Edinburgh: John Donald Publishers, Ltd.

Mary Rose Trust, The. 2007. The *Mary Rose*: The Ship: Mary Rose Trust Electronic Archive. http://www.maryrose.org/mary_rose_archive.html (19 August 2007).

Meide, C. 1997. Field Notes from the *La Belle* Excavation. Unpublished records, Austin: Texas Historical Commission.

Miller, T. 1957. Reprint. “The Complete Modellist of Thomas Miller, 1667.” *The American Neptune* 17(2). Original edition, London: W. G. for George Hurlock, 1667.

Molaug, S. 1998. “The Excavation of the Norwegian Frigate *Lossen*, 1717.” In *Excavating Ships of War*, edited by M. Bound, 159-167. Shropshire: Anthony Nelson.

Molaug, S. and R. Scheen. 1983. *Fregatten* Lossen *et Kulturhistorisk Skattkammer,* no. 43. Oslo: Norsk Sjøfartsmuseum.

Mondfeld, W. zu. 1989. *Historic Ship Models.* New York: Sterling.

Mountaine, W. 1756. *The Seaman's* Vade-Mecum*, and Defensive War by Sea*. London: William and John Mount and Thomas Page.

Nance, R. M. 2000. *Classic Sailing-Ship Models in Photographs*. New York: Dover Publications.

Ohrelius, B., Cdr. 1962. Vasa*, The King's Ship*. London: Cassell.

Olausson, C. W. *The* Vasa*'s Sails*. Unpublished paper on file at the *Vasa* Museum, Stockholm.

Ollivier, B. 1992 [1737]. *18th Century Shipbuilding: Remarks on the Navies of the English and the Dutch from Observations Made at their Dockyards in 1737.* Translated by D. H. Roberts. Rotherfield: Jean Boudriot Publications.

Petersen, B. M. 1987. “The Dutch Fluitship *Anna Maria*, Foundered in Dalarö Harbour in 1709.” *IJNA* 16.4: 293-304.

_____. 1993. Katalog Över Skeppsdelar Och Foremal Inventerade Fran Flojt-Skeppet *Anna Maria* Förlist I Dalarö 1709. Unpublished paper, Stockholm: Marine Archaeology Department, Stockholm University.

Petersson, L. 2000. *Rigging Period Ship Models*. Annapolis: Naval Institute Press.

Pipping, O. 2000. "Whipstaff and Helmsman: An Account of the Steering-gear of the *Vasa.*" *Mariner's Mirror*, 86.1:19-36.

Price, R. and K. Muckelroy. 1977. "The *Kennemerland* Site: The Third and Fourth Seasons, 1974 and 1976. An Interim Report." *IJNA* 6.3:187-218.

_____. 1979. "The *Kennemerland* Site: The Fifth Season, 1978. An Interim Report." *IJNA* 8.4:311-320.

Rålamb, Å. C. 1943. Reprint. *Skeps Byggerij eller Adelig Öfnings Tionde Tom*. Malmo: Sjohistoriska Museet. Original edition, Stockholm, Niclas Wankijfs Tryckerij, 1691.

Rochefort Royal Shipyard Archives. 1684. "Proportion of a Barque of 40 to 50 Tons Named *La Belle*." Records on file (1 L 3-19, Folio 88 verso and Folio 89 recto), Rochefort: Rochefort Royal Shipyard archives.

Romme, C. 1778. *Description de l'art de la mature.* Paris: L.F. Delatour.

Rule, M. 1982. *The* Mary Rose: *The Excavation and Raising of the Henry VIII's Flagship*. Annapolis: Naval Institute Press.

Smith, J., Capt. 1970. Reprint. *A Sea Grammar with the Plaine Exposition of Smiths Accidence for Young Sea-men, Enlarged*, edited by K. Goell. Old Surrey: Unwin Brothers Limited. Original edition, London: John Haviland, 1627.

Statens Sjöhistoriska Museet Archives. 1981. *Riksäpplet* Artifact Catalogue. Artifact records, 24.520-6; Ö.2.037-9. Stockholm: Statens Sjöhistoriska Museet.

_____. 1982. Jutholmen Artifact Catalogue. Artifact records, 24.859:1-5; 24:888. Stockholm: Statens Sjöhistoriska Museet.

Sténuit, R. 1974. "Early Relics of the VOC Trade from Shetland: The Wreck of the Flute *Lastrager* Lost off Yell, 1653." *IJNA* 3.2:213-256.

_____. 1977. "The Wreck of the *Curaçao*: A Dutch Warship Lost off Shetland in 1729 While Convoying a Fleet of Returning East Indiamen. An Interim Report." *IJNA* 6.2:101-125.

Thompson, B. F. C. 1988. "The Rigging of a 17th-Century Frigate at Mombasa, Kenya." M.A. thesis, Texas A&M University.

Victoria, Del Marques de la. 1756. Reprint. *Architectura naval antigua y moderna*. Cadiz. Original edition, 1719.

Warren, J. S., ed. 1998. *The La Salle Expedition to Texas: The Journal of Henri Joutel, 1684-1687.* Austin: Texas State Historical Association.

Weddle, R. S., ed. 1987. *La Salle, the Mississippi, and the Gulf: Three Primary Documents.* College Station: Texas A&M University Press.

Weddle, R. S. 2001. *The Wreck of the* Belle*, the Ruin of La Salle*. College Station: Texas A&M University Press.

Western Australian Maritime Museum. 2007. *Maritime Archeology/Shipwrecks: Online Databases: Artifacts Database.* http://www.museum.wa.gov.au/collections/databases/maritime/artefacts/artefacts.asp (19 August 2007).

Winter, H. 1967. *Der Holländische Zweidecker von 1660/1670*. Berlin: Delius Klasing Verlag.

Witsen, N. 1671. *Architectura Navalis*. Amsterdam: Pieter and Joan Blaeu.

APPENDIX A

ARTIFACT CATALOGUE

Block

Artifact #	SubType	Material	Provenience
314		Wood	no provenience

Measurements

Length	na
Width	na
Thickness	na
Score Width	na
Pin Diameter	na
Sheave Diameter	na
Sheave Thickness	na

Comments

This block is in very poor condition. It remains only as a cast of rope and the surface of a portion of the block. So little remains of the block that its type cannot be identified, nor can it effectively be measured.

Artifact #	SubType	Material	Provenience
694		Wood	no provenience

Measurements

Length	na
Width	na
Thickness	na
Score Width	na
Pin Diameter	na
Sheave Diameter	na
Sheave Thickness	na

Comments

This block is in very poor condition. Only portions remain. Too little remains to identify its type, nor can it effectively be measured.

Block

Artifact #	SubType	Material	Provenience
695	Single Sheave	Wood	no provenience

Measurements

Length	16.6 cm
Width	12.7 cm
Thickness	7.9 cm
Score Width	2.4 cm
Pin Diameter	1.8 cm
Sheave Diameter	9.0 cm
Sheave Thickness	2.3 cm

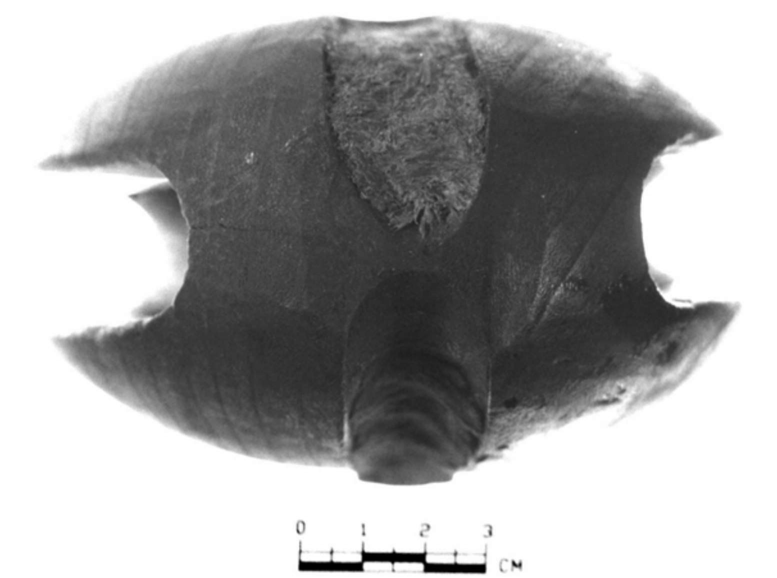
Comments

This block is in very good condition, and is of standard construction. Rope fragments from the block's strop have been conserved inside the scoring. The pin shows wear at its junction with the sheave. There is scoring on the center and base of the inside surface of the shell.

Block

Artifact # 695

695



695

Block

Artifact #	SubType	Material	Provenience
1592	Single Sheave	Wood	y2016.5 x2012.6 z-5.20

Measurements

Length	17.5 cm
Width	14.0 cm
Thickness	9.5 cm
Score Width	2.1 cm
Pin Diameter	2.4 cm
Sheave Diameter	8.9 cm
Sheave Thickness	2.4 cm

Comments

This block is in fair condition, and it is of standard construction. The pin is worn at its junction with the sheave. The base is preserved, while one quarter of the crown is missing. This block was associated with rope and remnants of sail cloth, which are listed by the same artifact number in the rope section of the catalogue.

Block

Artifact # 1592

1592

1592

Block

Artifact #	SubType	Material	Provenience
1599	Single Sheave	Wood	no provenience

Measurements

Length	16.5 cm
Width	13.0 cm
Thickness	8.5 cm
Score Width	2.3 cm
Pin Diameter	2.2 cm
Sheave Diameter	8.7 cm
Sheave Thickness	2.6 cm

Comments

This block is in good condition, and is of standard construction. The pin is worn at its junction with the sheave. The edge of one cheek is missing.

1599

Block

Artifact # 1599

1599

Block

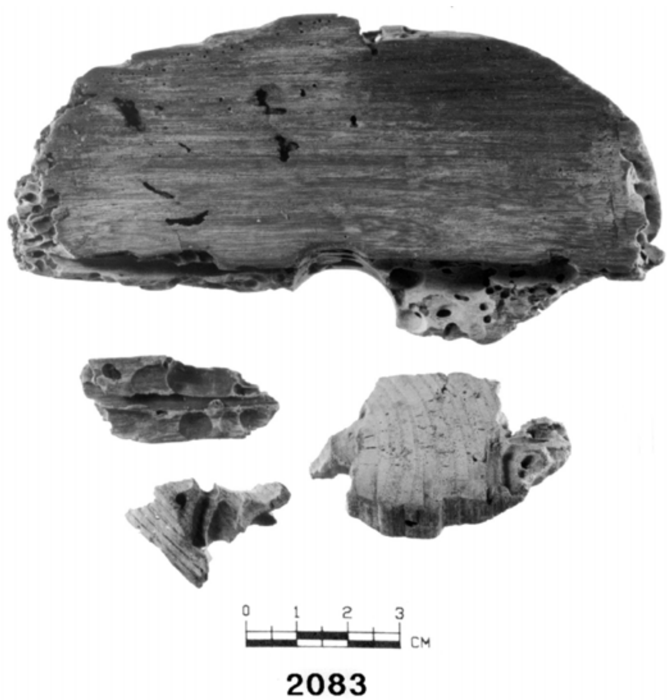
Artifact #	SubType	Material	Provenience
2083	Single Sheave	Wood	y2021 x2012

Measurements

Length	13.4 cm
Width	na
Thickness	na
Score Width	na
Pin Diameter	2.2 cm
Sheave Diameter	na
Sheave Thickness	na

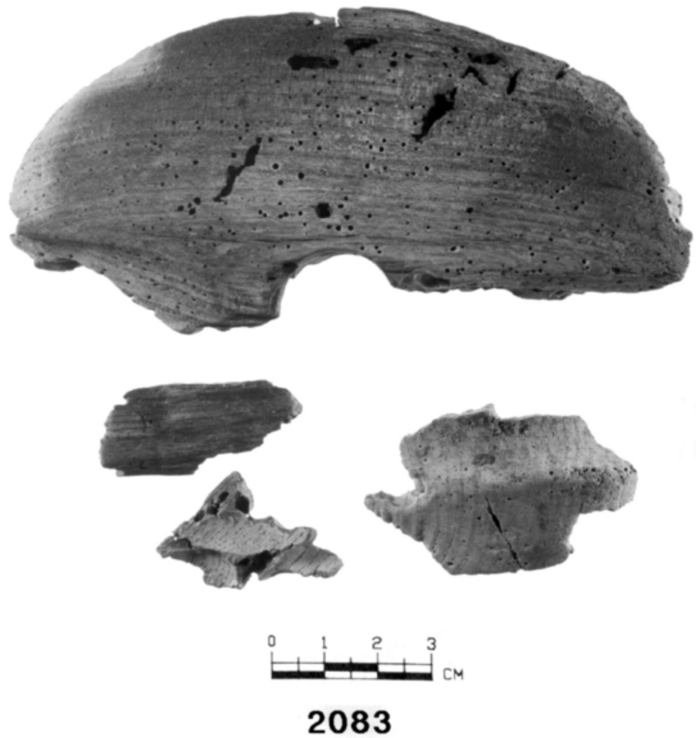
Comments

This block is in poor condition; it has suffered damage from teredo worms and is in four pieces. Its type of construction can not be determined. The length is very near its original, and the pin diameter measurement is based on the hole in the shell.



Block

Artifact # 2083



Block

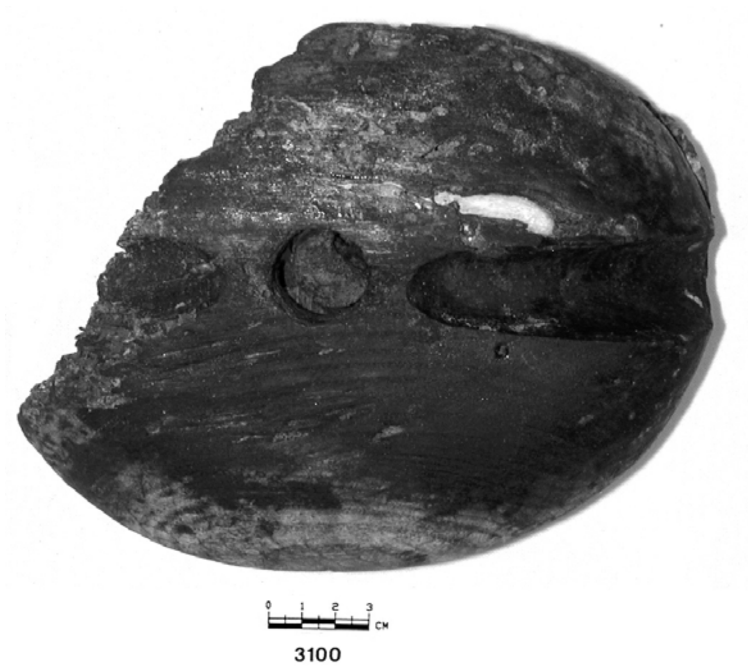
Artifact #	SubType	Material	Provenience
3100	Sheet	Wood	y2013 x2012

Measurements

Length	20.0 cm
Width	16.0 cm
Thickness	10.5 cm
Score Width	2.8 cm
Pin Diameter	2.6 cm
Sheave Diameter	11.8 cm
Sheave Thickness	2.7 cm

Comments

This block is in fair condition. It is missing the bottom third; the crown is preserved. It appears to be of standard construction. The projected length, based on the block's complete half, is 23.0 cm. The projected width is 18.0 cm. Half the sheave is missing and the preserved half is warped; the pin is missing its bottom quarter. This block is associated with rope, grommets and a knot that share this artifact number and are recorded in the rope section of the catalogue.



Block

Artifact # 3100

3100

3100

Block

Artifact #	SubType	Material	Provenience
3101	Clewgarnet	Wood	y2013 x2012

Measurements

Length	15.8 cn
Width	12.8 cm
Thickness	8.2 cm
Score Width	2.2 cm
Pin Diameter	2.2 cm
Sheave Diameter	8.2 cm
Sheave Thickness	2.5 cm

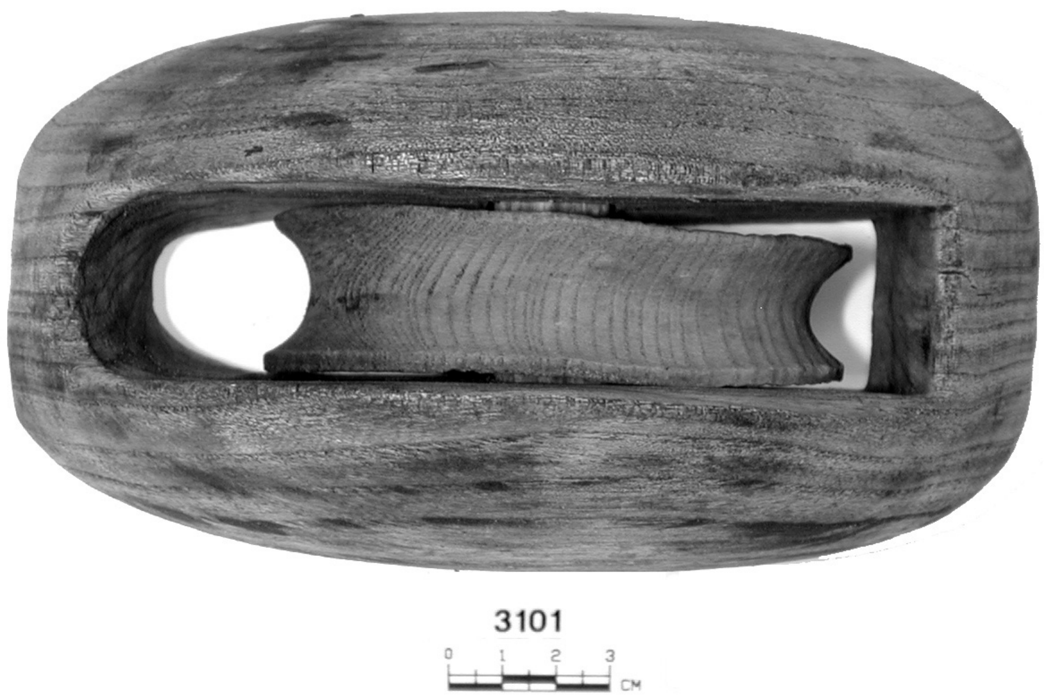
Comments

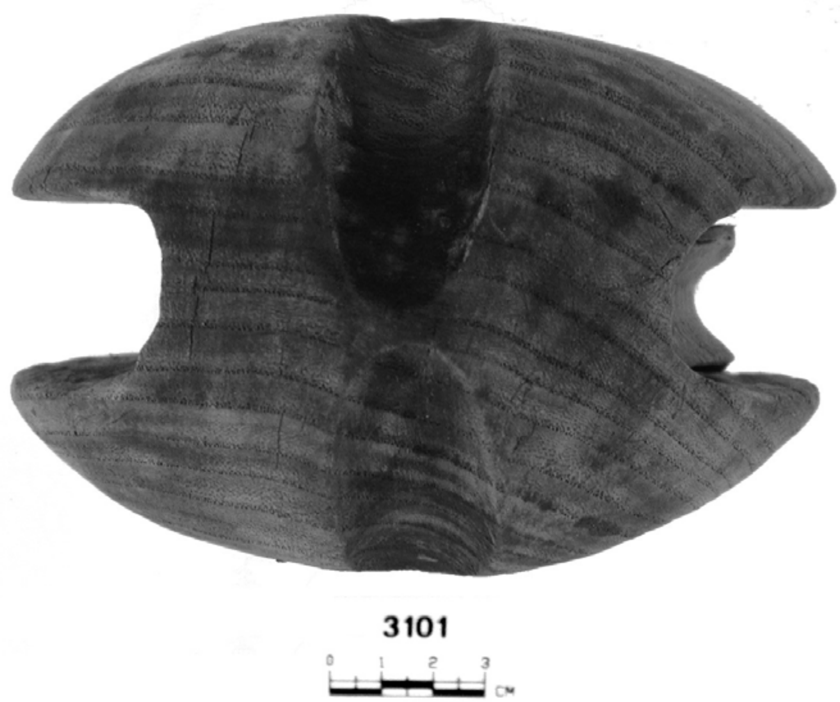
This block is in very good condition. It is of standard construction. It was found still stropped and connected to bolt rope and sail cloth; these items are catalogued in the rope section under the same artifact number. The pin is worn at its junction with the sheave. The sheave has concentric scoring on its surface as does the interior surface of the shell.

3101

Block

Artifact # 3101





Block

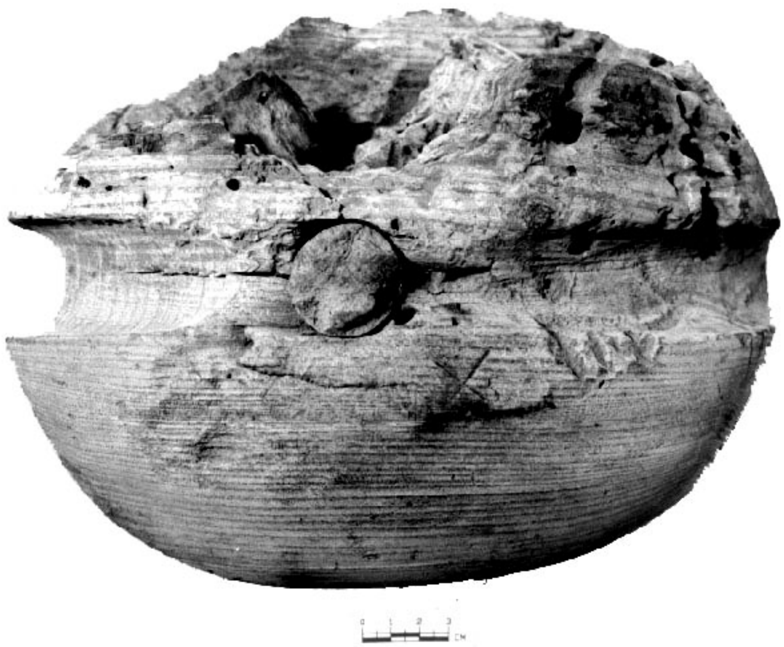
Artifact #	SubType	Material	Provenience
3302	Double Sheave	Ash (Fraxinus)	y2021 x2010

Measurements

Length	32.0 cm
Width	24.0 cm
Thickness	20.9 cm
Score Width	4.7 cm
Pin Diameter	4.1 cm
Sheave Diameter	17.8 cm
Sheave Thickness	3.7 cm

Comments

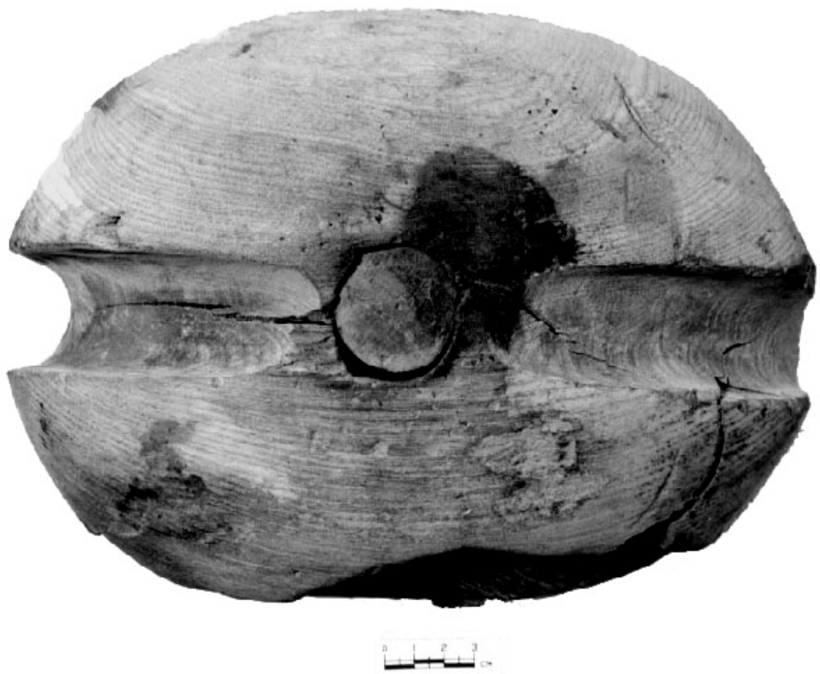
This double block, of standard construction, is the largest of the blocks recovered from La Belle. It is in fair condition; one cheek is in poor condition with teredo worm damage.



3302

Block

Artifact # 3302



3302

3302

Block

Artifact #	SubType	Material	Provenience
3315	Single Sheave	Elm (Ulmus)	y2011 x2007

Measurements

Length	14.0 cm
Width	11.5 cm
Thickness	na
Score Width	2.6 cm
Pin Diameter	2.3 cm
Sheave Diameter	na
Sheave Thickness	na

Comments

This block is in poor condition and has suffered damage from teredo worms; it is in two pieces. Measurements from the preserved portions of the block are given. The projected length of the block, based on doubling the preserved half, is 17.0 cm; the projected width is 13.0 cm. The pin diameter was measured from the pin hole.

Block

Artifact #	SubType	Material	Provenience
3326	Single Sheave	Wood	y2012 x2011

Measurements

Length	14.6 cm
Width	11.9 cm
Thickness	8.2 cm
Score Width	2.2 cm
Pin Diameter	2.1 cm
Sheave Diameter	8.3 cm
Sheave Thickness	2.2 cm

Comments

This block is not of standard construction. The external shell has two crowns and no base--both ends are constructed without complete scoring. The interior of the shell is of standard construction, however, with one a rounded channel for the feed. The pin is worn at its junction with the sheave.

3326

Block

Artifact # 3326

3326

3326

Block

Artifact #	SubType	Material	Provenience
3372		Wood	y2021 x2009

Measurements

Length	na
Width	na
Thickness	na
Score Width	na
Pin Diameter	na
Sheave Diameter	na
Sheave Thickness	na

Comments

This block has been almost completely destroyed by teredo worms. Only dirt held it together, and once removed during conservation, the block fell into pieces.

3372

Block

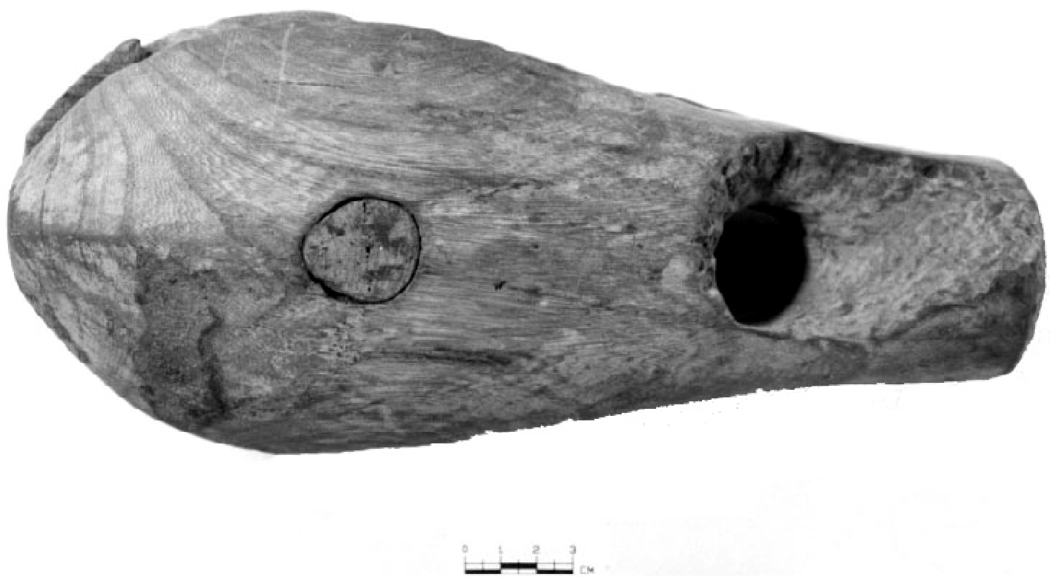
Artifact #	SubType	Material	Provenience
3389	Pendant	Elm (Ulmus)	y2021 x2010

Measurements

Length	29.2 cm
Width	12.3 cm
Thickness	9.5 cm
Pin Diameter	2.7 cm
Sheave Diameter	10.1 cm
Sheave Thickness	3.0 cm
Hole	3.7 cm

Comments

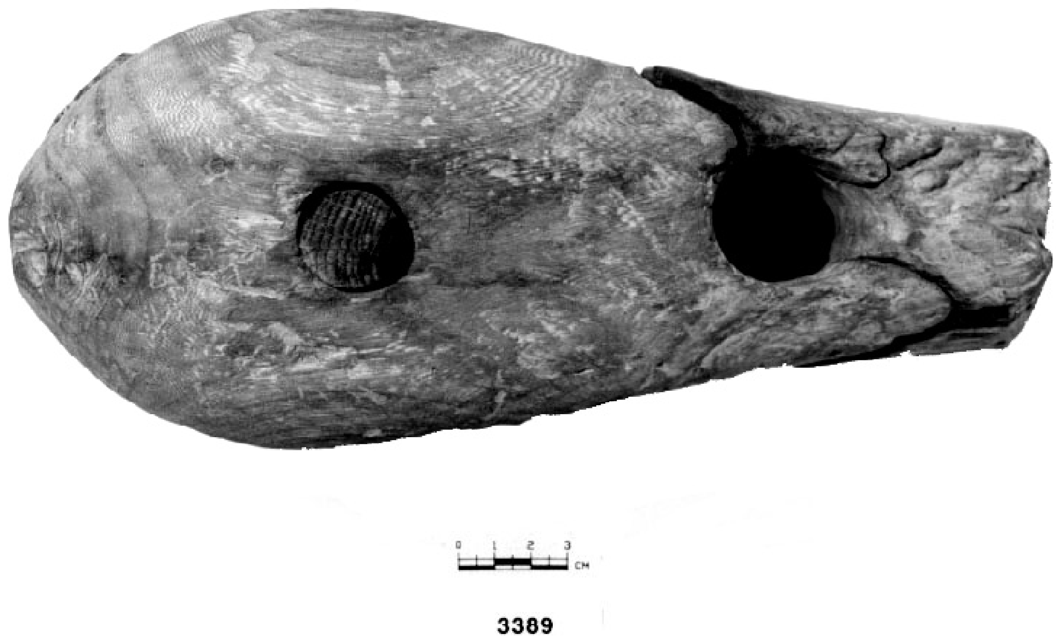
The interior of the shell is of standard construction. The block is in fair condition. Its shell is split in two through the pendant hole and at the base. Both cheeks show signs of wear around the pendant hole. The pin is slightly worn at its junction with the sheave.



3389

Block

Artifact # 3389



Block

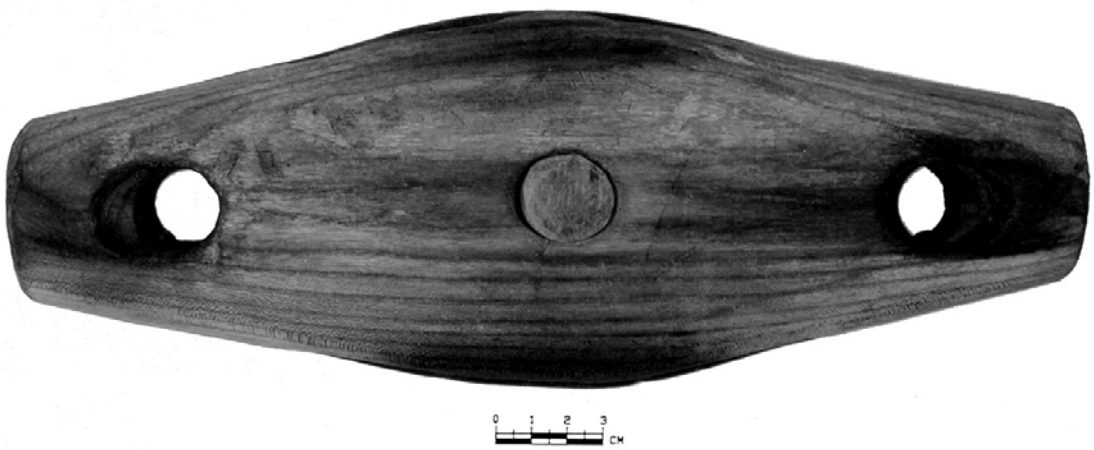
Artifact #	SubType	Material	Provenience
3395	Dutch Lift	Wood	y2011 x2007

Measurements

Length	27.5 cm
Width	10.5 cm
Thickness	7.3 cm
Pin Diameter	2.5 cm
Sheave Diameter	8.4 cm
Sheave Thickness	2.3 cm
Hole	3.4 cm

Comments

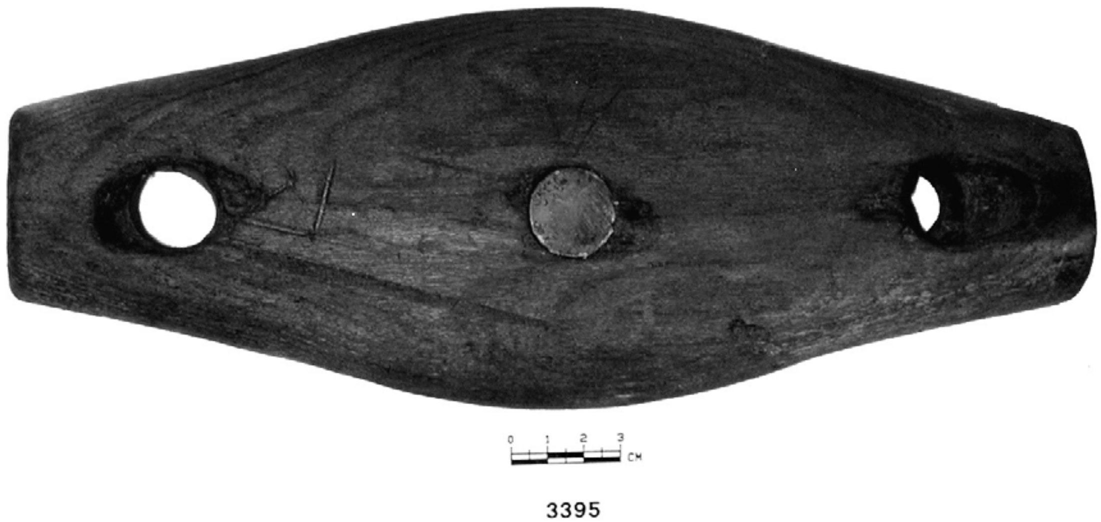
This block is in very good condition. The marks on the surface of one cheek are impressions left from a storage container used during conservation. The interior of the shell allows for a feed on either side of the sheave. The holes through both ends of the shell show wear on the outside edges, making them wider in one dimension than the other.

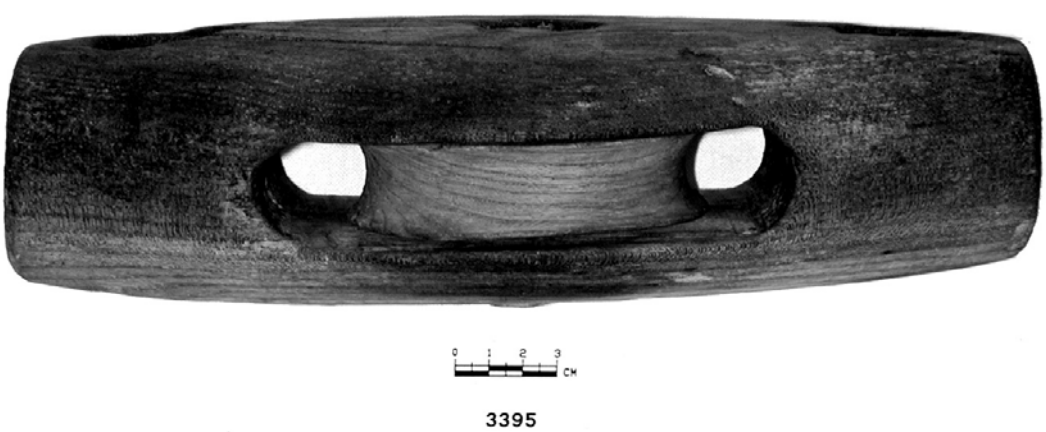


3395

Block

Artifact # 3395





Block

Artifact #	SubType	Material	Provenience
3419.08	Single Sheave	Composite	y2015 x2010

Measurements

Length	10.9 cm
Width	9.2 cm
Thickness	5.4 cm
Pin Diameter	1.6 cm
Sheave Diameter	6.3 cm
Sheave Thickness	1.7 cm
Thimble Diameter	3.4 cm
Hook Length	12.6 cm
Hook Thickness	1.7 cm
Rope Diameter	3.4 cm
Strand Diameter	1.7 cm
Hawser Length	23.8 cm

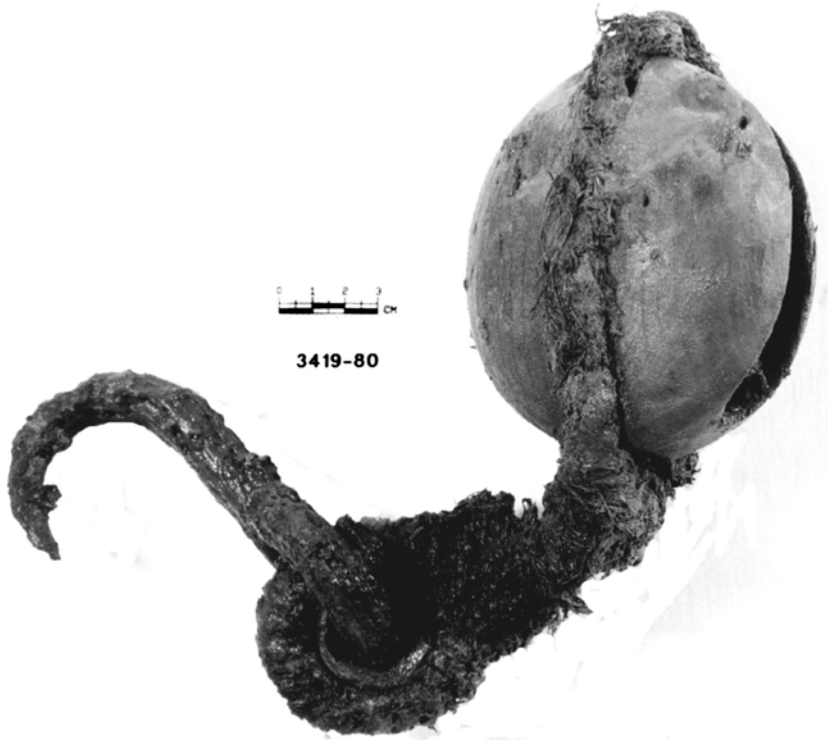
Comments

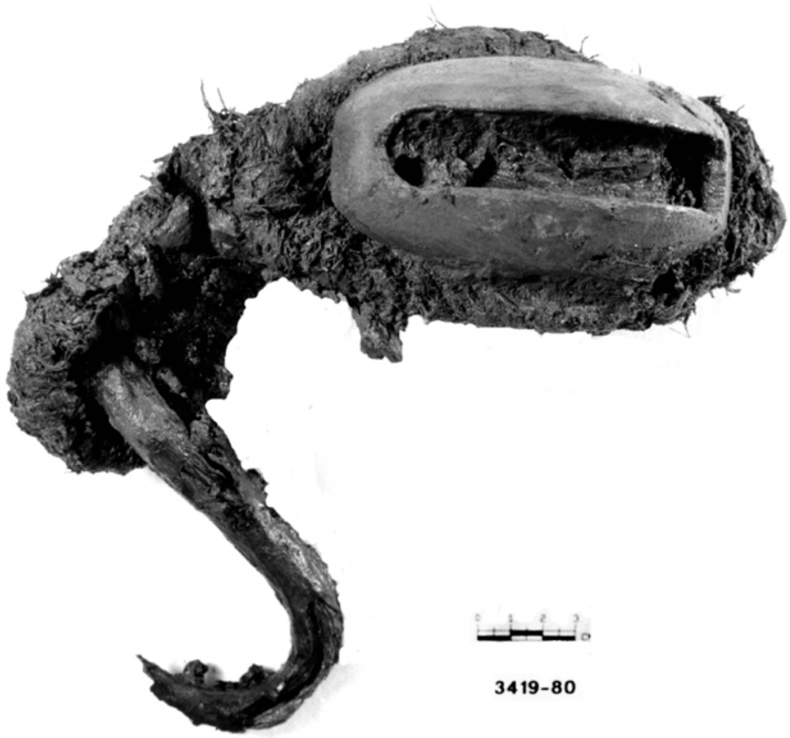
The block is in very good condition and is of standard construction. The pin is only slightly worn at its junction with the sheave. The strand width increases closer to the block. The rope is served between the block and the eyehook. It was excavated from within a cask within the hold.

3419.80

Block

Artifact # 3419.08





Block

Artifact #	SubType	Material	Provenience
3740	Single Sheave	Wood	y2012 x2007

Measurements

Length	25.4 cm
Thickness	10.5 cm
Score Width	3.9 cm
Pin Diameter	3.0 cm
Sheave Diameter	15.1 cm
Sheave Thickness	5.5 cm

Comments

The block is in very good condition and is of standard construction. It was excavated with its strop still set around it. This rope is recorded under the same artifact number in the rope section of the catalogue.

Block

Artifact # 3740

3740

3740

Block

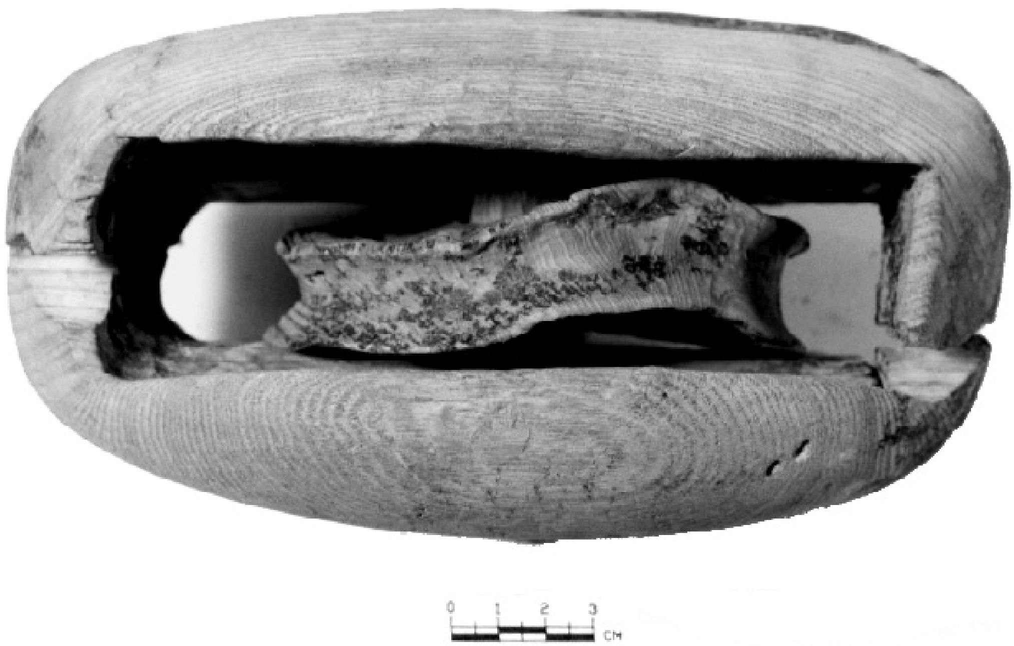
Artifact #	SubType	Material	Provenience
3759	Single Sheave	Ash (Fraxinus)	y2012 x2007

Measurements

Length	25.0 cm
Width	17.0 cm
Thickness	12.5 cm
Score Width	2.3 cm
Pin Diameter	3.0 cm
Sheave Diameter	13.0 cm
Sheave Thickness	3.7 cm

Comments

The block is in good condition and is of standard construction. The pin is worn at its junction with the sheave, which is distorted and oval in shape rather than round. The scoring is stained black from the rope that stropped the block. It was excavated with the strop still set around it. There are also traces of black stain on the sheave.



3759

Block

Artifact # 3759

3759

3759

Block

Artifact #	SubType	Material	Provenience
7215	Single Sheave	Wood	y2011 x2010

Measurements

Length	18.0 cm
Width	17.4 cm
Thickness	10.3 cm
Score Width	2.7 cm
Pin Diameter	2.4 cm
Sheave Diameter	10.5 cm
Sheave Thickness	2.7 cm

Comments

The block is in good condition and is of standard construction. The shell has broken into two halves, one cheek from the other. The pin is worn with concentric marks at its junction with the sheave. It was found in the stern of the ship behind the bulkhead in the area called Main II.

Block

Artifact # 7215

Block

Artifact #	SubType	Material	Provenience
7727	Single Sheave	Wood	y2015 x2011

Measurements

Length	28.8 cm
Width	21.0 cm
Thickness	11.0 cm
Score Width	3.0 cm
Pin Diameter	3.8 cm
Sheave Diameter	18.0 cm
Sheave Thickness	2.7 cm

Comments

This block is in good condition and is of standard construction. It was excavated from within the hull at approximately midships from the area known as Main I.

Block

Artifact # 7727

Block

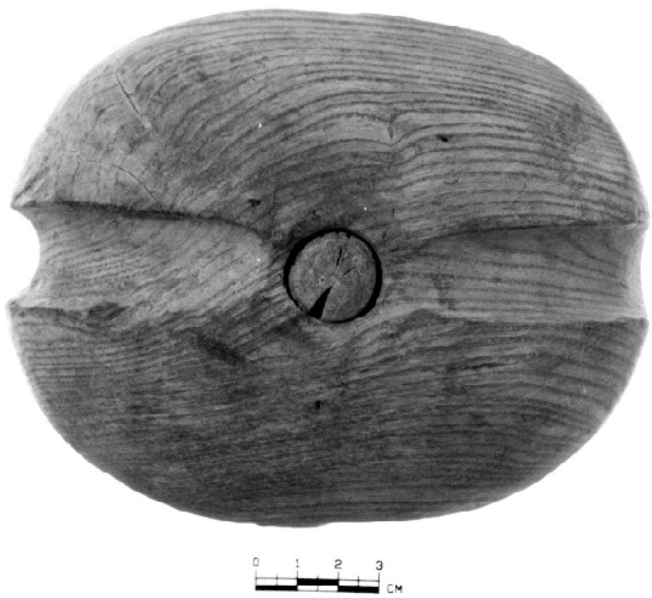
Artifact #	SubType	Material	Provenience
7737	Single Sheave	Wood	y2012 x2010

Measurements

Length	15.5 cm
Width	13.6 cm
Thickness	8.8 cm
Score Width	2.7 cm
Pin Diameter	2.5 cm
Sheave Diameter	9.5 cm
Sheave Thickness	2.5 cm

Comments

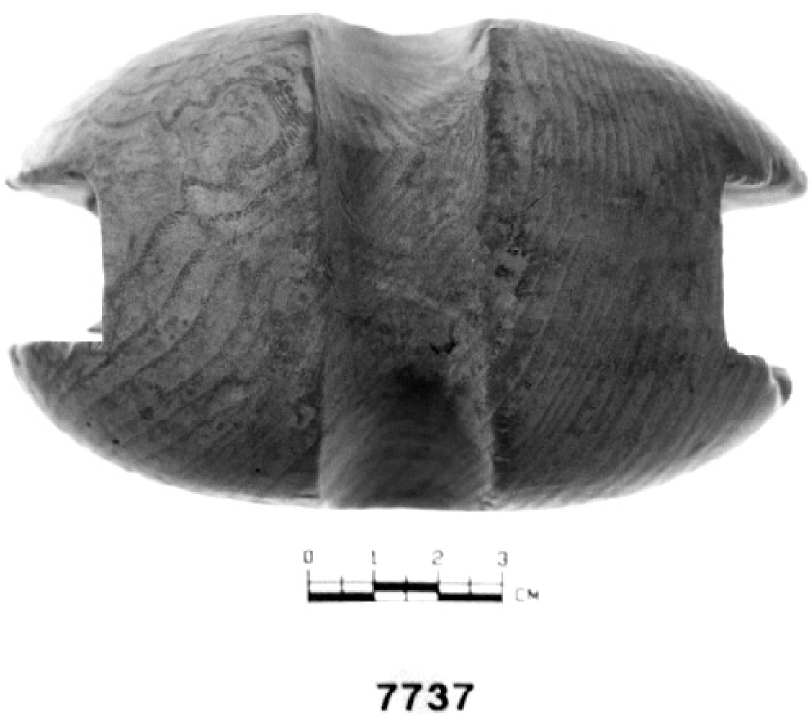
This block is in very good condition and is of standard construction. The pin shows concentrical marks at its junction with the sheave. It was excavated from within the hull among several casks in the area known as Main II in the stern of the ship.



7737

Block

Artifact # 7737



Block

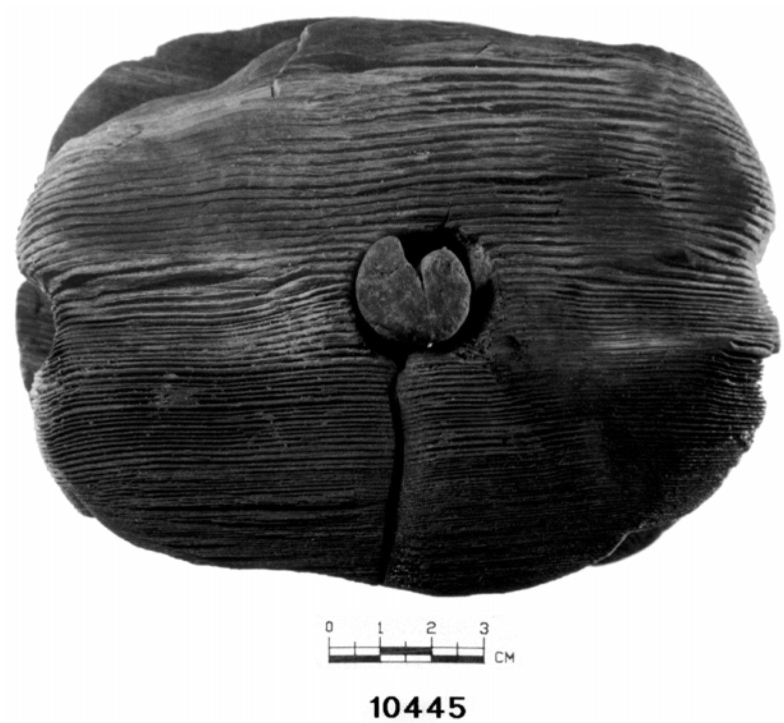
Artifact #	SubType	Material	Provenience
10445	Single Sheave	Wood	N 2012 E 2009

Measurements

Length	16.7 cm
Width	13.2 cm
Thickness	6.8 cm
Score Width	2.3 cm
Pin Diameter	2.3 cm
Sheave Diameter	8.8 cm
Sheave Thickness	1.9 cm

Comments

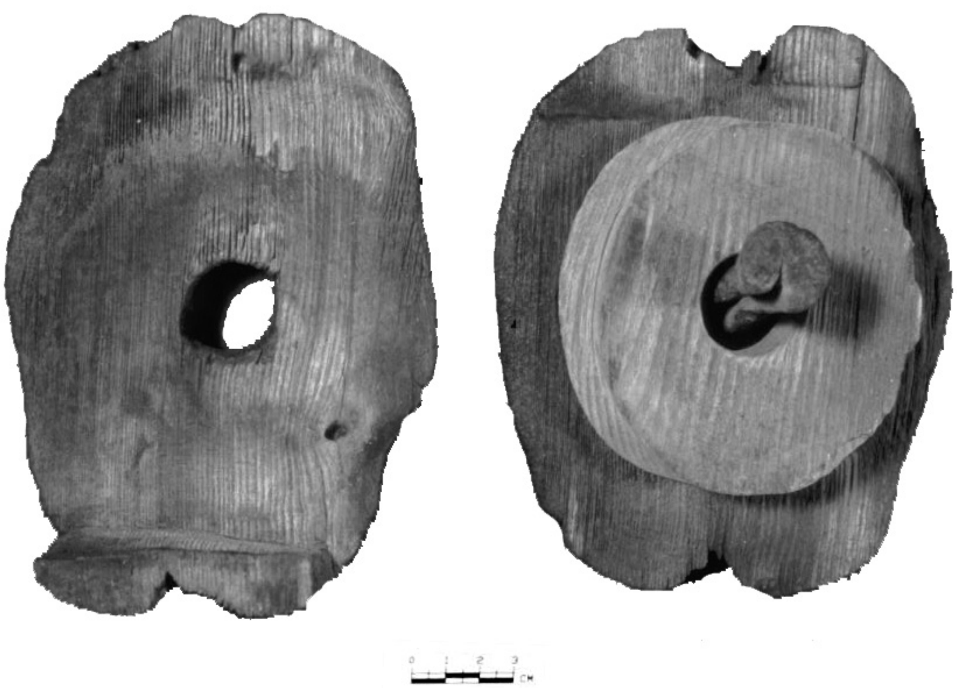
This block is in fair condition and is of standard construction. The two cheeks are no longer attached to each other. A portion of the crown is missing, causing its collapsed appearance. The wheel is distorted and compressed on one side. The pin is extremely worn at its junction with the sheave.



Block

Artifact # 10445

10445



10445

Block

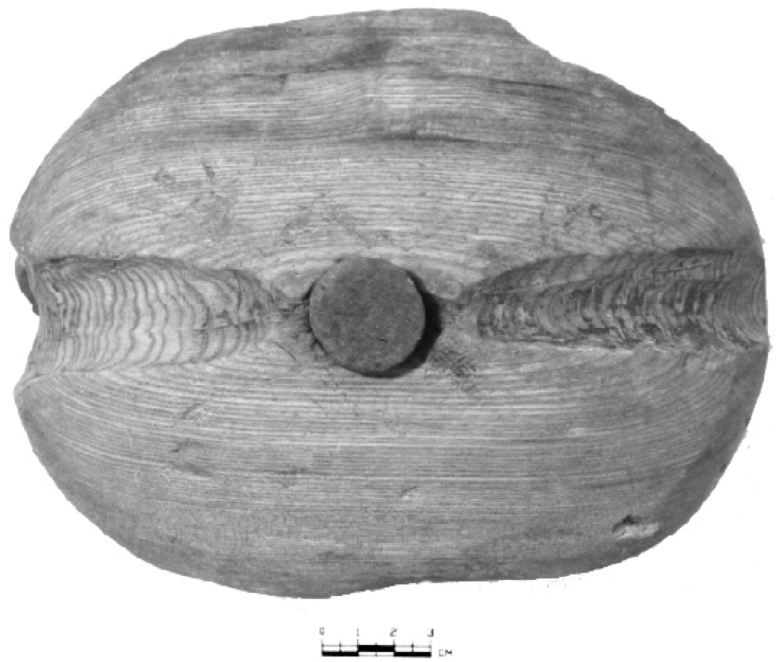
Artifact #	SubType	Material	Provenience
10513	Single Sheave	Wood	N 2013 E 2011

Measurements

Length	21.8 cm
Width	17.5 cm
Thickness	10.5 cm
Score Width	3.3 cm
Pin Diameter	2.7 cm
Sheave Diameter	13.0 cm
Sheave Thickness	2.4 cm

Comments

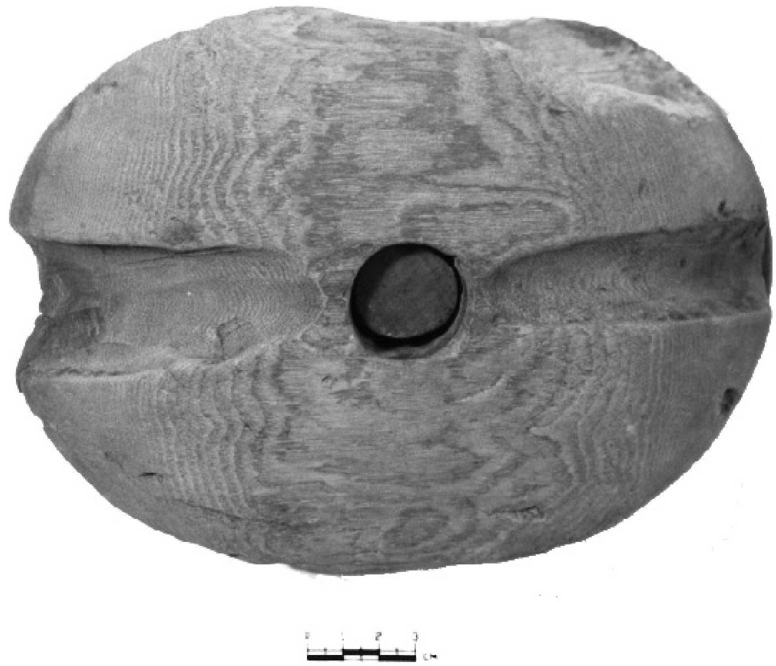
This block is in good condition and is of standard construction. The pin is worn and has concentric marks at its junction with the sheave. There are score marks in the interior shell at each of the four corners. It was excavated from inside the hull in Main II in the stern of the ship. The block was found with rope, among several casks and against the ceiling planking.



10513

Block

Artifact # 10513



10513

10513

Block

Artifact #	SubType	Material	Provenience
11302	Double Sheave	Wood	y2017 x2010

Measurements

Length	22.0 cm
Width	17.5 cm
Thickness	17.0 cm
Score Width	3.5 cm
Pin Diameter	2.2 cm
Sheave Diameter	12.5 cm
Sheave Thickness	3.3 cm

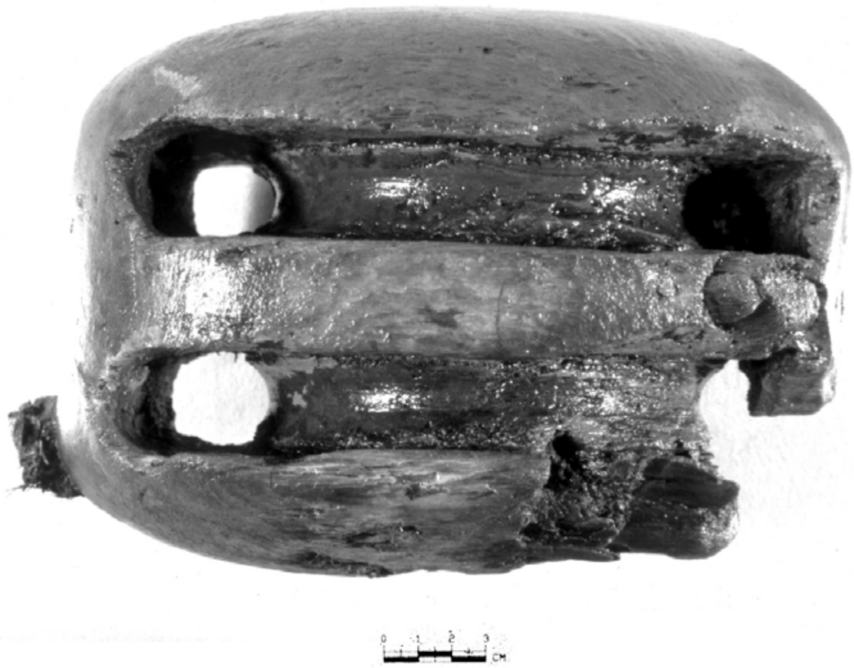
Comments

This double block is of standard construction. One cheek is in very good condition, the opposite cheek is in poor condition and is missing a portion of its base. This block was excavated with a portion of its strop.

11302

Block

Artifact # 11302



11302

11302

Block

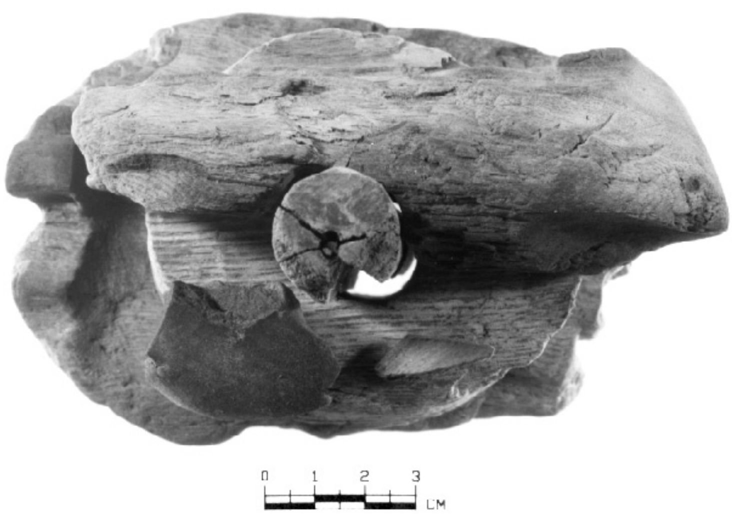
Artifact #	SubType	Material	Provenience
11305	Single Sheave	Wood	y2018 x2010

Measurements

Length	14.5 cm
Width	10.5 cm
Thickness	7.5 cm
Score Width	1.8 cm
Pin Diameter	2.5 cm
Sheave Diameter	8.5 cm
Sheave Thickness	2.2 cm

Comments

This block is badly damaged and in poor condition. Five pieces remain: one mostly intact cheek, a partially intact cheek, a small piece of the shell, the pin, and the sheave. The measurements represent the preserved portion of the block. The projected length is 16.0 cm, and the projected width is 11.0 cm. The interior of the shell is of standard construction. The scoring on the surface of the cheek comes closer to the pin on one side than the other, which is unique among this collection of artifacts. The pin is worn at its junction with the sheave.



11305

Block

Artifact # 11305

11305

Block

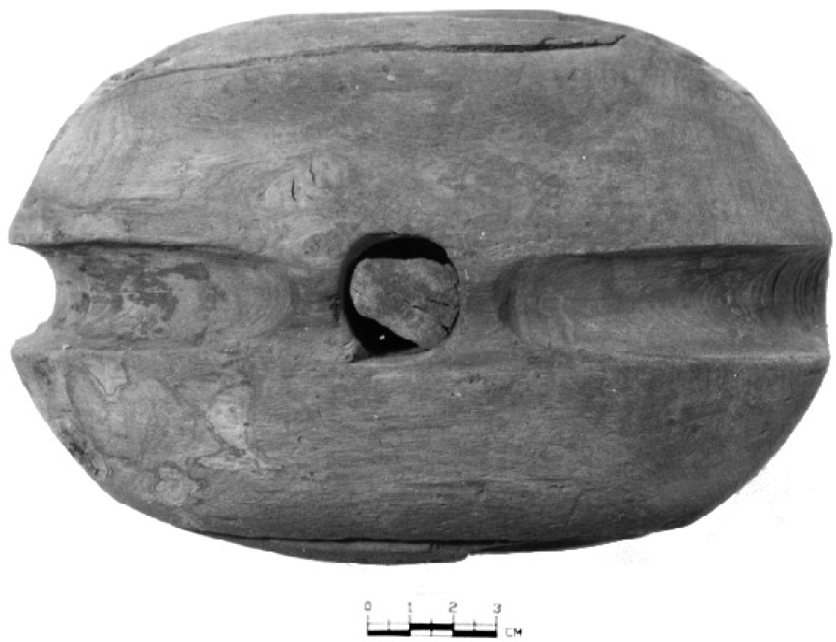
Artifact #	SubType	Material	Provenience
11317	Double Sheave	Wood	y2019 x2009

Measurements

Length	19.0 cm
Width	13.5 cm
Thickness	12.8 cm
Score Width	2.8 cm
Pin Diameter	2.5 cm
Sheave Diameter	9.2 cm
Sheave Thickness	2.3 cm

Comments

This double block is in good condition and is of standard construction. It was excavated with its rope strop still intact. Iron corrosion stains are present on the cheeks and the internal divider between the sheaves.



11317

Block

Artifact # 11317

11317

11317

Block

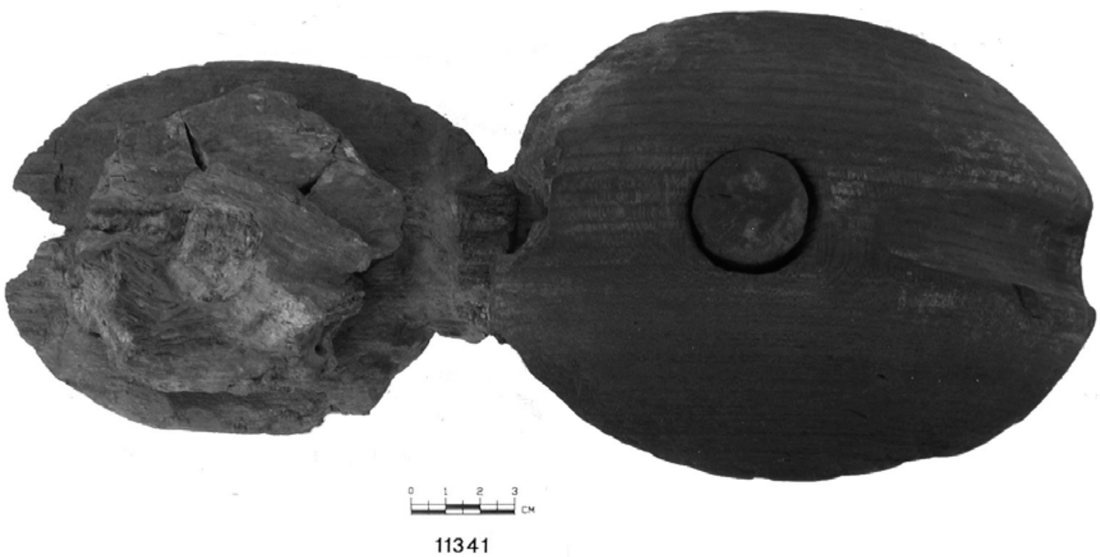
Artifact #	SubType	Material	Provenience
11341	Fiddle	Wood	y2019 x2009

Measurements

Length	29.1 cm
Width	11.3 cm
Thickness	7.0 cm
Score Width	2.6 cm
Pin Diameter	2.8 cm
Sheave Diameter	8.8 cm
Sheave Thickness	2.4 cm

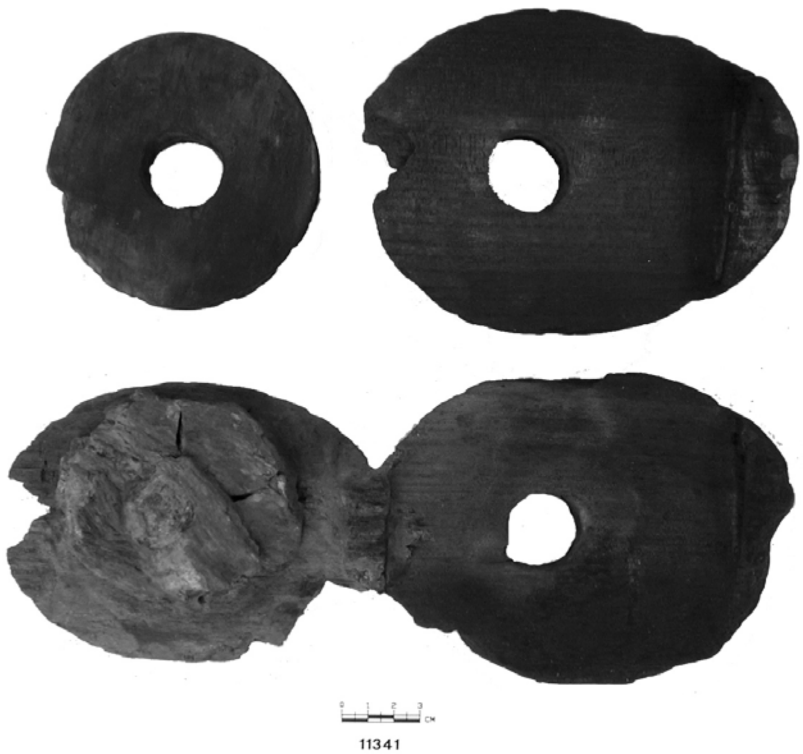
Comments

This fiddle block is in poor condition and is of standard construction. The base is damaged; one cheek of the small base block is missing, and the corresponding sheave is impregnated with iron corrosion. It was found in bow storage.



Block

Artifact # 11341



Block

Artifact #	SubType	Material	Provenience
11379	Fiddle	Wood	y2019 x2009

Measurements

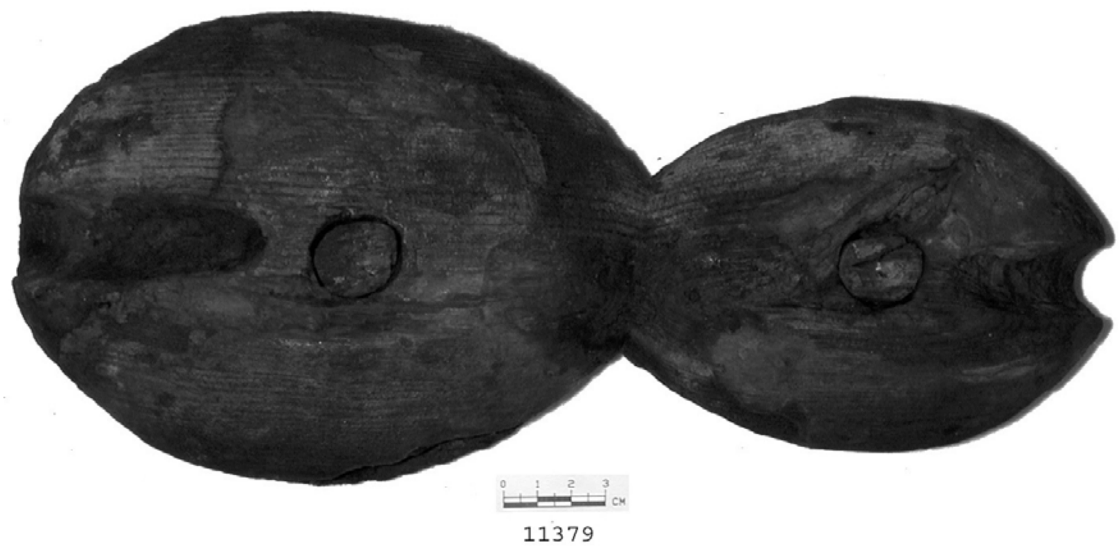
Length	31.8 cm
Width	13.3 cm
Thickness	8.5 cm
Pin Diameter	2.3 cm
Sheave Diameter	9.7 cm
Sheave Thickness	2.0 cm

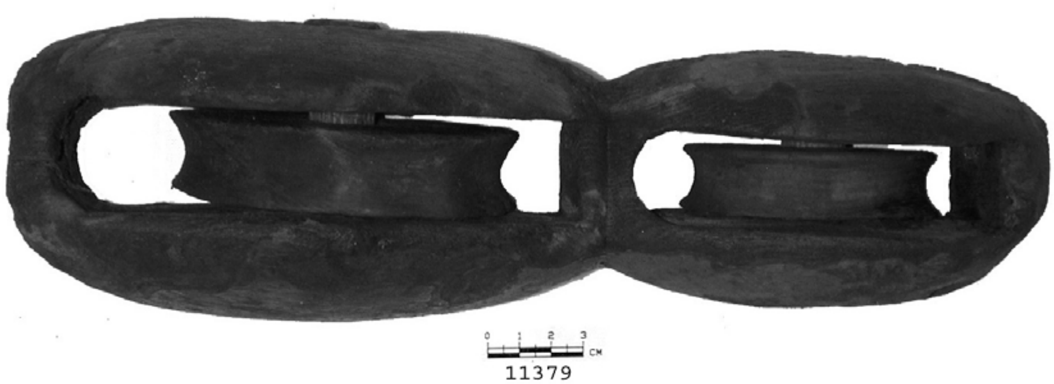
Comments

This fiddle block is in good condition and is of standard construction. The wood shows signs of iron corrosion. It was found in bow storage.

Block

Artifact # 11379





Block

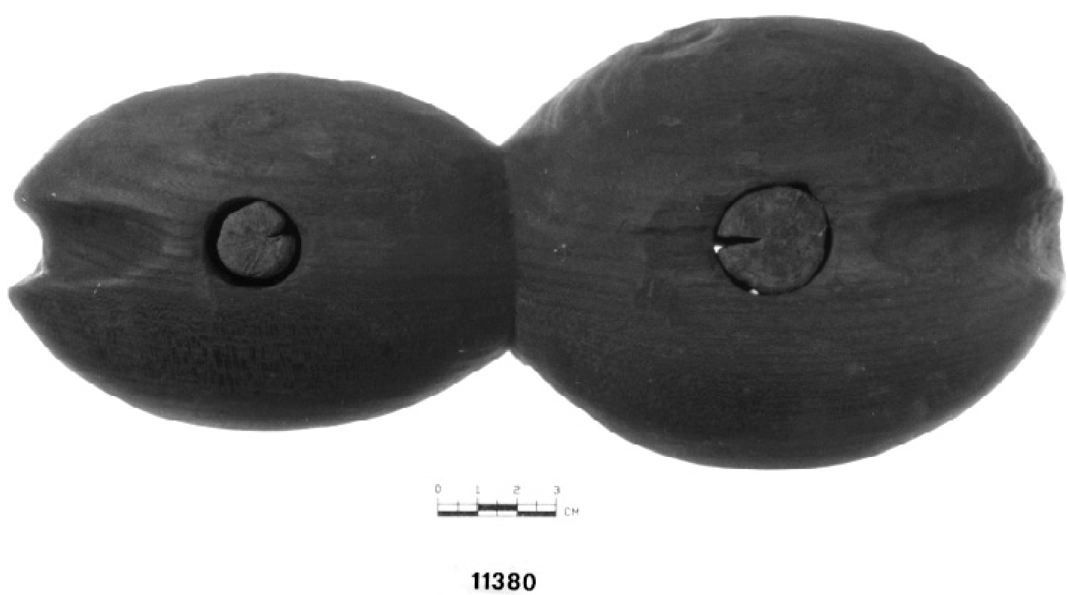
Artifact #	SubType	Material	Provenience
11380	Fiddle	Wood	y2020 x2009

Measurements

Length	27.5 cm
Width	12.0 cm
Thickness	8.4 cm
Score Width	2.1 cm
Pin Diameter	3.1 cm
Sheave Diameter	8.9 cm
Sheave Thickness	2.3 cm

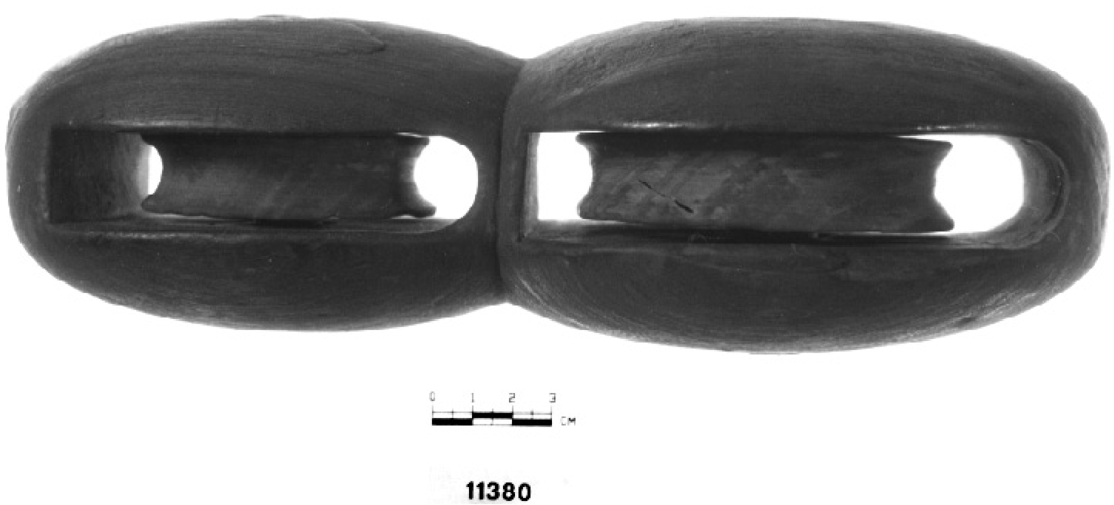
Comments

This fiddle block is of standard construction. It is in very good condition. It was found in bow storage.



Block

Artifact # 11380



Block

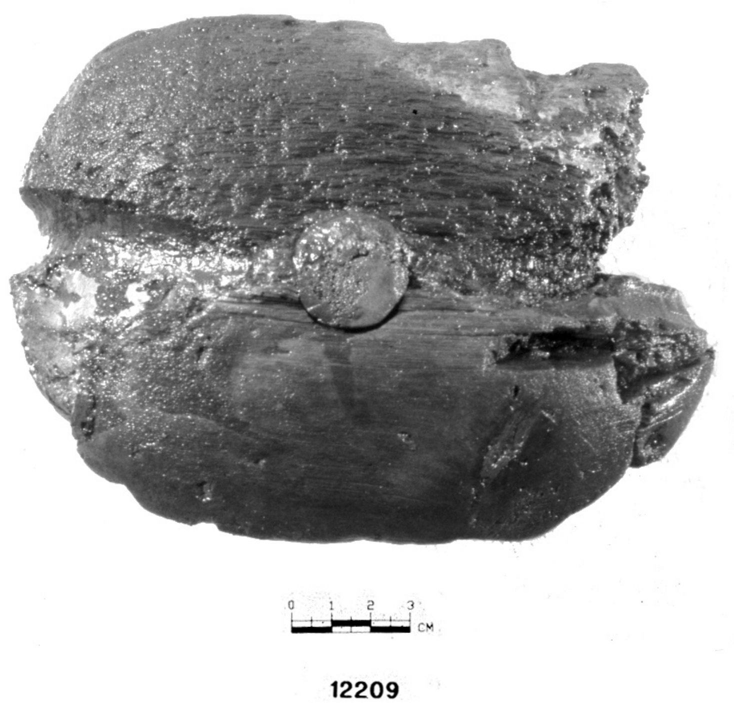
Artifact #	SubType	Material	Provenience
12209	Single Sheave	Wood	y2019 x2010

Measurements

Length	16.7 cm
Width	12.5 cm
Thickness	8.7 cm
Score Width	2.0 cm
Pin Diameter	2.5 cm
Sheave Diameter	9.6 cm
Sheave Thickness	2.0 cm

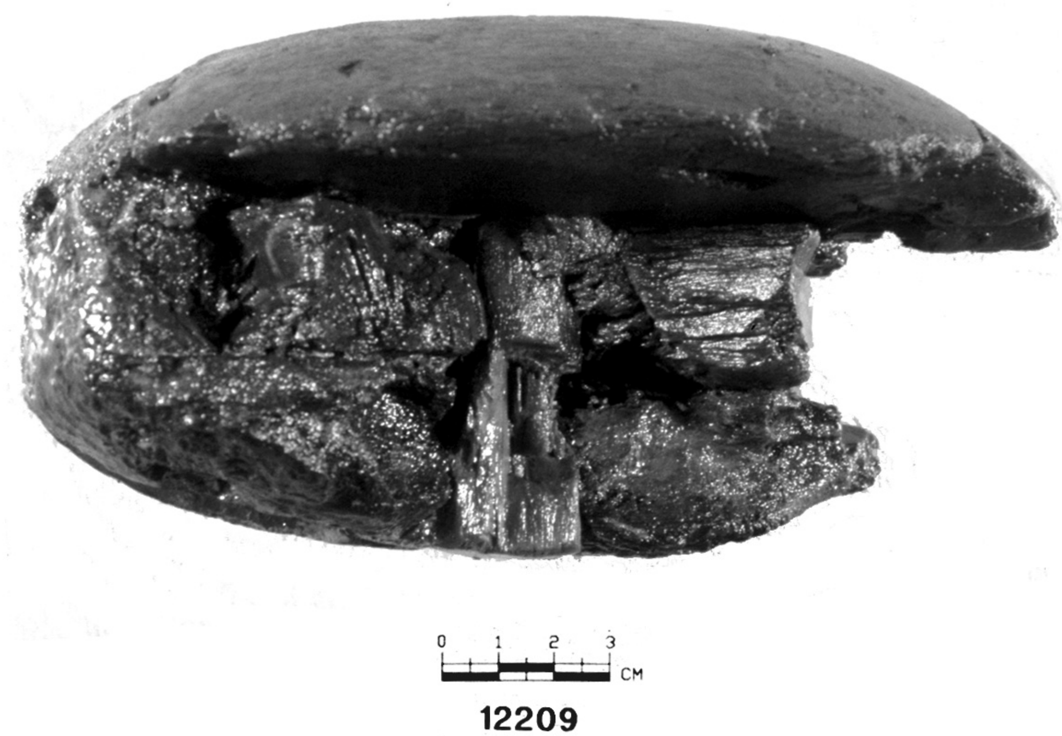
Comments

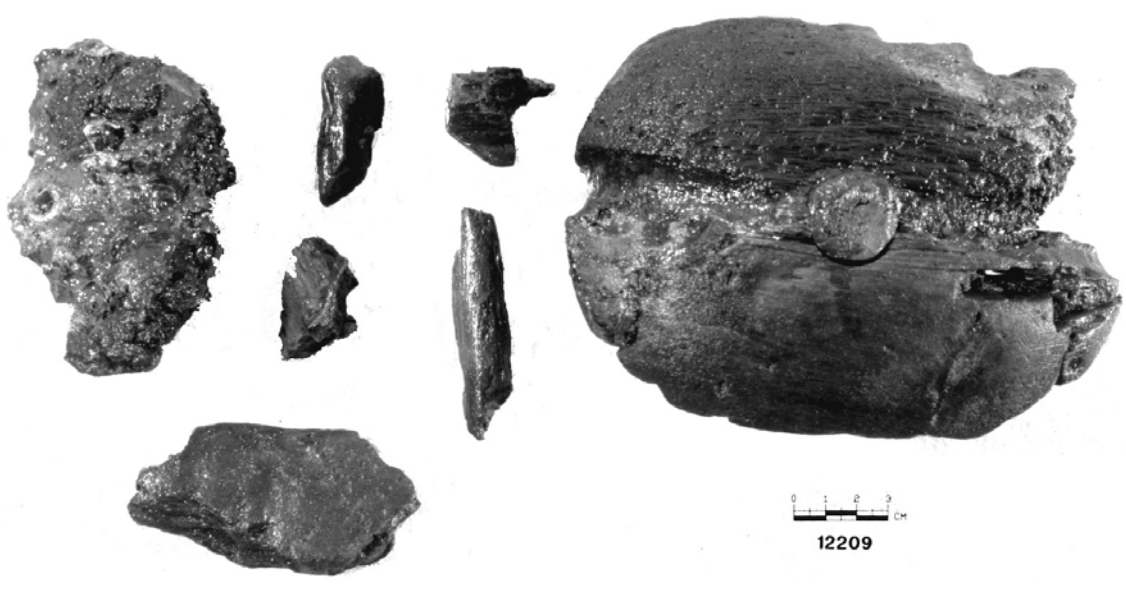
This block is apparently of standard construction, but is in poor condition. The crown is missing and the block is in several pieces.



Block

Artifact # 12209





Block

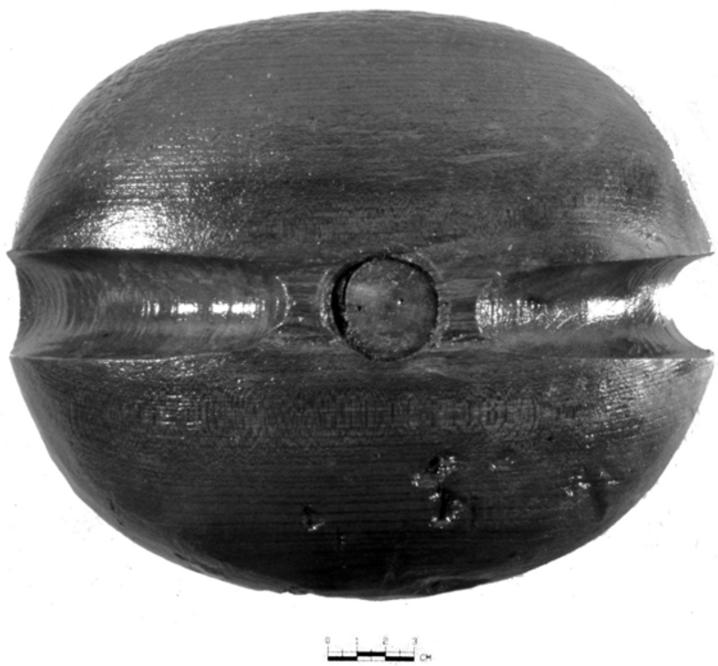
Artifact #	SubType	Material	Provenience
12504	Single Sheave	Wood	y2010 x2010

Measurements

Length	23.0 cm
Width	19.0 cm
Thickness	12.5 cm
Score Width	3.5 cm
Pin Diameter	3.3 cm
Sheave Diameter	13.8 cm
Sheave Thickness	3.3 cm

Comments

This block is of standard construction, and in very good condition.



12504

Block

Artifact # 12504

12504

12504

Block

Artifact #	SubType	Material	Provenience
12569	Dutch Lift	Wood	y2008 x2010

Measurements

Length	26.0 cm
Width	9.9 cm
Thickness	8.0 cm
Score Width	2.3 cm
Sheave Diameter	6.6 cm
Sheave Thickness	2.2 cm

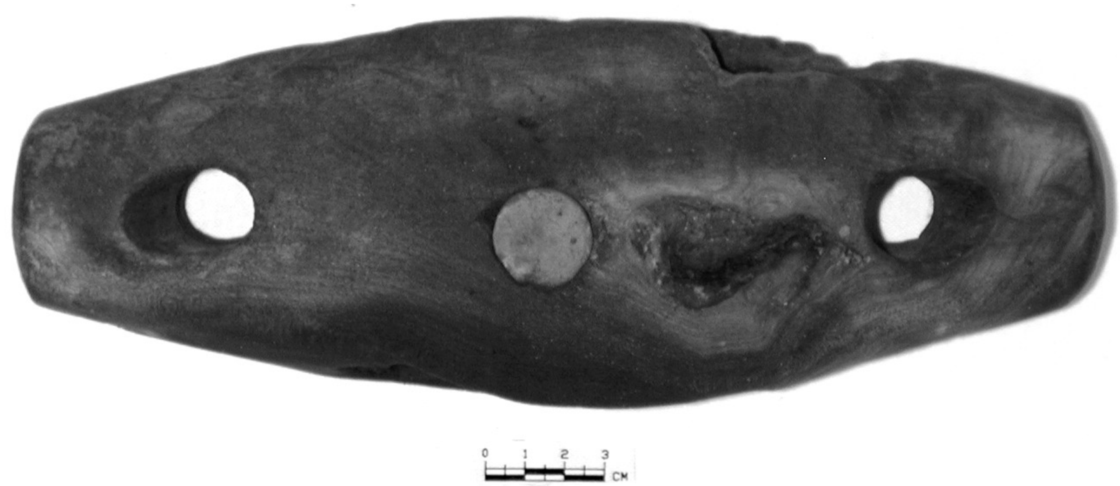
Comments

This lift block is in good condition. It shows signs of wear at both holes. The interior of the shell allows for a feed on either side of the sheave. The holes through both ends of the shell show wear on the outside edges.

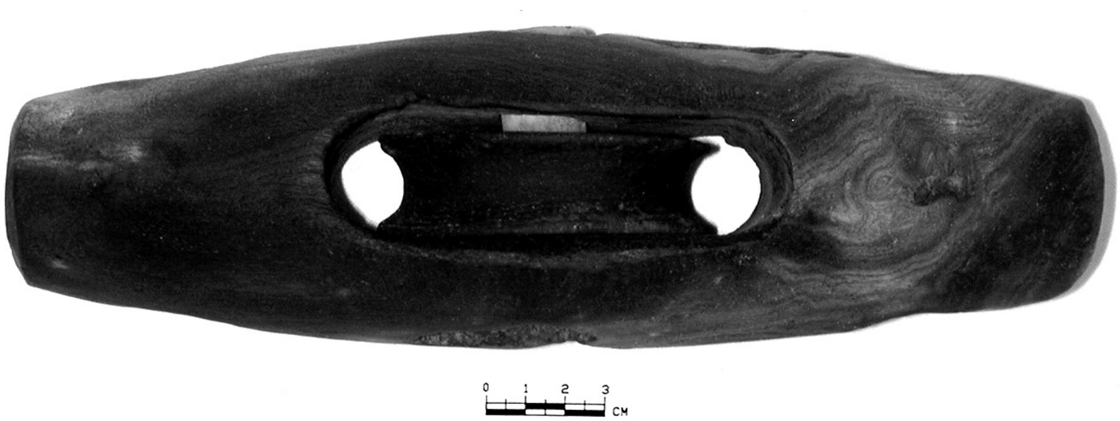
12569

Block

Artifact # 12569



12569



12569

Block

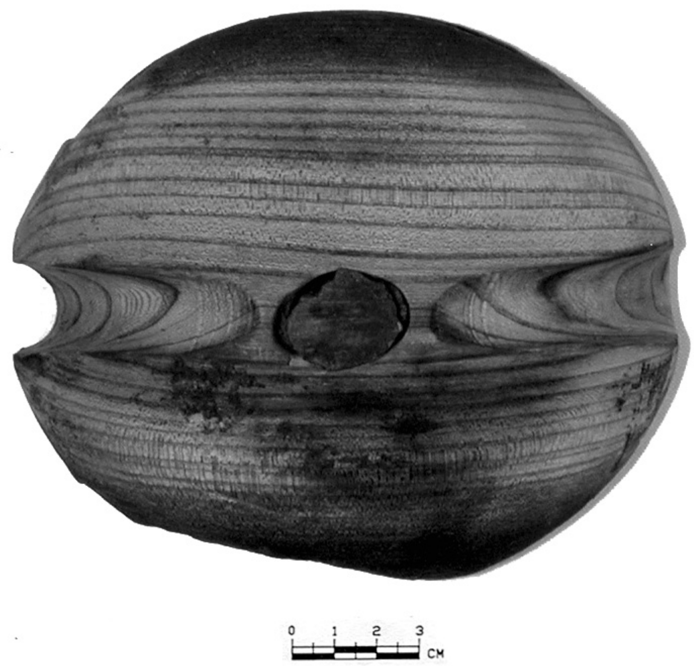
Artifact #	SubType	Material	Provenience
12947	Single Sheave	Wood	y2022 x2010

Measurements

Length	17.5 cm
Width	13.9 cm
Thickness	8.9 cm
Score Width	2.2 cm
Pin Diameter	2.2 cm
Sheave Diameter	9.4 cm
Sheave Thickness	2.7 cm

Comments

This block is of standard construction, and is in good condition. The pin shows wear at its junction with the sheave, but bark remains at both ends. Grooves from a chisel used in construction are present inside the shell at the base. It was excavated in association with bolt rope 12947.2, sail cloth and a grommet.



12947

Block

Artifact # 12947

12947

12947

Block

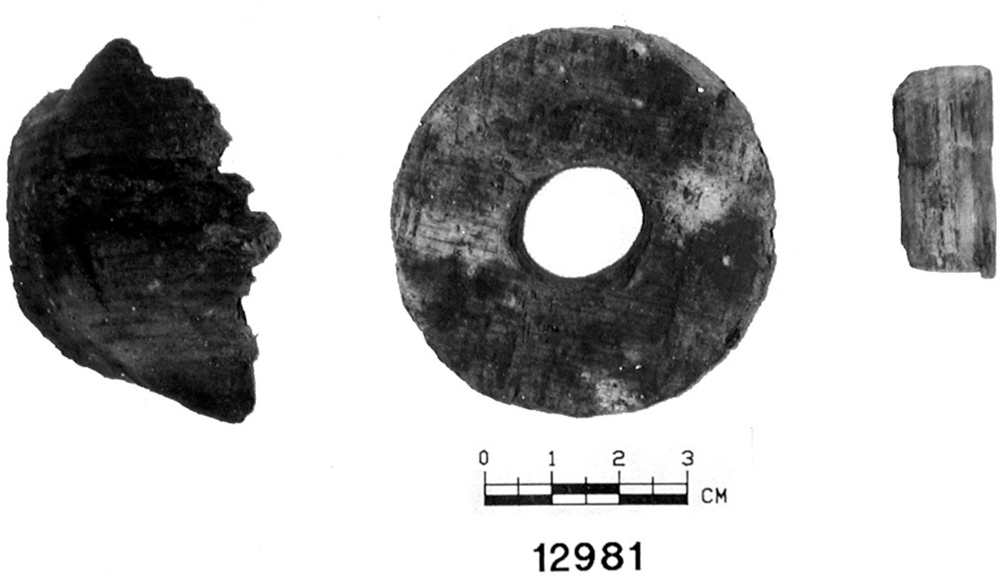
Artifact #	SubType	Material	Provenience
12981	Single Sheave	Wood	y2008 x2009

Measurements

Length	na
Width	na
Thickness	na
Score Width	1.2 cm
Pin Diameter	1.4 cm
Sheave Diameter	5.6 cm
Sheave Thickness	1.8 cm

Comments

This block is in poor condition; the type of construction can not be determined. It is represented only by the sheave, partial pin and shell fragment.



Block

Artifact #	SubType	Material	Provenience
12995	Single Sheave	Wood	y2022 x2009

Measurements

Length	16.5 cm
Width	13.3 cm
Thickness	8.8 cm
Score Width	2.2 cm
Pin Diameter	2.5 cm
Sheave Diameter	8.8 cm
Sheave Thickness	2.5 cm

Comments

This block is of standard construction, and is in good condition. The edges of the cheeks on one side are clipped. This block was excavated with associated rope recorded under the same artifact number.

12995

Block

Artifact # 12995

12995

12995

Block

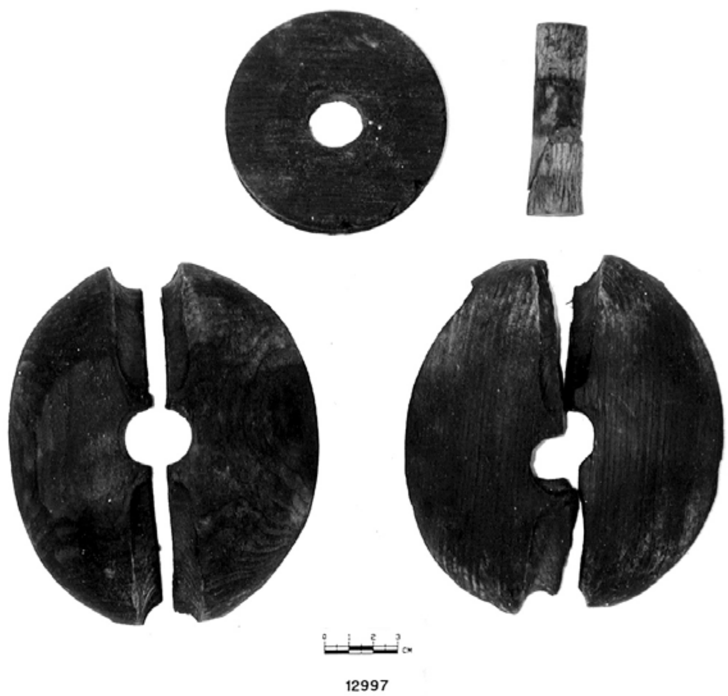
Artifact #	SubType	Material	Provenience
12997	Single Sheave	Wood	y2021 x2010

Measurements

Length	15.5 cm
Width	12.0 cm
Thickness	6.5 cm
Score Width	2.5 cm
Pin Diameter	2.0 cm
Sheave Diameter	7.7 cm
Sheave Thickness	2.3 cm

Comments

This block is in fair condition and is of standard construction; it is now in six pieces. Each cheek is split lengthwise. It was excavated in this condition, and associated with its rope strop, bolt rope and grommets, and sail cloth, all of which are recorded under the same artifact number in the rope section of the catalogue.



Deadeye

Artifact #	SubType	Material	Provenience
3419.002	Stropped	Composite	y2015 x2010

Measurements

Thickness	5.8 cm
Score Width	1.8 cm
Diameter	13.5 cm
Hole	2.1 cm
Thimble Diameter	4.9 cm
Thimble Thickness	2.7 cm
Rope Diameter	3.3 cm
Strand Diameter	1.8 cm
Hawser Length	23.8 cm

Comments

This deadeye is in fair condition, has a base and is designed to be stropped. It was excavated with a length of hawser still stropped around it with a thimble and hook. It was found within cask 3419, which was in Main I.

Deadeye

Artifact # 3419.002

Deadeye

Artifact #	SubType	Material	Provenience
3419.078	Strapped	Wood	y2015 x2010

Measurements

Thickness	6.0 cm
Score Width	1.6 cm
Diameter	10.2 cm
Hole	1.6 cm

Comments

This iron deadeye strap is artifact 3419.23 and is recorded under that number. The deadeye is in very good condition. It is scored entirely in its circumference and does not have a base. The vertical diameter is longer than the horizontal, but the artifact gives the overall impression of being entirely round. Wear is noticeable on the tops of the eyes. It was found within cask 3419, which was in Main I.

Deadeye

Artifact # 3419.078

Deadeye

Artifact #	SubType	Material	Provenience
5501	Stropped	Wood	y2016 x2008

Measurements

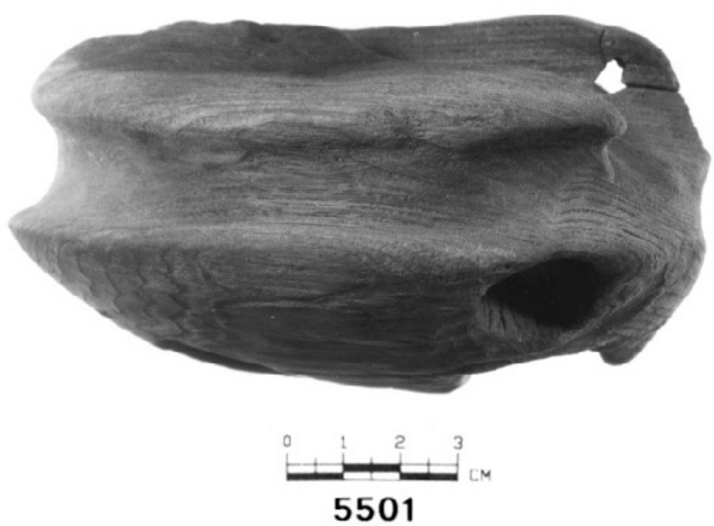
Thickness	7.0 cm
Score Width	2.1 cm
Diameter	12.9 cm
Hole	3.2 cm

Comments

This is a poorly preserved example of a deadeye that is designed to be stropped and has a base. Its exterior surface is very worn, and there are large teredo worm holes that extend through the artifact. The lanyard holes are larger than normal due to erosion. Signs of use can not be determined with so little of the original surface remaining. It was found within the hull in Main I.

Deadeye

Artifact # 5501



Deadeye

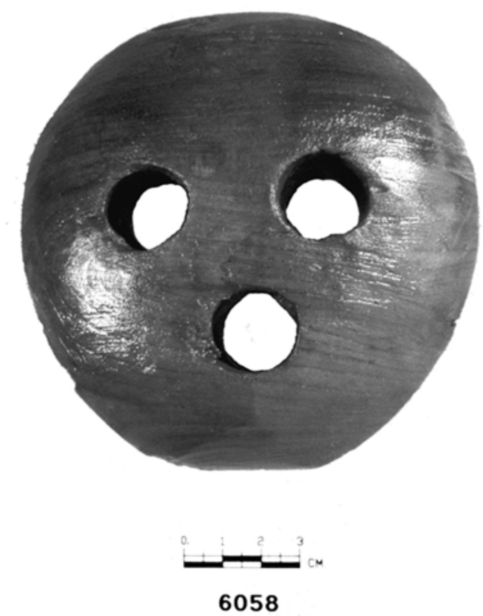
Artifact #	SubType	Material	Provenience
6058	Stropped	Wood	y2019 x2011

Measurements

Thickness	7.3 cm
Score Width	2.2 cm
Diameter	11.7 cm
Hole	2.3 cm

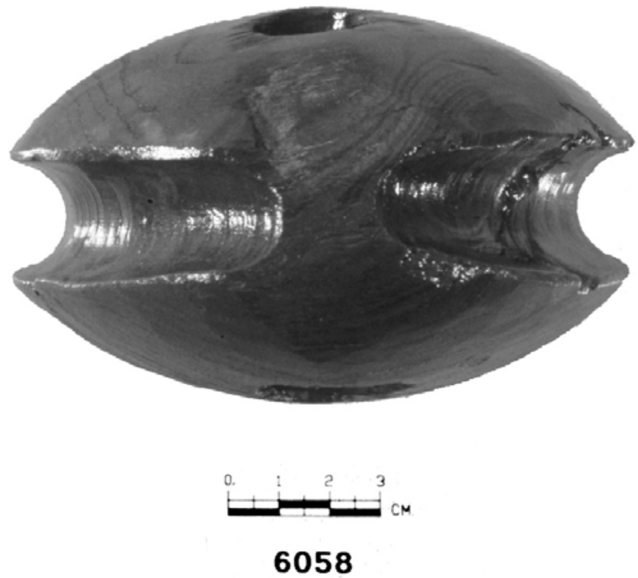
Comments

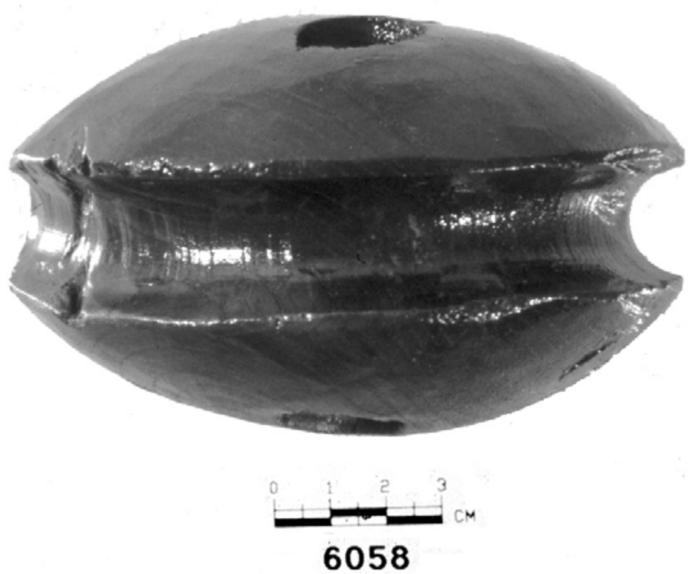
This deadeye was stropped and has a base. It is in very good condition and does not show signs of wear. It was found against the ceiling planking in the bow storage area.



Deadeye

Artifact # 6058





Deadeye

Artifact #	SubType	Material	Provenience
7227	Stropped	Wood	y2007 x2009

Measurements

Thickness	8.5 cm
Score Width	2.8 cm
Diameter	17.1 cm
Hole	3.0 cm

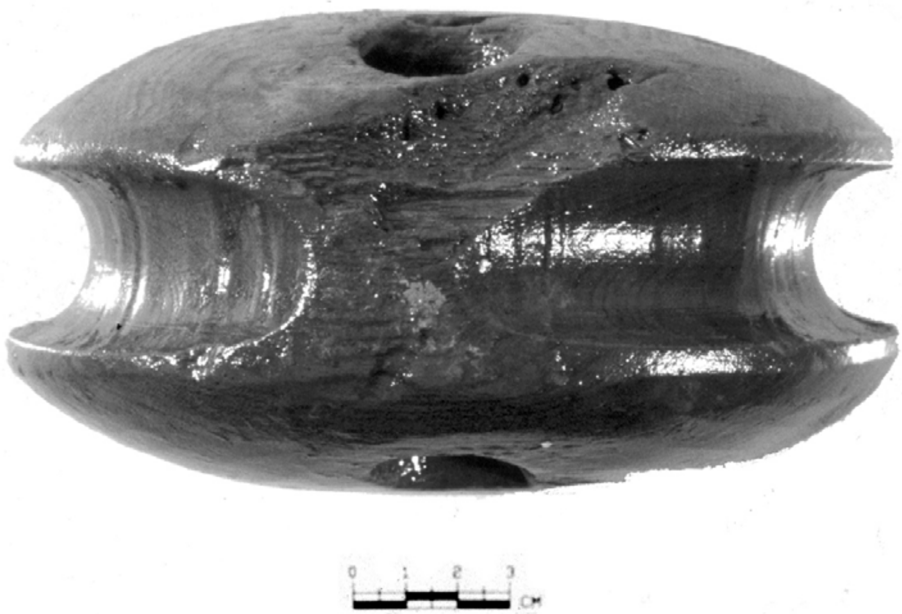
Comments

This deadeye is designed to be stropped and has a base. It is in good condition, and does not show signs of wear. It was found in the extreme stern of the ship. It was found at the extreme end on the stern on the starboard side.

7227

Deadeye

Artifact # 7227



7227

7227

Deadeye

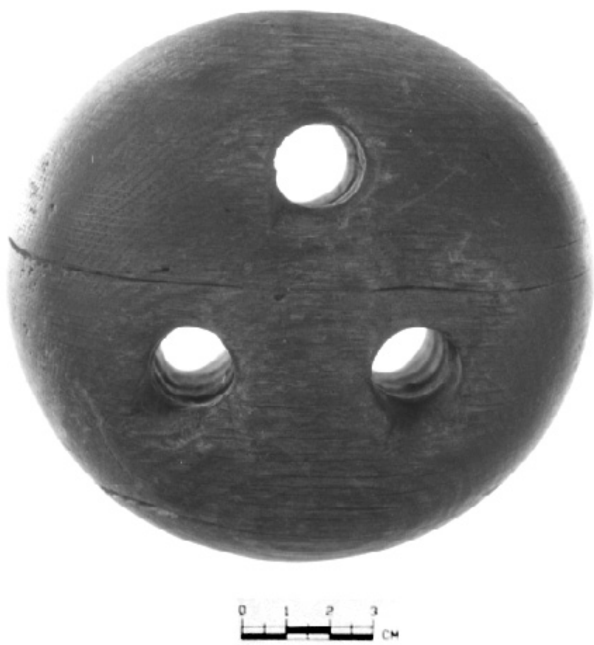
Artifact #	SubType	Material	Provenience
7294	Stropped	Wood	y2012 x2011

Measurements

Thickness	7.9 cm
Score Width	2.3 cm
Diameter	14.0 cm
Hole	2.1 cm

Comments

This deadeye is scored entirely in its circumference and has no base; it is round and designed to be stropped. It is in very good condition. There are signs of rope wear in the eyes. It was excavated from next to the ceiling planking in the stern of the ship in Main II, and was found with rope still around it.



7294

Deadeye

Artifact # 7294

7294

Deadeye

Artifact #	SubType	Material	Provenience
10739	Stropped	Wood	y2013 x2011

Measurements

Thickness	7.7 cm
Score Width	1.7 cm
Diameter	14.7 cm
Hole	2.2 cm

Comments

This deadeye is in good condition, it has a base and is designed to be stropped. The scoring is stained black, which may be from rope. The groove is neither clearly rounded nor square. It was excavated with rope still in its eyes, and from within the hull in Main II in the stern of the ship.

Deadeye

Artifact # 10739

Deadeye

Artifact #	SubType	Material	Provenience
10764	Strapped	Wood	y2013 x2011

Measurements

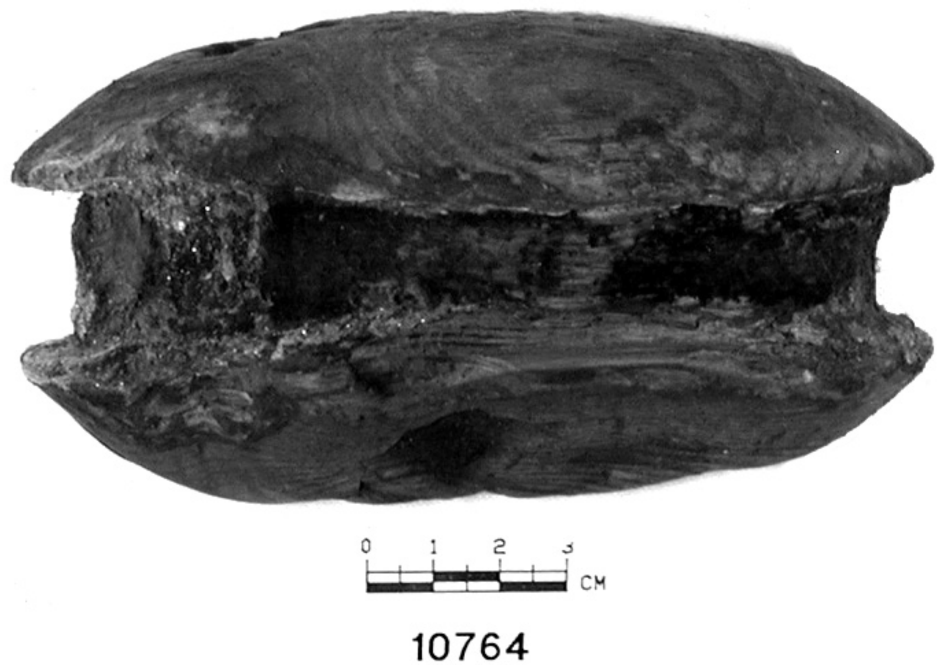
Thickness	7.2 cm
Score Width	1.8 cm
Diameter	14.2 cm
Hole	2.2 cm

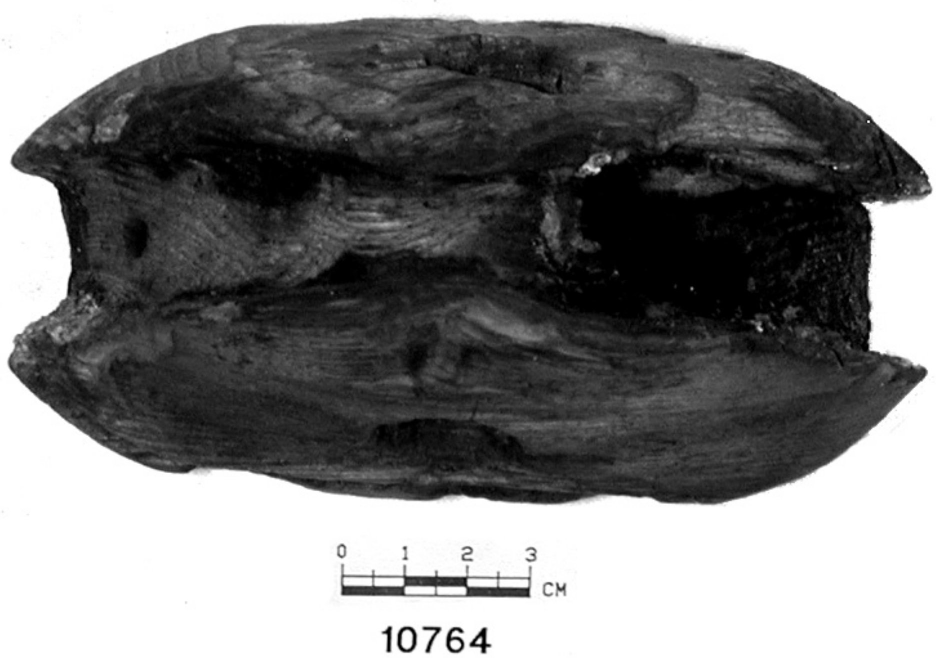
Comments

This deadeye is in good condition, has a base and is designed to be strapped. Portions of the iron deadeye strap have been conserved separately. The holes show signs of wear. It was excavated from within the hull in Main II in the stern of the ship.

Deadeye

Artifact # 10764





Deadeye

Artifact #	SubType	Material	Provenience
10788	Stropped	Wood	y2012 x2011

Measurements

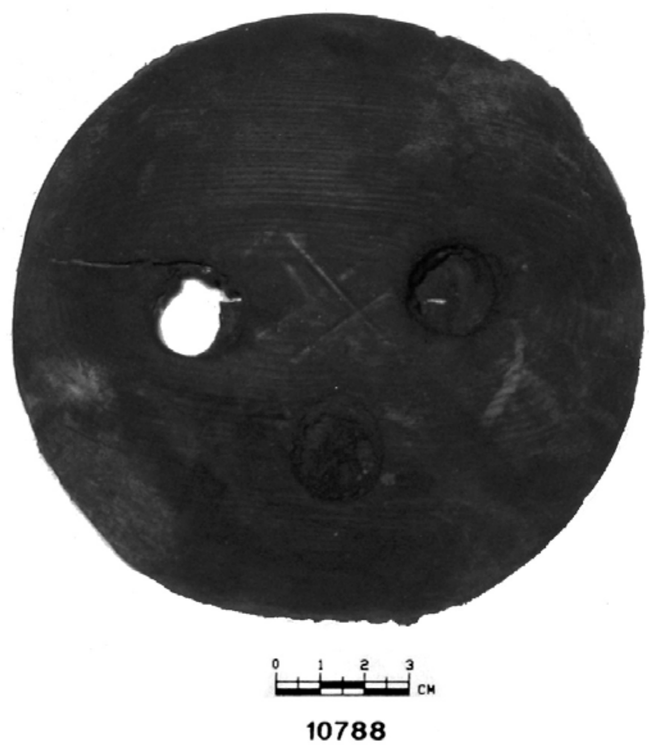
Thickness	7.1 cm
Score Width	1.7 cm
Diameter	14.5 cm
Hole	2.3 cm

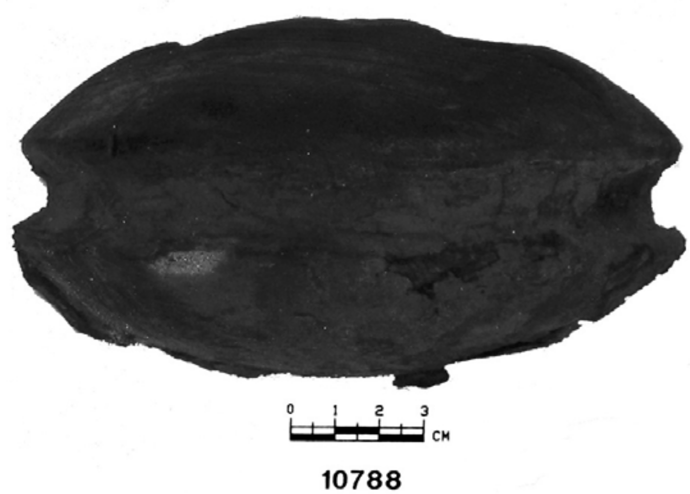
Comments

This deadeye has a base and is designed to be stropped. The score is rounded, unlike strapped deadeyes that have square scoring. The wood is impregnated with iron corrosion, possibly from its location near other iron objects and not necessarily its own strap. Signs of wear are visible around the holes. The cross hatch marks are from a storage crate during conservation. It was found within the hull in Main II.

Deadeye

Artifact # 10788





Deadeye

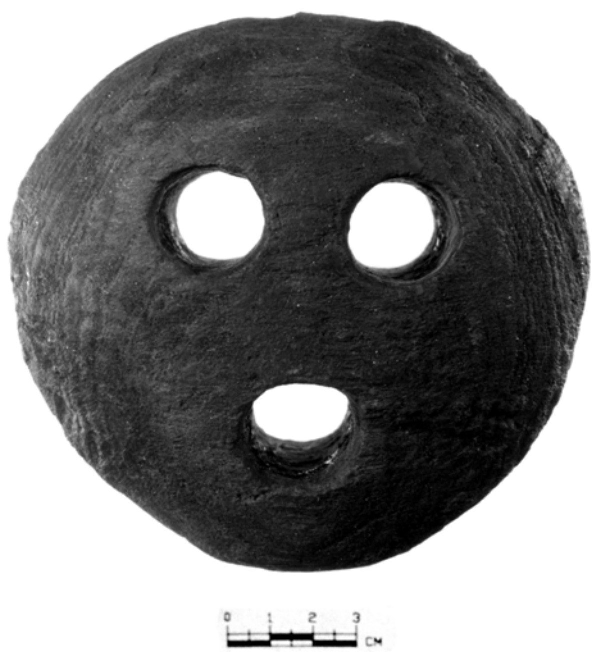
Artifact #	SubType	Material	Provenience
11361	Stropped	Wood	y2019 x2009

Measurements

Thickness	6.5 cm
Score Width	2.3 cm
Diameter	12.3 cm
Hole	2.2 cm

Comments

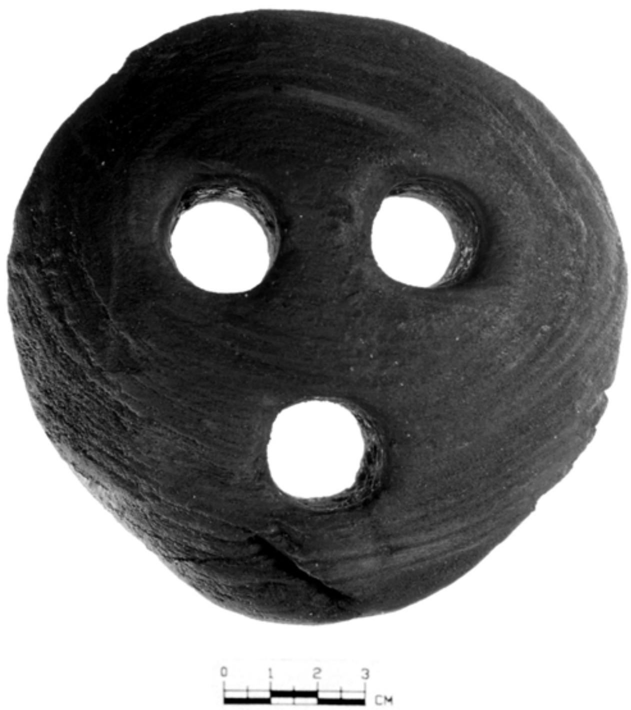
This deadeye is in good condition, has a base and is designed to be stropped. The surface is eroded, so it is difficult to determine signs of use. It was found in the bow storage area with crucibles and the three fiddle blocks, between 25 cm and the ceiling planking.



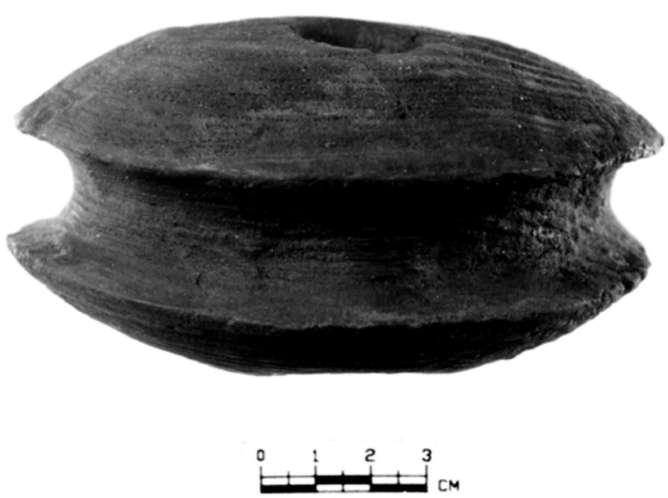
11361

Deadeye

Artifact # 11361



11361



11361

Deadeye

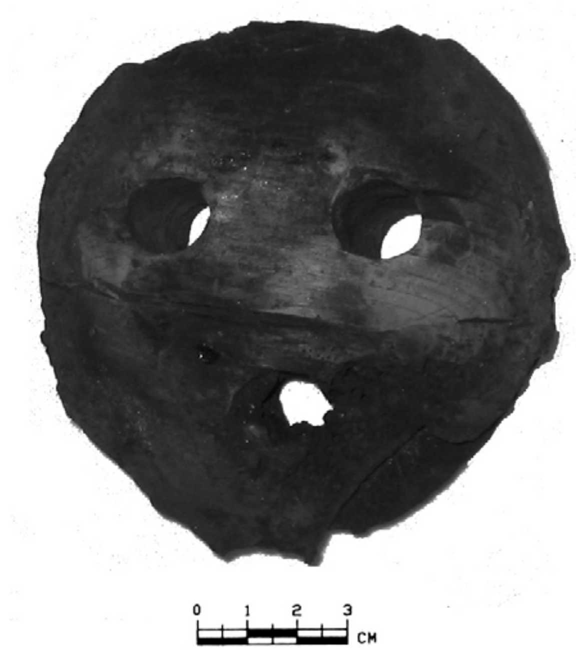
Artifact #	SubType	Material	Provenience
13009	Strapped	Wood	y2008 x2012

Measurements

Thickness	6.5 cm
Score Width	1.7 cm
Diameter	10.7 cm
Hole	1.7 cm

Comments

This deadeye is in good to fair condition, has a base and is designed to be strapped. The score is clearly square in cross section. The wood is impregnated with iron corrosion. It was found outside the hull on the starboard side of the stern.



13009

Deadeye

Artifact # 13009

0 1 2 3 CM

13009

0 1 2 3 CM

13009

Deadeye

Artifact #	SubType	Material	Provenience
13277	Stropped	Wood	y2009 x2009

Measurements

Thickness	7.5 cm
Score Width	2.9 cm
Diameter	na
Hole	2.4 cm

Comments

This deadeye has a base and is designed to be stropped. It is in very poor condition, only three extremely damaged pieces of the base of the deadeye remain. It was found with its strop still set around the remaining portions. Only the base and bottom half of two holes remain. The rope is recorded under the same artifact number. It was found outside the hull on the port side of the stern.

Cleat

Artifact #	SubType	Material	Provenience
5107		Wood	y2016 x2010 z-5.236

Measurements

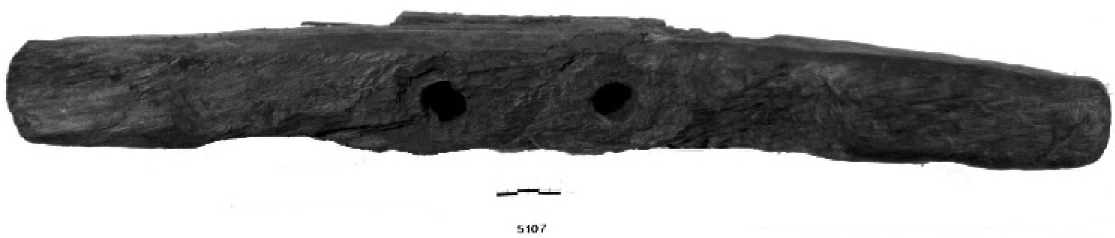
Length	48.9 cm
Width	9.4 cm
Thickness	5.8 cm
Base Length	12.6 cm
Nail Hole Diameter	1.6 cm

Comments

This cleat has two vertical nail holes through the center of its body. The holes are circular in cross-section and are on either side of the artifact's center-line.

Cleat

Artifact # 5107



Cleat

Artifact #	SubType	Material	Provenience
6285		Wood	y2021 x2007

Measurements

Length	51.0 cm
Width	9.0 cm
Thickness	6.6 cm
Base Length	12.8 cm

Comments

This cleat is in very good condition. It was found outside the ship on the port side of the bow. It was found near rope #6295, which was connected to the crosstree assemblage #6013.

Cleat

Artifact #	SubType	Material	Provenience
10526		Wood	y2013 x2010

Measurements

Length	33.4 cm
Width	6.5 cm
Thickness	4.9 cm
Base Length	8.5 cm
Nail Hole Diameter	1.1 cm

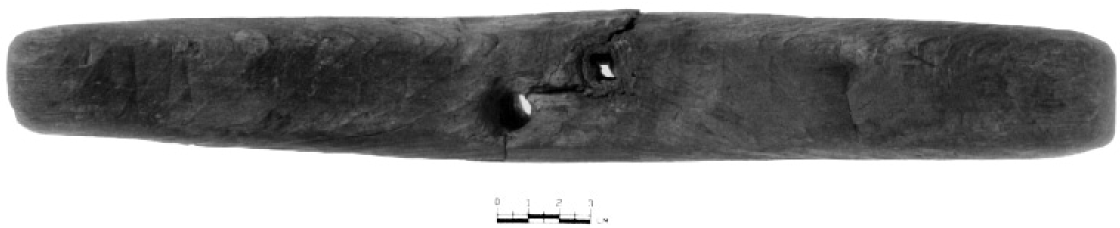
Comments

This cleat has two vertical nail holes through its base. These holes are square in cross-section. This cleat was excavated from within the hull behind the bulkhead in Main II. It was excavated from among coils of rope and casks.

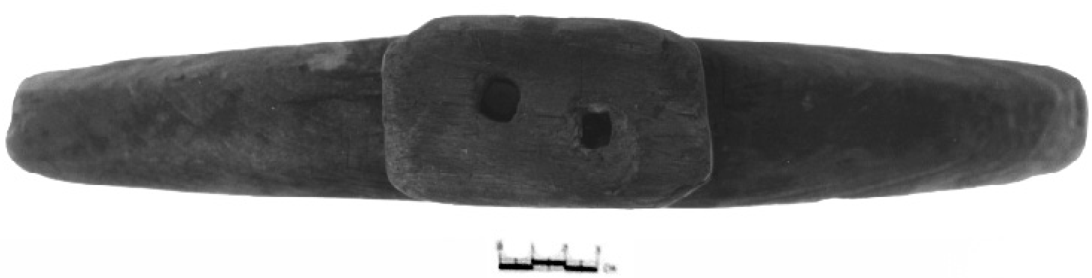
10526

Cleat

Artifact # 10526



10526



10526

Cleat

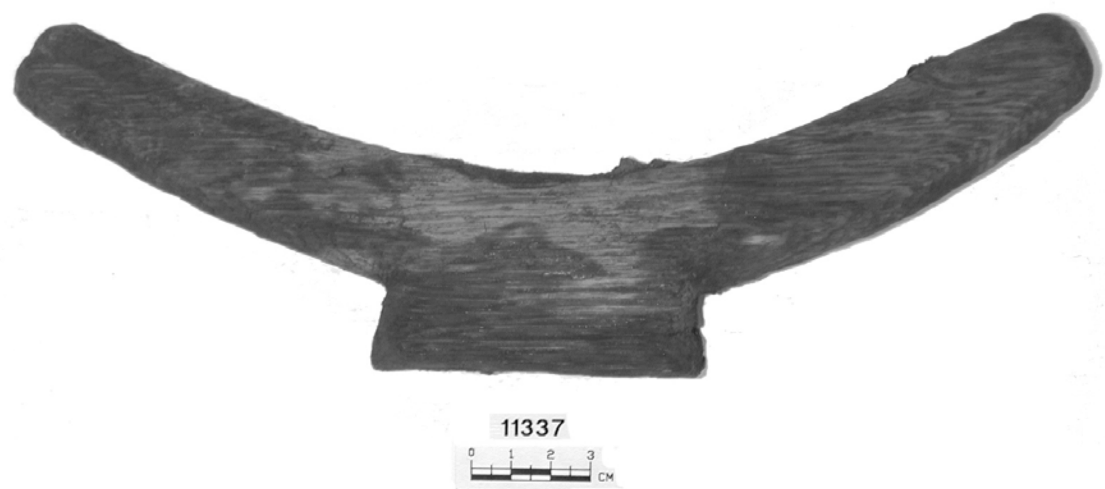
Artifact #	SubType	Material	Provenience
11337		Wood	y2019 x2009

Measurements

Length	27.0 cm
Width	6.5 cm
Thickness	3.7 cm

Comments

This cleat is in good condition. The two nail holes in its center are round in cross section. The arms are beveled along the edges, so are octagonal in cross section.



Cleat

Artifact # 11337

Fairlead

Artifact #	SubType	Material	Provenience
5519		Wood	y2016 x2010

Measurements

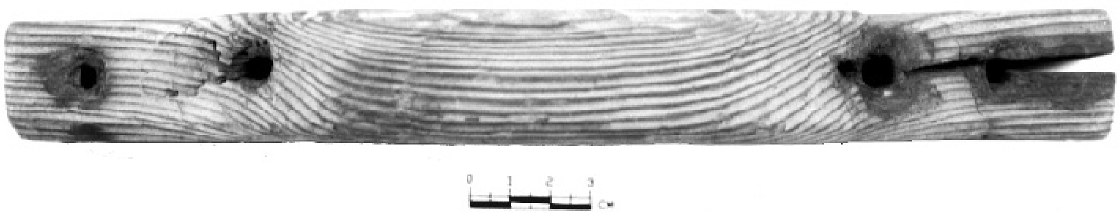
Length	26.2 cm
Width	7.0 cm
Thickness	3.0 cm
Hole	3.6 cm

Comments

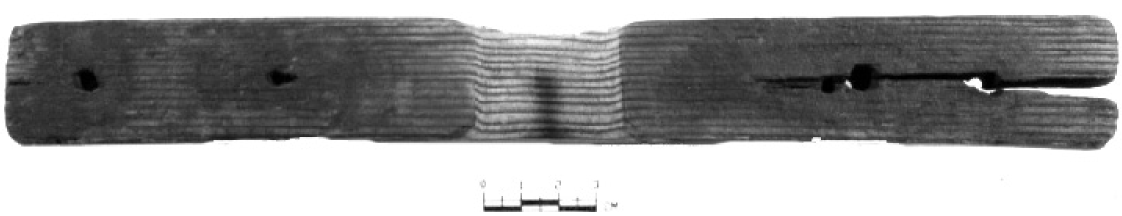
This fairlead has two nail holes through the ends of each arm; there is a fifth shallow hole on the upper surface next to a nail hole. The holes are square in cross-section. One arm is split between its nail holes. There are signs of rope wear in the lead.

Fairlead

Artifact # 5519



5519



5519

Truck

Artifact #	SubType	Material	Provenience
3324	Parral	Wood	y2021 x2009

Measurements

Length	6.8 cm
Diameter	7.3 cm
Hole	3.5 cm

Comments

This parral truck is in good condition. It is circumscribed by an incised line that is approximately centered on the body, 3.2 cm and 3.6 cm from each end.

Truck

Artifact # 3324

Truck

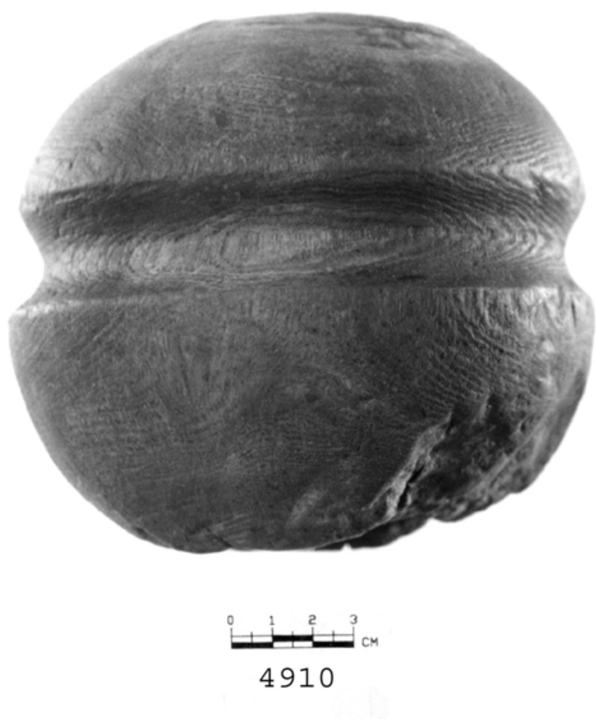
Artifact #	SubType	Material	Provenience
4910	Fairlead	Wood	y2019 x2010

Measurements

Length	7.8 cm
Score Width	4.7 cm
Diameter	8.3 cm
Groove	1.5 cm
Hole	2.8 cm

Comments

This fairlead parral is in very good condition. The length was measured between the holes. The body is scored around its middle except where it meets the vertical groove.



Truck

Artifact # 4910

Truck

Artifact #	SubType	Material	Provenience
5152	Parral	Wood	y2020 x2010

Measurements

Length	7.4 cm
Diameter	7.6 cm
Hole	3.3 cm

Comments

This parral truck is in very good condition. It has a circumscribed line around its center.

5152

Truck

Artifact # 5152

Truck

Artifact #	SubType	Material	Provenience
11353	Parral	Wood	y2019 x2011

Measurements

Length	5.6 cm
Diameter	6.3 cm
Hole	3.0 cm

Comments

This is a standard parrel truck. It is circumscribed around its middle. It is in very good condition.

Crosstree

Artifact #	SubType	Material	Provenience
6013		Oak, white oak group (Quercus)	y2020 x2008

Measurements

Length	40.0 cm
Width	10.3 cm
Thickness	5.0 cm
Hole	2.8 cm

Comments

This composite artifact consists of the wood crosstree through which extended an iron topmast deadeye strap that became an eyebolt on the bottom side that functioned as a futtock strap. The eyebolt did not survive conservation, but the deadeye strap is recorded under the same artifact number in the iron section of the catalogue. The end of the crosstree, at the point where the iron extends through it, is stained black from iron corrosion product. Half of another fastener hole is present at the opposite end of the crosstree. At least five small nail holes have been identified on the extreme end of the crosstree within the black iron stain. These small nail holes are square in cross-section and are all approximately 0.36 cm square. The holes vary in depth from 0.87 cm to 1.45 cm.

Crosstree

Artifact # 6013

Crosstree

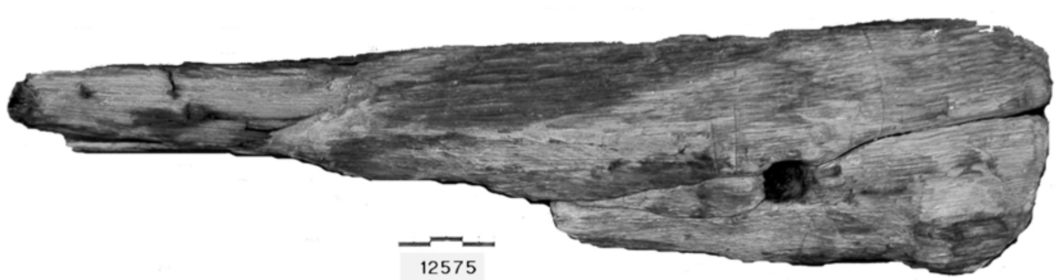
Artifact #	SubType	Material	Provenience
12575		Wood	y2011.1 x2008

Measurements

Length	32.0 cm
Width	8.3 cm
Thickness	4.0 cm

Comments

This partial crosstree is in poor condition and slightly distorted. The hole for the futtock strap is visible through its end, which is split. No other nail holes are now apparent. Black stain remains on portions of its surface.



Sheave

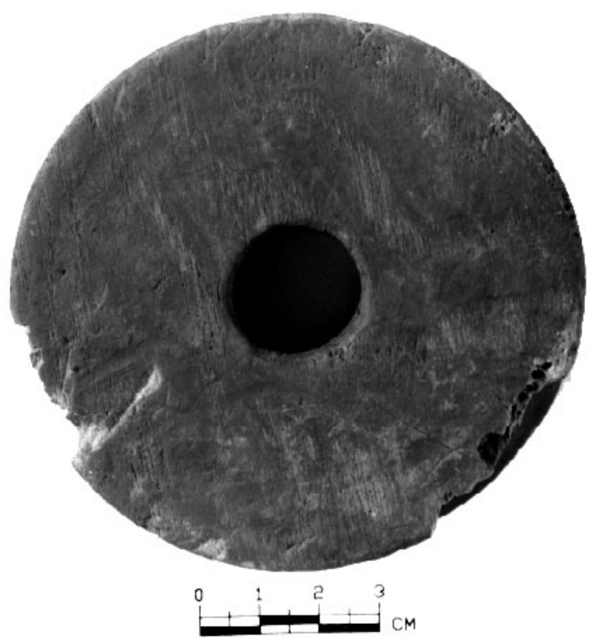
Artifact #	SubType	Material	Provenience
670		Wood	no provenience

Measurements

Pin Diameter	2.55 cm
Sheave Diameter	8.31 cm
Sheave Thickness	2.52 cm

Comments

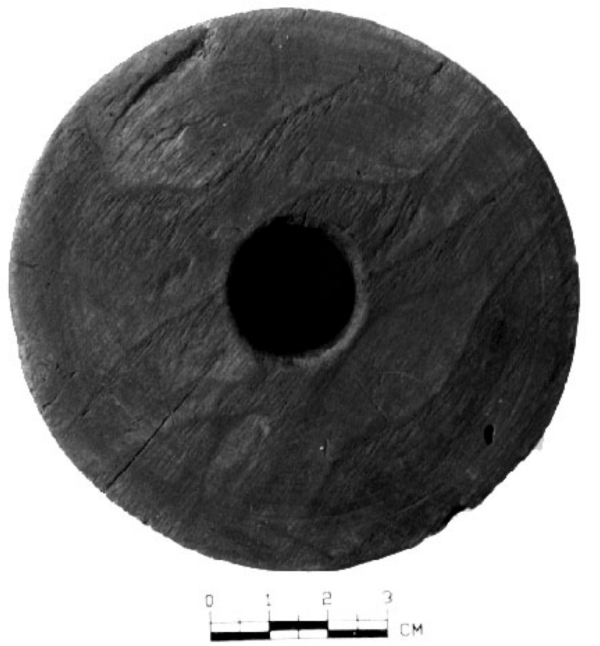
This sheave is of standard construction. Its surface shows some concentric scoring.



670

Sheave

Artifact # 670



670

Sheave

Artifact #	SubType	Material	Provenience
5837		Wood	y2007 x2011

Measurements

Thickness	2.8 cm
Pin Diameter	4.6 cm
Diameter	21.0 cm

Comments

This sheave is of standard construction, and is in fair condition.

5837

Deadeye Strap

Artifact #	SubType	Material	Provenience
1184	Lower	Iron	y2014 x2014

Measurements

Length	26.4 cm
Thickness	2.1 cm
Diameter	12.0 cm
External Diameter	16.7 cm

Comments

This deadeye strap was cast from its concretion. The epoxy cast revealed a deadeye strap of standard construction. The bottom portion of the loop has not been preserved. It was recovered from outside the hull on the starboard side at midships. It probably belonged to the mainmast's starboard side shrouds.

Deadeye Strap

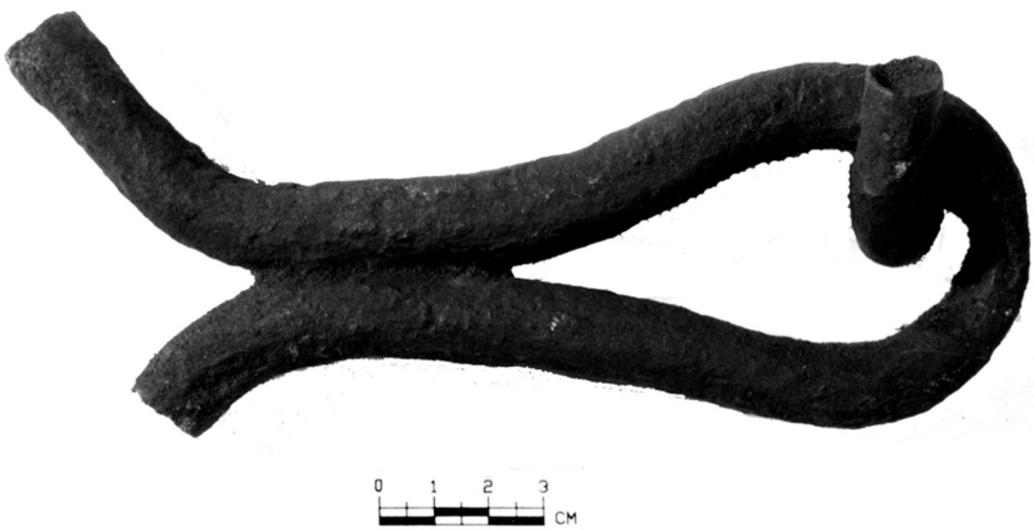
Artifact #	SubType	Material	Provenience
1209	Lower	Iron	y2013.0 x2016.4 z-5.07

Measurements

Length	18.0 cm
Thickness	1.6 cm
Diameter of foot	6.6 cm

Comments

This deadeye strap was cast from its concretion. The epoxy cast has revealed only the bottom loop of a deadeye strap, which is round in cross-section unlike the other deadeye straps, which were square in cross section. It was found outside the hull on the starboard side near midships.



1209

Deadeye Strap

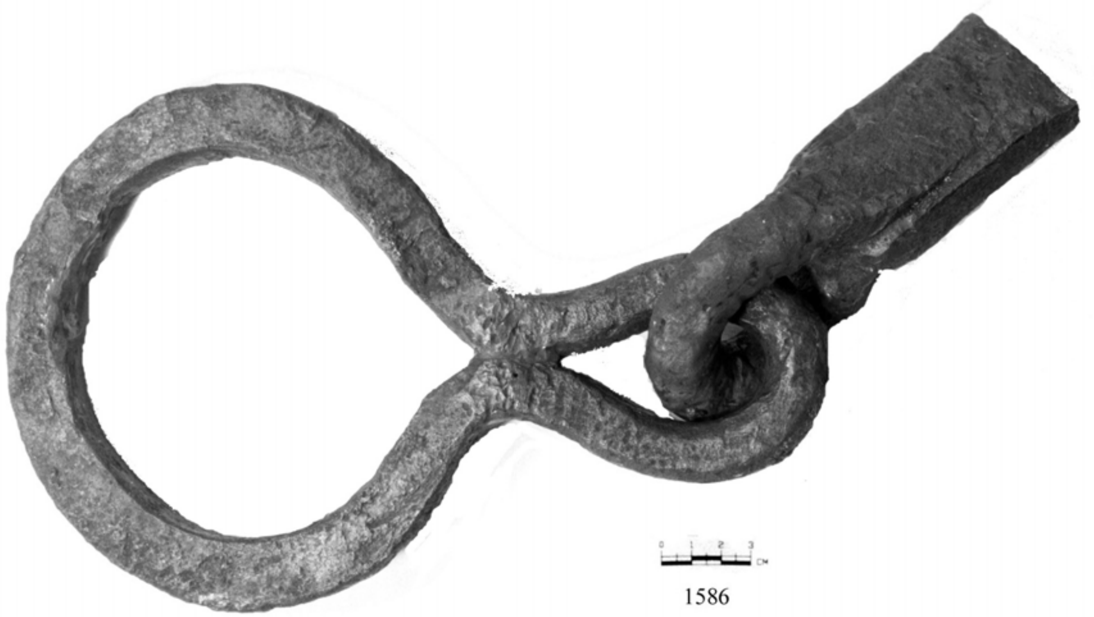
Artifact #	SubType	Material	Provenience
1586	Lower	Iron	y2023.2 x2012.9 z-5.29

Measurements

Length	26.6 cm
Thickness	2.5 cm
Diameter	13.0 cm
External Diameter	17.5 cm
Diameter of foot	7.3 cm
Chainplate Diameter	7.3 cm

Comments

This deadeye strap was cast from its concretion. The epoxy cast has revealed a complete strap of standard construction with the top portion of a chainplate. It was located on the starboard side of the ship near and slightly foreward of the bow. It probably belonged to the foremast's starboard side shrouds.



1586

Deadeye Strap

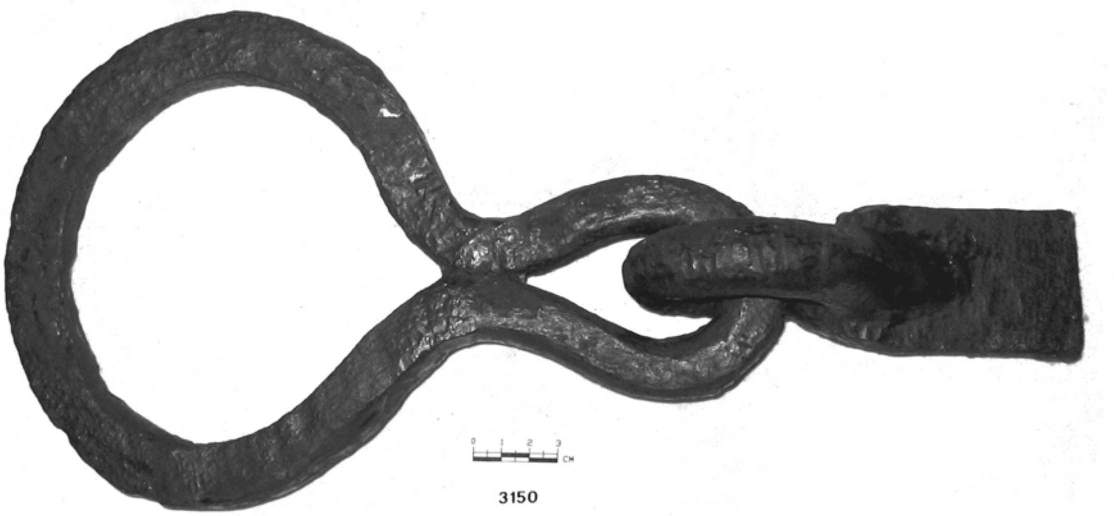
Artifact #	SubType	Material	Provenience
3150	Lower	Iron	y2013 x2012

Measurements

Length	29.8 cm
Thickness	2.5 cm
Diameter	12.0 cm
External Diameter	16.8 cm
Diameter of foot	8.1 cm

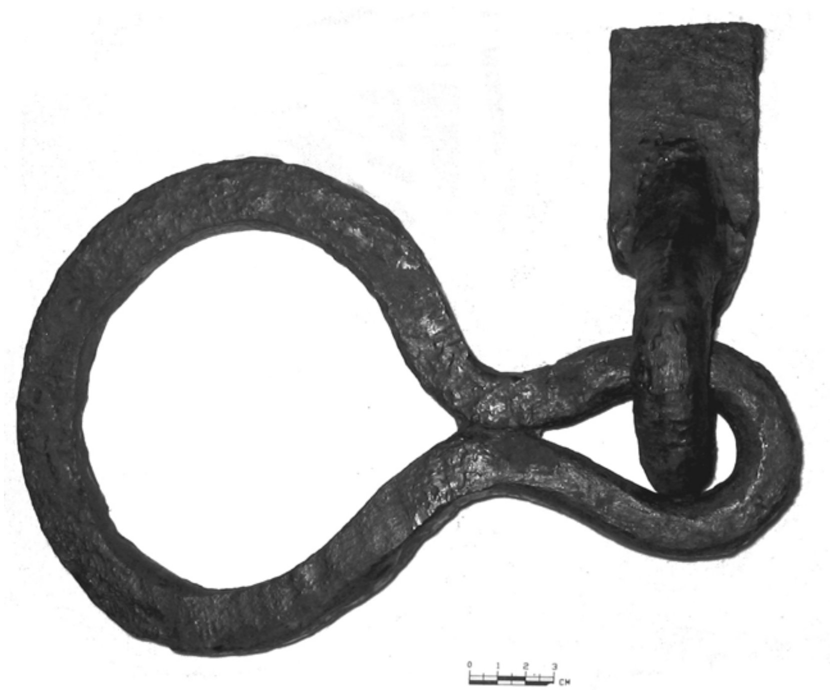
Comments

This deadeye strap was cast from its concretion. The epoxy cast revealed a complete deadeye strap of standard construction with a portion of the chainplate. It was recovered from the starboard side of the ship at midships. It probably belonged to the mainmast's starboard side shrouds.



Deadeye Strap

Artifact # 3150



3150

Deadeye Strap

Artifact #	SubType	Material	Provenience
3275	Lower	Iron	y2011 x2012

Measurements

Length

Thickness

Diameter

External Diameter

Diameter of foot

Comments

This deadeye strap and chainplate were located on the starboard side of the ship near the bow, and probably belonged to the foremast's starboard side shrouds. The chainplate is recorded separately under that category of the catalogue.

Deadeye Strap

Artifact #	SubType	Material	Provenience
3393	Topmast	Iron	y2019 x2006

Measurements

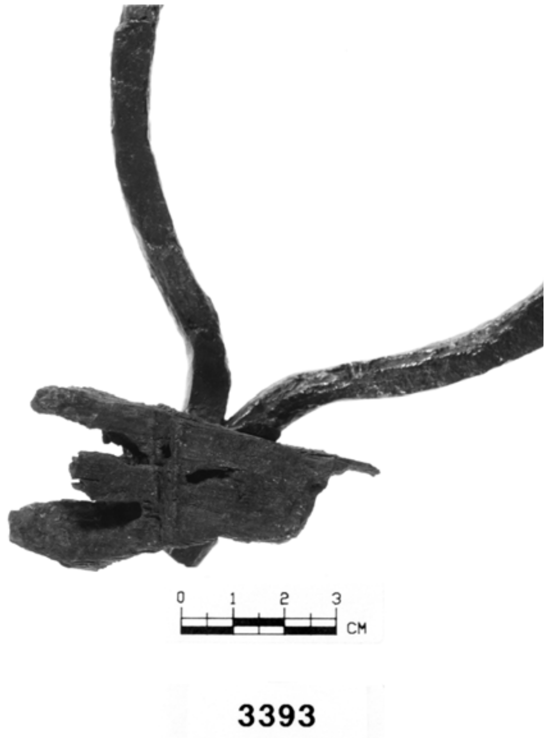
Length	15.1 cm
Thickness	1.5 cm
Diameter	9.2 cm
External Diameter	10.9 cm

Comments

This topmast deadeye strap was cast from its concretion. The preserved portion is of standard construction. Wood has been preserved surrounding its neck, but the foot below was not preserved. The seam in the head is the thickest part of the head, and best indicator of its original size. Two small nail holes have been preserved in the wood. Both are square in cross-section (0.3 - 0.4 cm), and run vertically into the wood. This strap was found outside the hull on the port side of the bow.

Deadeye Strap

Artifact # 3393



Deadeye Strap

Artifact #	SubType	Material	Provenience
3419.023	Topmast	Iron	y2015 x2010

Measurements

Length	na
Thickness	1.5 cm
Diameter	na
External Diameter	10.2 cm

Comments

This topmast artifact was found in association with deadeye 3419.78, which is recorded separately under that number. The preserved portion is of standard construction. It was impossible to measure the internal diameter because of the deadeye. This strap was found inside cask 3419 inside Main I in the hull of the ship.

Deadeye Strap

Artifact # 3419.023

Deadeye Strap

Artifact #	SubType	Material	Provenience
4287	Lower	Iron	y2020 x2007

Measurements

Length	21.0 cm
Thickness	2.2 cm
Diameter	11.8 cm
External Diameter	16.0 cm

Comments

This deadeye strap was cast from its concretion. Only the head of this deadeye strap was preserved. The preserved portions are of standard construction. It was recovered from outside the port side of the ship near the bow, and probably belonged to the foremast's port side shrouds.

Deadeye Strap

Artifact #	SubType	Material	Provenience
6013	Topmast	Iron	y2020 x2008

Measurements

Length

Thickness

Diameter

External Diameter

Comments

This composite artifact consists of the wood crosstree through which extended an iron topmast deadeye strap and an eyebolt that functioned as a futtock strap. The eyebolt did not survive conservation, and the crosstree is recorded under the same artifact number in the wood section of the catalogue. This artifact is of standard construction, but is the lone example from this collection of the combined topmast deadeye strap and futtock plate in the form of an eyebolt.

Deadeye Strap

Artifact #	SubType	Material	Provenience
12576	Topmast	Iron	y2021 x2012

Measurements

Length	22.0 cm
Thickness	1.6 cm
Diameter	na
External Diameter	15.4 cm

Comments

This topmast deadeye strap was cast from its concretion. The top portion of the head did not survive, but the remaining portions are of standard construction. This strap was found outside the ship on the starboard side of the bow.

Chainplate

Artifact #	SubType	Material	Provenience
3275		Iron	y2011 x2012

Measurements

Length

Diameter

Comments

This deadeye strap and chainplate were located on the starboard side of the ship near the bow, and probably belonged to the foremast's starboard side shrouds. The deadeye strap is recorded separately under that category of the catalogue.

Chainplate

Artifact #	SubType	Material	Provenience
3468		Iron	y2013 x2010

Measurements

Length	49.5 cm
Thickness	2.8 cm
Bolt Head	6.5 cm
Plate Width	7.0 cm
Plate Thickness	1.2 cm

Comments

This is a substantial bolt with a portion of the flat iron plate it once secured still attached. This has been interpreted as a bolt from a chainplate and a small preserved portion of the chainplate itself. It was recovered from inside the ship in Main II. It was apparently not in use at the time of the wreck, but was stored with coils of rope and other supplies.

Futtock Plate

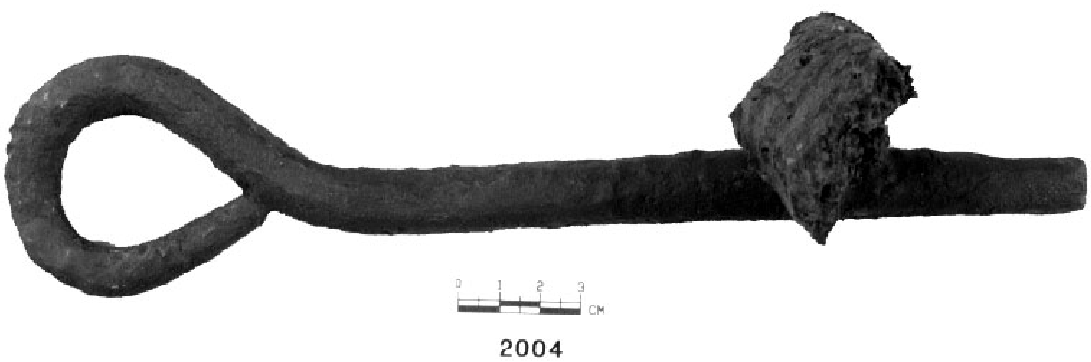
Artifact #	SubType	Material	Provenience
2004		Iron	y2020 x2012

Measurements

Length	27.0 cm
Thickness	1.4 cm
Diameter	6.1 cm

Comments

This futtock plate was cast from its concretion and was of standard construction. The lower portion of the shank is surrounded by wood that has two small nail holes. These nail holes are square in cross-section (0.26 square cm, and 0.34 square cm).



Futtock Plate

Artifact #	SubType	Material	Provenience
4146		Iron	y2020 x2006

Measurements

Length	34.0 cm
Thickness	5.9 cm
Diameter	13.3 cm

Comments

This futtock strap is in poor condition, although the iron was conserved. It is of standard construction.

Ringbolt

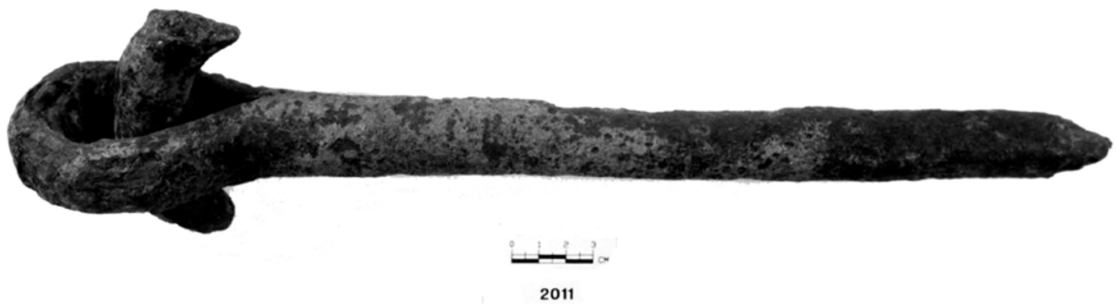
Artifact #	SubType	Material	Provenience
2011		Iron	y2020 x2012

Measurements

Length	41.5 cm
Thickness	2.8 cm
Diameter	8.0 cm

Comments

The ring from this ringbolt was only partially preserved. As well, the eye of the eyebolt was damaged during conservation due to being extremely corroded, and is now only 6.9 cm in diameter. The measurements recorded here represent pre-conservation dimensions.



Ringbolt

Artifact #	SubType	Material	Provenience
2030	with Thimble and wood	Iron	y2009 x2007

Measurements

Thickness	1.3 cm
Diameter	4.0 cm
Ring Diameter	9.0 cm
Thimble Diameter	2.5 cm
Thimble Height	2.3 cm
Ring Thickness	

Comments

This ringbolt was cast from its concretion. The small eyebolt is square in cross-section and emerges from a portion of conserved wood. A seam is visible where the two sides meet. A thimble encircles the ring. It is the only surviving representation of a thimble from La Belle.

Ringbolt

Artifact #	SubType	Material	Provenience
2070		Iron	y2009 x2008

Measurements

Length	7.7 cm
Thickness	1.4 cm
Diameter	4.3 cm
Ring Diameter	1.3 cm
Ring Thickness	na

Comments

This ringbolt was cast from its concretion. The eyebolt emerges from a portion of preserved wood, which has a small, square nail hole (0.4 square cm). There is a visible seam where the two sides of the eyebolt join. The joint in the ring is visible and slightly thicker than the rest of the ring (1.5 cm).

2070

Ringbolt

Artifact # 2070

Ringbolt

Artifact #	SubType	Material	Provenience
3124		Iron	y2019 x2009

Measurements

Thickness	1.3 cm
Diameter	9.6 cm
Small Ring Diameter	4.0 cm
Small Ring Thickness	0.9 cm

Comments

This ringbolt was cast from its concretion. This artifact is a large ring around which a smaller ring is attached; the smaller ring was most likely the eye of an eyebolt.

Ringbolt

Artifact #	SubType	Material	Provenience
3184		Iron	y2013 x2012

Measurements

Length	29.7 cm
Thickness	3.5 cm
Diameter	8.0 cm
Ring Diameter	14.9 cm
Ring Thickness	2.5 cm

Comments

This ringbolt was cast from its concretion. Both the ring and the eyebolt are round in cross-section.

3184

Ringbolt

Artifact #	SubType	Material	Provenience
3419.004		Iron	y2015 x2010

Measurements

Length	24.1 cm
Thickness	2.7 cm
Diameter	7.6 cm
Ring Diameter	13.2 cm
Ring Thickness	2.4 cm

Comments

This ringbolt consists of artifact 3419.4, the ring, and 3419.59, the eyebolt. The iron from this ringbolt has been conserved. Both ring and eyebolt are round in cross-section. The bottom tip of the eyebolt has not survived.

Ringbolt

Artifact #	SubType	Material	Provenience
3419.016		Iron	y2015 x2010

Measurements

Length	30.0 cm
Thickness	2.6 cm
Diameter	7.4 cm
Ring Diameter	13.9 cm
Ring Thickness	2.6 cm

Comments

This ringbolt consists of artifact 3419.16, the ring, and artifact 3419.41, the eyebolt. The iron has been conserved, but the tip did not survive.

Ringbolt

Artifact #	SubType	Material	Provenience
3419.031		Iron	y2015 x2010

Measurements

Length	11.2 cm
Thickness	1.7 cm
Diameter	5.3 cm
Ring Diameter	9.6 cm
Ring Thickness	1.7 cm

Comments

This ringbolt consists of artifact 3419.31, the ring, and artifact 3419.96, the eyebolt. The iron from this artifact has been conserved. The tip of the eyebolt did not survive. Both ring and eyebolt are round in cross-section.

Ringbolt

Artifact #	SubType	Material	Provenience
5132		Iron	y2016 x2010

Measurements

Length	17.0 cm
Thickness	4.1 cm
Ring Diameter	15.9 cm
Ring Thickness	2.5 cm

Comments

This eyebolt was cast from its concretion. It is set into wood out of which emerges a bolt head.

Ringbolt

Artifact #	SubType	Material	Provenience
13030	with Washer and Forelock	Iron	y2009 x2008

Measurements

Length	28.6 cm
Thickness	2.6 cm
Ring Diameter	12.6 cm
Ring Thickness	2.2 cm

Comments

The iron from this artifact has been conserved. The base of the eyebolt is encircled by a forelock key, which supports a round washer. Both ring and eyebolt are rounded in cross-section.

Ringbolt

Artifact # 13030

Ring

Artifact #	SubType	Material	Provenience
2296.2		Iron	y2006 x2009

Measurements

Thickness	2.4 cm
Diameter	13.7 cm

Comments

This ring was most likely part of a ringbolt. It is round in cross-section.

2296.2

Ring

Artifact #	SubType	Material	Provenience
3177		Iron	y2014 x2012

Measurements

Thickness	1.2 cm
Diameter	8.6 cm

Comments

This ring is very nearly round, and was presumably part of a ring bolt. It is round in cross-section.

3177

Ring

Artifact #	SubType	Material	Provenience
3475.2		Iron	y2013 x2009

Measurements

Thickness	1.2 cm
Diameter	9.8 cm

Comments

The iron from this artifact was preserved but was in poor condition, so the original surface has not survived.

Ring

Artifact #	SubType	Material	Provenience
3748		Iron	y2011 x2013

Measurements

Thickness	1.5 cm
Diameter	13.7 cm

Comments

This partial ring was cast from its concretion, which was associated with a nail. The ring was most likely part of a ringbolt, the eyebolt of which no longer exists.

Hook

Artifact #	SubType	Material	Provenience
6501	with Rove and Forelock	Iron	y2009 x2008

Measurements

Length	33.7 cm
Thickness	2.5 cm
Washer Diameter	5.0 cm
Washer Thickness	0.8 cm
Forelock Width	2.5 cm

Comments

The iron from this artifact has been conserved. The bottom of the hook has a washer over the top of a forelock, which extends around the shank. There is a small extension on the shank opposite the hook with a flat horizontal surface.

Cable

Artifact #	SubType	Material	Provenience
1589	Cable-Laid	Rope	no provenience

Measurements

Length	25.0 cm
Cable Diameter	5.6 cm
Rope Diameter	2.5 cm
Strand Diameter	1.2 cm

Comments

Two sizes of hawser and a length of cable were excavated under this artifact number. These measurements represent the cable.

Artifact #	SubType	Material	Provenience
4909	Cable-Laid	Rope	x2009 y2020

Measurements

Length	24.4 m
Cable Diameter	6.3 cm
Rope Diameter	
Strand Diameter	

Comments

This cable was found in a large coil in the bow of the ship. The nearly complete skeletal remains of a man were found on top of this bow rope. These measurements only represent the cable among this bow rope.

Shroud-Laid

Artifact #	SubType	Material	Provenience
2266.2		Rope	x 2013 y2014

Comments

2266.2 represents two portions of shroud-laid rope. The strands of the rope are wrapped around individual rope yarns that extend through the length of the rope.

Artifact #	SubType	Material	Provenience
2725.4		Rope	x2007 y2010

Measurements

Length	12.0 cm
Rope Diameter	2.90 cm
Strand Diameter	1.45 cm

Comments

2725.4 represents a portion of hawser and shroud-laid rope. These measurements are from the shroud-laid rope.

Artifact #	SubType	Material	Provenience
3147	Bolt Rope	Rope	x2012 y2011

Measurements

Length	24.8 cm; 19.5 cm; 13.3 cm; 9.0 cm
Rope Diameter	3.00 cm
Strand Diameter	1.10 cm

Comments

These measurements represent four lengths of shroud-laid rope, two of which were served, and one of these had sail cloth still attached. Two lengths do not show signs of serving or sail cloth, but were likely part of the same length of rope.

Shroud-Laid

Artifact #	SubType	Material	Provenience
3162		Rope	x2012 y2011

Measurements

Length	19.0 cm; 23.0 cm
Rope Diameter	3.00 cm
Strand Diameter	1.60 cm

Artifact #	SubType	Material	Provenience
3392	Lower Shroud	Rope	x2007 y 2011

Measurements

Length	55.3 cm
Rope Diameter	2.79 cm
Strand Diameter	1.00 cm
Lanyard Diameter	0.60 cm

Comments

Artifact number 3392 represents two lengths of shroud-laid rope that are served and connected to each other at each end by lanyards. The diameter where the serving remains is thicker (3.52 cm). This was the seizing on top of a deadeye that was set into a lower shroud.

Artifact #	SubType	Material	Provenience
12995		Rope	y2022 x2009

Measurements

Length	7.5 cm
Rope Diameter	2.8 cm
Strand Diameter	1.1 cm

Comments

Two sizes of hawser and a strand of shroud-laid rope were associated with the block recorded under the same number. The shroud laid rope's measurements are recorded here.

Shroud-Laid

Artifact #	SubType	Material	Provenience
13277	Lower Shroud	Rope	y2009 x2009

Measurements

Rope Diameter	3.1 cm
Strand Diameter	1.1 cm

Comments

This shroud laid rope was found still set around the remaining portions of a deadeye. This shroud-laid rope has a wick of rope yarn in its center.

Artifact #	SubType	Material	Provenience
13287		Rope	x2010 y2010

Measurements

Length	11.35 cm
Rope Diameter	5.0 cm
Strand Diameter	1.85 cm

Hawser

Artifact #	SubType	Material	Provenience
689		Rope	no provenience

Measurements

Length	5.65 cm
Rope Diameter	1.48 cm
Strand Diameter	0.80 cm

Artifact #	SubType	Material	Provenience
693		Rope	no provenience

Measurements

Length	8.64 cm
Rope Diameter	1.51 cm
Strand Diameter	0.84 cm

Artifact #	SubType	Material	Provenience
1220		Rope	x2005.6 y2010.9 z-5.35

Measurements

Length	5.80 - 20.30 cm
Rope Diameter	1.60 - 1.85 cm
Strand Diameter	0.75 - 0.90 cm

Comments

1220 represents nine separate hawser fragments probably from the same rope considering the dimensions. These measurements represent the range of dimensions from all nine fragments.

Hawser

Artifact #	SubType	Material	Provenience
1315	Served	Rope	x2010 y2021

Measurements

Length	4.6 cm
Rope Diameter	1.7 cm

Comments

This is the served tip of braided rope, most likely part of a splice.

Artifact #	SubType	Material	Provenience
1589		Rope	no provenience

Measurements

Length	6.6 - 24.3 cm
Rope Diameter	1.5 - 2.0 cm
Strand Diameter	0.9 cm

Comments

Two sizes of hawser and a length of cable were excavated under this artifact number. These measurements reflect the 13 portions of hawser that share roughly the same diameter.

Artifact #	SubType	Material	Provenience
1589		Rope	no provenience

Measurements

Length	11.6 cm
Rope Diameter	2.7 cm
Strand Diameter	1.3 cm

Comments

Two sizes of hawser and a length of cable were excavated under this artifact number. These measurements reflect the large hawser.

Hawser

Artifact #	SubType	Material	Provenience
1592	Bolt Rope	Rope	x2012.6 y2016.5 z-5.20

Measurements

Length	11.6 cm
Rope Diameter	2.0 cm
Strand Diameter	1.0 cm

Comments

Two sizes of hawser and one length of bolt rope were excavated under this artifact number. These measurements represent the bolt rope, which had sail cloth attached. This rope was excavated in association with a block recorded under the same number.

Artifact #	SubType	Material	Provenience
1592		Rope	x2012.6 y2016.5 z-5.20

Measurements

Length	5.6 - 9.4 cm
Rope Diameter	1.7 cm
Strand Diameter	0.9 cm

Comments

Two sizes of hawser and one length of bolt rope were excavated under this artifact number. These measurements represent six pieces of hawser of the same diameter. This rope was also excavated in association with a block recorded under the same artifact number.

Artifact #	SubType	Material	Provenience
1592		Rope	x2012.6 y2016.5 z-5.20

Measurements

Length	3.9 - 11.9 cm
Rope Diameter	2.4 cm
Strand Diameter	1.2 cm

Comments

Two sizes of hawser and one length of bolt rope were excavated under this artifact number. These measurements represent four pieces of hawser of the same diameter. This rope was also excavated in association with a block recorded under the same artifact number.

Hawser

Artifact #	SubType	Material	Provenience
1598.1		Rope	x2013 y2012 z-5.144

Measurements

Length	16.82 m
Rope Diameter	1.71 cm
Strand Diameter	0.91 cm

Artifact #	SubType	Material	Provenience
1598.4		Rope	x2013 y2012 z-5.144

Measurements

Length	28.60 cm
Rope Diameter	2.10 cm

Artifact #	SubType	Material	Provenience
1598.5		Rope	x2013 y2012 z-5.144

Measurements

Length	7.00 - 39.10 cm
Rope Diameter	1.50 cm
Strand Diameter	1.20 cm

Comments

1598.5 represents 12 pieces of hawser. The measurements reflect their range in length. They were all once part of the same rope.

Hawser

Artifact #	SubType	Material	Provenience
1630		Rope	x2014.5 y2020.8 z -5.10

Measurements

Length	10.40 cm
Rope Diameter	1.68 cm
Strand Diameter	0.78 cm

Comments

This rope is a small portion of a hawser and two strands. The measurements reflect pre-conservation dimensions as the rope survived conservation only as strands.

Artifact #	SubType	Material	Provenience
1681		Rope	x2014.5 y2014.2 z-5.15

Measurements

Length	6.50 - 10.00 cm
Rope Diameter	1.20 - 1.50 cm
Strand Diameter	0.77 - 0.90 cm

Comments

1681 represents three portions of a hawser. The measurements represent the range of lengths; they are apparently from the same rope.

Artifact #	SubType	Material	Provenience
2002	Bolt Rope	Rope	x2013.5 y2016 z-5.286

Measurements

Length	33.9 cm
Rope Diameter	3.5 cm
Strand Diameter	1.2 cm

Comments

Sail cloth is served to this hawser.

Hawser

Artifact #	SubType	Material	Provenience
2024	Served	Rope	x2013 y2015

Measurements

Length	16.5 - 18.5 cm
Rope Diameter	1.80 - 2.20 cm
Strand Diameter	1.10 cm

Comments

2024 is comprised of two individual hawsers, one of which was partially served.

Artifact #	SubType	Material	Provenience
2069.3		Rope	x2012 y2019

Measurements

Length	3.0 -8.0 cm
Rope Diameter	1.0 cm
Strand Diameter	0.60 - 0.80 cm

Comments

Sub Lot 3 is comprised of 10 portions of hawser of two different diameters. All have iron corrosion product. These measurements include the range from the smaller hawser.

Artifact #	SubType	Material	Provenience
2069.3		Rope	x2012 y2019

Measurements

Length	4.50 - 7.00 cm
Rope Diameter	2.00 cm
Strand Diameter	1.00 cm

Comments

Sub Lot 3 is comprised of 10 portions of hawser of two different diameters. All have iron corrosion product. These measurements include the range from the larger hawser.

Hawser

Artifact #	SubType	Material	Provenience
2069.E		Rope	x2012 y2019

Measurements

Length	12.36 cm
Rope Diameter	1.92 cm
Strand Diameter	0.97 cm

Artifact #	SubType	Material	Provenience
2069.G		Rope	x2012 y2019

Measurements

Length	7.94 cm
Rope Diameter	1.42 cm
Strand Diameter	0.60 cm

Artifact #	SubType	Material	Provenience
2069.H		Rope	x2012 y2019

Measurements

Length	14.68 cm
Rope Diameter	2.00 cm
Strand Diameter	1.00 cm

Hawser

Artifact #	SubType	Material	Provenience
2069.I	Spliced	Rope	x2012 y2019

Measurements

Length	14.82 cm
Rope Diameter	2.83 cm
Strand Diameter	0.96 cm

Comments

A small portion of a fourth strand, approximately two centimeters long, has been inserted among the strands. This could be the remnants of a fourth strand (meaning this was from a shroud-laid rope), or a repair, but was most likely part of a splice.

Artifact #	SubType	Material	Provenience
2072	Bolt Rope	Rope	x2014 y2014.8 z-5.208

Measurements

Length	24.0 cm
Rope Diameter	3.5 cm
Strand Diameter	1.2 cm

Comments

Sail cloth is served to this hawser.

Artifact #	SubType	Material	Provenience
2266.1		Rope	x2013 y2014

Measurements

Length	16.0 cm
Rope Diameter	2.01 cm
Strand Diameter	1.20 cm

Hawser

Artifact #	SubType	Material	Provenience
2330		Rope	x2004 y2005

Measurements

Length	5.65 cm
Rope Diameter	1.90 cm
Strand Diameter	0.95 cm

Artifact #	SubType	Material	Provenience
2725.1		Rope	x2007 y2010

Measurements

Length	9.0 cm
Rope Diameter	1.60 cm
Strand Diameter	0.90 cm

Artifact #	SubType	Material	Provenience
2725.2		Rope	x2007 y2010

Measurements

Length	10.0 - 16.20 cm
Rope Diameter	2.20 cm
Strand Diameter	1.12 cm

Comments

2725.2 represents two hawsers of the same diameter.

Hawser

Artifact #	SubType	Material	Provenience
2725.3		Rope	x2007 y2010

Measurements

Length	23.00 cm
Rope Diameter	2.65 cm
Strand Diameter	1.10 cm

Artifact #	SubType	Material	Provenience
2725.4		Rope	x2007 y2010

Measurements

Length	10.5 cm
Rope Diameter	2.45 cm
Strand Diameter	1.30 cm

Comments

2725.4 represents a portion of hawser and a portion of shroud-laid rope. These measurements are from the hawser.

Artifact #	SubType	Material	Provenience
2725.5		Rope	x2007 y2010

Measurements

Length	19.0 cm
Rope Diameter	2.60 cm
Strand Diameter	1.25 cm

Hawser

Artifact #	SubType	Material	Provenience
2725.6		Rope	x2007 y2010

Measurements

Length	28.0 cm
Rope Diameter	2.23 cm
Strand Diameter	1.23 cm

Artifact #	SubType	Material	Provenience
2878		Rope	x2011 y2020

Measurements

Length	11.0 - 23.5 cm
Rope Diameter	2.40 cm
Strand Diameter	1.20 cm

Artifact #	SubType	Material	Provenience
2958.2		Rope	x2009 y2005

Measurements

Length	10.5 - 24.5 cm
Rope Diameter	1.25 - 1.9 cm
Strand Diameter	0.70 - 0.80 cm

Comments

2958.2 represents the smaller of two sizes of hawser excavated under this number.

Hawser

Artifact #	SubType	Material	Provenience
2958.2		Rope	x2009 y2005

Measurements

Length	7.70 - 13.85 cm
Rope Diameter	2.65 cm
Strand Diameter	1.4 cm

Comments

2958.2 represents the larger of two sizes of hawser excavated under this number.

Artifact #	SubType	Material	Provenience
3100	Sheet	Rope	x2012 y2013

Comments

Associated with block 3100, and grommets, and sail cloth.

Artifact #	SubType	Material	Provenience
3101.1	Spliced	Rope	x2012 y2013

Measurements

Length	33.00 cm
Rope Diameter	1.70 cm
Strand Diameter	1.0 cm

Comments

This portion of hawser has an eyesplice through which lanyards are tied (six strands). The lanyards are 0.5 cm in diameter, and the strands are 0.3 cm thick.

Hawser

Artifact #	SubType	Material	Provenience
3101.10		Rope	x2012 y2013

Measurements

Length	10.0 - 82.0 cm
Rope Diameter	1.50 cm
Strand Diameter	0.80 cm

Comments

These five pieces of hawser represent one strand of rope. The measurements reflect the range of length.

Artifact #	SubType	Material	Provenience
3101.11		Rope	x2012 y2013

Measurements

Length	63.00 cm
Rope Diameter	1.90 cm
Strand Diameter	1.10 cm

Artifact #	SubType	Material	Provenience
3101.12		Rope	x2012 y2013

Measurements

Length	40.00 cm; 11.3 cm
Rope Diameter	1.70 cm
Strand Diameter	0.85 cm

Comments

This hawser is in three pieces; the measurements reflect the lengths of each.

Hawser

Artifact #	SubType	Material	Provenience
3101.13	Bolt Rope	Rope	x2012 y2013

Measurements

Length	1.1 m
Rope Diameter	2.9 cm

Comments

Sail cloth is served to this hawser.

Artifact #	SubType	Material	Provenience
3101.16		Rope	x2012 y2013

Measurements

Length	22.00 cm
Rope Diameter	2.60 cm
Strand Diameter	0.70 cm

Artifact #	SubType	Material	Provenience
3101.17		Rope	x2012 y2013

Measurements

Rope Diameter	3.0 cm

Hawser

Artifact #	SubType	Material	Provenience
3101.19	Bolt Rope	Rope	x2012 y2013

Measurements

Length	99.0 cm
Rope Diameter	3.6 cm

Comments

Sail cloth is served to this hawser.

Artifact #	SubType	Material	Provenience
3101.4		Rope	x2012 y2013

Measurements

Length	32.00 cm; 26.2 cm
Rope Diameter	1.70 cm; 1.65 cm
Strand Diameter	0.75 cm; 1.00 cm

Comments

This artifact is two pieces after conservation, but represents one span of hawser that becomes braided at the end where there was an eyesplice that no longer exists. The measurements reflect each half of this hawser.

Artifact #	SubType	Material	Provenience
3101.5		Rope	x2012 y2013

Measurements

Length	46.00 cm; 18.00 cm
Rope Diameter	2.25 cm
Strand Diameter	1.32 cm

Comments

This hawser is in two pieces; the length measurement represents both lengths.

Hawser

Artifact #	SubType	Material	Provenience
3101.3.1		Rope	x2012 y2013

Measurements

Length	19.00 cm
Rope Diameter	1.90 cm

Artifact #	SubType	Material	Provenience
3101.3.3		Rope	x2012 y2013

Measurements

Length	29.00 cm
Rope Diameter	1.97 cm
Strand Diameter	1.04 cm

Artifact #	SubType	Material	Provenience
3101.3.2		Rope	x2012 y2013

Hawser

Artifact #	SubType	Material	Provenience
3101.8		Rope	x2012 y2013

Measurements

Length	15.50 cm
Rope Diameter	2.10 cm
Strand Diameter	1.10 cm

Artifact #	SubType	Material	Provenience
3101.9		Rope	x2012 y2013

Measurements

Length	56.00 cm
Rope Diameter	2.00 cm

Artifact #	SubType	Material	Provenience
3140		Rope	x2012 y2011

Measurements

Length	36.00 cm; 32.00 cm
Rope Diameter	1.8 cm; 2.2 cm
Strand Diameter	0.80 cm; 1.00 cm

Hawser

Artifact #	SubType	Material	Provenience
3147		Rope	x2012 y2011

Measurements

Length	5.1 - 6.6 cm
Rope Diameter	0.80 cm
Strand Diameter	0.60 cm

Comments

These measurements represent three lengths of hawser of the same diameter that were excavated as part of artifact number 3147.

Artifact #	SubType	Material	Provenience
3147		Rope	x2012 y2011

Measurements

Length	14.0 cm
Rope Diameter	1.40 cm
Strand Diameter	1.0 cm

Comments

These measurements represent one length of hawser of a different diameter that was excavated as part of artifact number 3147.

Artifact #	SubType	Material	Provenience
3147		Rope	x2012 y2011

Measurements

Length	19.0 cm
Rope Diameter	2.25 cm
Strand Diameter	1.20 cvm

Comments

These measurements represent one length of hawser of a different diameter that was excavated as part of artifact number 3147.

Hawser

Artifact #	SubType	Material	Provenience
3178		Rope	x2013 y2014

Measurements

Length	15.10 cm; 25.20 cm
Rope Diameter	2.20 cm
Strand Diameter	1.10 cm

Comments

This hawser is in two pieces; the measurements reflect each.

Artifact #	SubType	Material	Provenience
3182		Rope	x2013.6 y2013.1 z-5.29

Measurements

Length	15.70 cm
Rope Diameter	2.25 cm
Strand Diameter	1.00 cm
No. of Yarns	4

Artifact #	SubType	Material	Provenience
3250.2		Rope	x2013 y2013

Measurements

Length	12.10 cm
Rope Diameter	2.00 cm

Hawser

Artifact #	SubType	Material	Provenience
3395.3	Spliced	Rope	x2007 y2011

Measurements

Length	10.3 cm
Rope Diameter	1.50 cm

Comments

This length of hawser is served. One end becomes braided, and was most likely the beginning of a splice that no longer remains.

Artifact #	SubType	Material	Provenience
3432		Rope	x2011 y2005

Measurements

Length	6.30 cm
Rope Diameter	1.50 cm
Strand Diameter	0.90 cm

Comments

3432 represents one portion of hawser, one strand and individual rope yarns. The measurements are from the piece of hawser.

Artifact #	SubType	Material	Provenience
3607		Rope	x2014 y2012

Measurements

Length	9.70 cm; 8.10 cm; 13.90 cm
Rope Diameter	1.80 cm; 1.50 cm; 2.60 cm
Strand Diameter	1.10 cm; 1.00 cm; 0.80 cm

Comments

3607 is comprised of three pieces; the measurements reflect their range of dimensions.

Hawser

Artifact #	SubType	Material	Provenience
3765		Rope	x2010 y2019

Measurements

Length	65.0 cm
Cable Diameter	5.90 cm
Rope Diameter	2.50 cm

Comments

The rope was part of the bow rope.

Artifact #	SubType	Material	Provenience
3778.1	Bolt Rope	Rope	x2009 y2019

Measurements

Length	20.5 cm
Rope Diameter	3.3 cm
Strand Diameter	1.9 cm

Comments

Two sizes of hawser were excavated under artifact number 3778.1. The measurements here represent four lengths of hawser of the same diameter. Sail material is served to this hawser, although the serving did not survive conservation.

Artifact #	SubType	Material	Provenience
3778.1		Rope	x2009 y2019

Measurements

Length	10.5 cm
Rope Diameter	2.3 cm
Strand Diameter	1.3 m

Comments

Two sizes of hawser were excavated under artifact number 3778.1. The measurements here represent two lengths of hawser of the same diameter. The range of measurements reflects the slight variations in their measurements.

Hawser

Artifact #	SubType	Material	Provenience
4709		Rope	x2010 y2020

Measurements

Length	6.48 - 20.86 cm
Rope Diameter	1.18 - 1.34 cm
Strand Diameter	0.61 - 0.81 cm

Comments

This rope is in eight pieces; the measurements reflect the range into which their measurements fall, but they represent rope that was of the same diameter.

Artifact #	SubType	Material	Provenience
4788		Rope	x2009 y2021

Measurements

Length	6.25 - 10.73 cm
Rope Diameter	2.41 - 2.54 cm
Strand Diameter	1.31 - 1.61 cm

Comments

These measurements represent three of four lengths of hawser excavated under artifact number 4788. These three pieces were part of the same rope, or rope of the same diameter.

Artifact #	SubType	Material	Provenience
4788		Rope	x2009 y2021

Measurements

Length	9.5 cm
Rope Diameter	3.33 cm
Strand Diameter	1.94 cm

Comments

These measurements represent the largest of four lengths of hawser excavated under artifact number 4788. This piece was part of a different rope than the other three.

Hawser

Artifact #	SubType	Material	Provenience
4985.1		Rope	x2010 y2021

Measurements

Length	48.36 m
Rope Diameter	1.39 cm
Strand Diameter	0.66 cm

Artifact #	SubType	Material	Provenience
6037.5		Rope	x2012 y2019

Measurements

Length	5.54 cm; 12.50 cm
Rope Diameter	2.44 cm; 2.15 cm

Comments

This hawser is in two pieces; the measurements reflect each piece, with the shorter piece's measurements shown first.

Artifact #	SubType	Material	Provenience
6295	Futtock Shroud	Rope	x2010 y2020

Measurements

Length	6.00 cm
Rope Diameter	1.85 cm

Comments

This hawser is badly deteriorated. It was found connected to the eyebolt futtock plate that was part of crosstree assemblage 6013. At the end of the rope excavators noticed a knot, which would have been the splice where the futtock shroud attached to the futtock stave.

Hawser

Artifact #	SubType	Material	Provenience
6856		Rope	x2010 y2011

Measurements

Length	3.3 - 5.7 cm
Rope Diameter	1.30 cm
Strand Diameter	0.80 cm

Comments

6856 represents many disarticulated rope yarns, some strands and one piece of hawser, the measurements of which are recorded here.

Artifact #	SubType	Material	Provenience
7132		Rope	x2010 y2013

Measurements

Length	5.00 cm
Rope Diameter	1.55 cm
Strand Diameter	0.90 cm

Artifact #	SubType	Material	Provenience
7162	Served	Rope	x2008 y2021

Measurements

Length	5.48 cm
Rope Diameter	1.90 cm
Strand Diameter	1.15 cm

Comments

This piece of hawser has the remnants of serving, with which it attached the sail cloth that remains in traces.

Hawser

Artifact #	SubType	Material	Provenience
7598		Rope	x2010 y2019

Measurements

Length	11.89 cm
Rope Diameter	1.44 cm
Strand Diameter	0.85 cm

Artifact #	SubType	Material	Provenience
7650		Rope	x2010 y2011

Measurements

Length	23.20 cm
Rope Diameter	1.46 cm
Strand Diameter	0.90 cm

Comments

This hawser was excavated in association with portions of sail cloth.

Artifact #	SubType	Material	Provenience
7690		Rope	x2009 y2007

Measurements

Length	6.66 cm
Rope Diameter	1.35 cm
Strand Diameter	0.96 cm

Hawser

Artifact #	SubType	Material	Provenience
7838	Served	Rope	x2012 y2017

Measurements

Length	4.80 cm
Rope Diameter	2.61 cm

Comments

This is a small portion of served rope.

Artifact #	SubType	Material	Provenience
7940		Rope	x2010 y2007

Measurements

Length	3.92 cm
Rope Diameter	2.54 cm
Strand Diameter	1.30 cm

Artifact #	SubType	Material	Provenience
7957		Rope	x2010 y2013

Measurements

Length	11.35 cm
Rope Diameter	1.40 cm
Strand Diameter	0.70 cm

Hawser

Artifact #	SubType	Material	Provenience
10053	Parcelled	Rope	E 2010 N 2009

Measurements

Length	6.30 cm
Rope Diameter	2.10 cm
Strand Diameter	1.10 cm

Comments

This hawser is parceled on one half. In association with this are several disarticulated yarns that most likely came from this piece of rope.

Artifact #	SubType	Material	Provenience
10518		Rope	E 2009 N 2013

Measurements

Length	6.26 cm
Rope Diameter	1.65 cm
Strand Diameter	1.00 cm

Artifact #	SubType	Material	Provenience
10525		Rope	E 2011 N 2018

Measurements

Length	13.0 cm; 10.1 cm
Rope Diameter	3.1 cm; 3.0 cm
Strand Diameter	1.50 cm; 1.40 cm

Comments

This artifact number represents four lengths of hawser, one length of two-stranded rope and two pieces of damaged hawser. These measurements represent the hawser.

Hawser

Artifact #	SubType	Material	Provenience
10553		Rope	x2010 y2013

Measurements

Length	5.70 - 9.05 cm
Rope Diameter	1.50 - 1.95 cm
Strand Diameter	0.80 - 0.90 cm

Comments

This artifact number represents four pieces of hawser, one two-stranded rope, and two incomplete portions of hawser. The measurements here represent the hawser.

Artifact #	SubType	Material	Provenience
10553		Rope	x2010 y2013

Measurements

Length	8.21 cm
Rope Diameter	1.91 cm
Strand Diameter	0.85 cm

Comments

This artifact number represents four pieces of hawser, one two-stranded rope, and two incomplete portions of hawser. The measurements here represent the two-stranded rope.

Artifact #	SubType	Material	Provenience
10951		Rope	x2009 y2013

Measurements

Length	16.00 cm
Rope Diameter	1.70 cm
Strand Diameter	1.10 cm

Hawser

Artifact #	SubType	Material	Provenience
11064		Rope	x2010 y2013

Measurements

Length	12.64 - 16.52 cm
Rope Diameter	1.39 - 1.65 cm
Strand Diameter	0.72 - 0.88 cm

Comments

These three pieces of hawser are either from the same rope, or rope of the same diameter.

Artifact #	SubType	Material	Provenience
11933	Served	Rope	x2011 y2010

Measurements

Length	13.75 cm
Rope Diameter	3.47 cm
Strand Diameter	0.96 cm

Comments

This piece of hawser is partially served over a 5.31 cm length.

Artifact #	SubType	Material	Provenience
12023.2		Rope	x2010 y2016

Measurements

Length	13.00 -18.40 cm
Rope Diameter	1.11 - 1.28 cm
Strand Diameter	0.74 - 0.89 cm

Hawser

Artifact #	SubType	Material	Provenience
12025		Rope	x2011 y2014

Measurements

Length	13.00 - 18.50 cm
Rope Diameter	1.10 cm
Strand Diameter	0.55 cm
No. of Yarns	4

Comments

The measurements represent three portions of hawser that were part of the same rope, or rope of the same diameter.

Artifact #	SubType	Material	Provenience
12212		Rope	x2010.1 y2016

Measurements

Length	5.30 cm
Rope Diameter	1.70 cm

Comments

This rope was in poor condition and impregnated with ferrous oxide. It fell apart in conservation.

Artifact #	SubType	Material	Provenience
12527.3		Rope	x2012 y2019

Measurements

Length	4.0 - 8.0 cm
Rope Diameter	1.25 - 1.35 cm
Strand Diameter	0.65 - 0.90 cm

Comments

Three pieces of hawser were excavated as artifact 12527.3. They are iron encrusted, and from the same rope.

Hawser

Artifact #	SubType	Material	Provenience
12904	Bolt Rope	Rope	x2012 y2016

Measurements

Length	7.9 cm
Rope Diameter	1.2 cm
Strand Diameter	0.7 cm

Comments

This artifact number represents three lengths of hawser, one individual strand, various disartculated yarns, and a partial grommet. The measurements here represent two of the lengths of hawsers of the same diameter to which sail cloth was served. The other items are recorded separately under the same artifact number.

Artifact #	SubType	Material	Provenience
12904		Rope	x2012 y2016

Measurements

Length	5.39 cm
Rope Diameter	1.65 cm
Strand Diameter	0.90 cm

Comments

This artifact number represents three lengths of hawser, one individual strand, various disartculated yarns, and a partial grommet. The measurements here represent the largest hawser. The other items are recorded separately under the same artifact number.

Artifact #	SubType	Material	Provenience
12931	Bolt Rope	Rope	x2011 y2015

Measurements

Length	27.0 cm
Rope Diameter	1.7 cm
Strand Diameter	0.8 cm

Comments

Sail cloth is served to this hawser, and a grommet was attached. Three pieces of smaller hawser were found inserted through the eye of the grommet, although they were no longer attached to anything (rope diameter 1.1 cm; strand diameter 0.5 cm).

Hawser

Artifact #	SubType	Material	Provenience
12945		Rope	no provenience

Measurements

Length	6.84 cm; 12.94 cm
Rope Diameter	1.40 cm
Strand Diameter	0.80 cm

Comments

These measurements show each hawser included with artifact number 12945. Both lengths of hawser were from the same rope, or rope of the same dimension.

Artifact #	SubType	Material	Provenience
12945		Rope	no provenience

Measurements

Length	12.94 cm; 6.84 cm
Rope Diameter	1.40 cm; 2.13 cm
Strand Diameter	0.80 cm; 0.85 cm

Comments

Two pieces of hawser are represented by the measurements for this artifact number; the first measurement represents the longer portion.

Artifact #	SubType	Material	Provenience
12947.2	Bolt Rope	Rope	x2010 y2022

Measurements

Length	1.0 m
Rope Diameter	3.1 cm
Strand Diameter	1.1 cm

Comments

Sail cloth is served to this hawser. Marlin hitches are spaced between each strand, about every 2.5 cm, along the length of the rope. A small portion of sail cloth attached to a grommet is associated with this length of rope, as is a single sheave block. Both are recorded under the main artifact number, 12947.

Hawser

Artifact #	SubType	Material	Provenience
12958.2	Bolt Rope	Rope	x2010 y2020

Measurements

Length	53.5 cm
Rope Diameter	2.5 cm
Strand Diameter	0.9 cm

Comments

Sail cloth is served to this hawser. Marlin hitches are spaced between each strand, about every 2.5 cm, along the length of the rope. None of the four associated grommets is now attached. These grommets are recorded under the same artifact number.

Artifact #	SubType	Material	Provenience
12988		Rope	x2011 y2021

Artifact #	SubType	Material	Provenience
12995		Rope	y2022 x2009

Measurements

Length	11.5 - 29.0 cm
Rope Diameter	2.2 cm
Strand Diameter	1.5 cm

Comments

Two sizes of hawser and a strand of shroud-laid rope were associated with the block recorded under the same number. The largest hawsers' measurements (two individual strands) are recorded here.

Hawser

Artifact #	SubType	Material	Provenience
12995		Rope	y2022 x2009

Measurements

Length	6.0 cm - 13.3 cm
Rope Diameter	1.8 cm
Strand Diameter	0.9 cm

Comments

Two sizes of hawser and a strand of shroud-laid rope were associated with the block recorded under the same number. The smallest hawsers' measurements (four individual strands) are recorded here.

Artifact #	SubType	Material	Provenience
13021.2	Spliced	Rope	x2012 y2016

Measurements

Length	22.41 cm
Rope Diameter	1.72 cm
Strand Diameter	0.96 cm

Comments

This hawser is in the form of an eyesplice; the rope immediately before the splice is braided. Around the end of the eye are lanyards. The measurements reflect the hawser. The rope diameter was taken from the eye itself because the braiding of the splice would not represent the rope's general diameter.

Artifact #	SubType	Material	Provenience
13021.3	Bolt Rope	Rope	x2012 y2016

Measurements

Length	23.8 cm
Rope Diameter	2.7 cm
Strand Diameter	1.2 cm

Comments

Sail cloth is served to this hawser. Marlin hitches between each strand hold remnants of sail cloth.

Hawser

Artifact #	SubType	Material	Provenience
13021.4	Bolt Rope	Rope	x2012 y2016

Measurements

Length	14.4 cm
Rope Diameter	2.2 cm
Strand Diameter	1.2 cm

Comments

Sail cloth is served to this hawser. Sail cloth (8.50 x 3.85 cm) is still attached.

Artifact #	SubType	Material	Provenience
13208	Served	Rope	x2011 y2010

Measurements

Length	23.64 cm; 18.50 cm
Rope Diameter	3.14 - 3.60 cm
Strand Diameter	1.2 cm

Comments

13208 represents two lengths of served hawser. The diameters of these pieces of rope were taken over the serving, so the diameter of the rope itself is smaller.

Grommet

Artifact #	SubType	Material	Provenience
2601		Rope	x2008 y2020 z-5.145

Measurements

Diameter	6.0 cm
Internal Diameter	1.6 cm

Comments

2601 is comprised of two grommets and portions of sail cloth.

Artifact #	SubType	Material	Provenience
3101.15		Rope	x2012 y2013

Comments

Some sail cloth is still attached to the grommets.

Artifact #	SubType	Material	Provenience
3101.18		Rope	x2012 y2013

Measurements

Diameter	5.80 x 9.10 cm

Artifact #	SubType	Material	Provenience
3101.21		Rope	x2012 y2013

Measurements

Diameter	4.30 cm
Internal Diameter	2.60 cm

Grommet

Artifact #	SubType	Material	Provenience
3101.22		Rope	x2012 y2013

Artifact #	SubType	Material	Provenience
3101.23		Rope	x2012 y2013

Artifact #	SubType	Material	Provenience
11351		Rope	x2011 y2020

Measurements

Thickness	1.20 cm
Diameter	3.40 cm

Comments

This grommet is associated with a piece of sail cloth (4.0 x 4.0 cm).

Artifact #	SubType	Material	Provenience
12904		Rope	x2012 y2016

Measurements

Diameter	4.17 cm
Internal Diameter	1.92 cm

Comments

This artifact number represents three lengths of hawser, one individual strand, various disartculated yarns, and a partial grommet. The measurements here represent the grommet. The other items are recorded separately under the same artifact number.

Grommet

Artifact #	SubType	Material	Provenience
12931		Rope	x2011 y2015

Comments

This hawser is a bolt rope, to which is attached a small portion of sail cloth, in which is set a grommet. Three pieces of smaller hawser were found inserted through the grommet, although no longer attached to anything. The second, smaller measurement represents the smaller ropes inserted through the grommet (0.83 cm thick).

Artifact #	SubType	Material	Provenience
12947.2		Rope	x2010 y2022

Measurements

Thickness	2.29 cm
Diameter	5.02 cm

Comments

This hawser is bolt rope; sail is still attached by serving that encircles the rope about every 2.5 cm. A small portion of sail cloth attached to a grommet is associated with this length of rope. The grommet's diameter and thickness are recorded here as well.

Artifact #	SubType	Material	Provenience
12958.2		Rope	x2010 y2020

Measurements

External Diameter	6.13 cm
Internal Diameter	3.02 cm

Comments

These grommets were found in association with the bolt rope recorded by the same artifact number. The grommets had sail cloth attached to them at the time of conservation, but after conservation they were no longer intact. Measurements were taken before conservation.

Grommet

Artifact #	SubType	Material	Provenience
13021.1		Rope	x2012 y2016

Measurements

Thickness	1.61 cm
Diameter	6.41 cm
Internal Diameter	2.72 cm

Comments

This grommet was excavated with rope still attached. The rope did not survive conservation. The sail attached to the edge of the grommet did survive conservation.

APPENDIX B
MAST AND SPAR DIMENSIONS

Date	*Source*	*Length*			ø *Diameter*		
Mainmast							
1627	Smith	4/5 Beam x 3	=	38.41 English ft	1 inch per yard tall	=	12.80 English in
			=	11.71 m		=	32.51 cm
		5/6 Keel	=	40.01 English ft		=	13.34 English in
			=	12.20 m		=	33.88 cm
1644	Manwayring	2.4 Beam	=	38.41 English ft	1 inch per yard tall	=	12.80 English in
			=	11.71 m		=	32.51 cm
1667	Miller	2.5 Beam	=	40.01 English ft			
			=	12.20 m			
1670	SH 144	2.5 Beam + 4 ft	=	39.00 French ft	1/36 Mainmast	=	13.00 French in
			=	12.68 m		=	35.23 cm
1670	Dean	(Keel+Beam+Depth)/5 (result in yards), add the difference between the beam and 27 feet.	=	54.21 English ft	15/16 inch per yard tall	=	16.94 English in
			=	16.52 m		=	43.03 cm
1695	Dassié	2.5 Beam + 5 ft	=	42.50 French ft	1/3 in per foot tall - 2 in	=	12.17 French in
			=	13.82 m		=	32.98 cm
1705	Love	2/3 Keel + Beam	=	48.01 English ft	1 in per yard tall	=	16.00 English in
			=	14.63 m		=	40.64 cm
		[(Beam+Depth)/1.5] x 3	=	48.01 English ft		=	16.00 English in
			=	14.63 m		=	40.64 cm
1707	*Seaman's* Vade Mecum	3 Beam	=	48.01 English ft			
			=	14.63 m			
1711	Davis	2.5 Beam + 1ft	=	41.01 English ft	No Formula Given		
			=	12.50 m			
		2 2/3 Beam	=	42.68 English ft			
			=	13.01 m			
1719	Allard	2 (Beam + Depth)	=	51.67 Dutch ft	Depth/6 ft	=	17.22 Dutch in
			=	14.63 m		=	40.64 cm
1746	Bouguer	2.5 Beam	=	37.50 French ft	3/4 in per foot in beam	=	11.25 French in
			=	12.20 m		=	30.49 cm
					1/40 Mainmast	=	11.25 French in
						=	30.49 cm

Date	Source	Length		Ø Diameter	
Mainmast					
1748	*Marine*	(Gun Deck+Beam+Depth)/2	= 39.88 English ft	4/5 to 3/4 in per yard tall	= 10.63 English in
	Architecture		= 12.16 m		= 27.00 cm
					= 9.97 English in
					= 25.32 cm
1756	Mountaine	1/2 Keel + Beam	= 40.01 English ft		
			= 12.20 m		
		20/7 Beam	= 45.73 English ft	3/4 Beam/12	= 12.00 English in
			= 13.94 m		= 30.48 cm
Foremast					
1627	Smith	4/5 Mainmast	= 30.73 English ft	1 in per yard tall	= 10.24 English in
			= 9.37 m		= 26.01 cm
1644	Manwayring	4/5 Mainmast	= 30.73 English ft	1 in per yard tall	= 10.24 English in
			= 9.37 m		= 26.01 cm
1667	Miller	8/9 Mainmast	= 35.56 English ft	No Formula Given	
			= 10.84 m		
1670	SH 144	Mainmast - 6.5 ft	= 32.50 French ft	1/36 Mainmast	= 10.83 French in
			= 10.57 m		= 29.35 cm
1670	Dean	9/10 Mainmast	= 48.79 English ft	15/16 in per yard tall	= 15.25 English in
			= 14.87 m		= 38.74 cm
1695	Dassié	Mainmast - Masthead	= 38.25 French ft	Mainmast Ø - 2 in	= 10.17 French in
			= 12.44 m		= 27.56 cm
1705	Love	8/9 Mainmast	= 42.68 English ft	1 in per yard tall	= 14.23 English in
			= 13.01 m		= 36.14 cm
1707	Seaman's	Mainmast - 1 yard	= 45.01 English ft		
	Vade Macum		= 13.72 m		
1711	Davis	8/9 Mainmast	= 36.45 English ft	No Formula Given	
			= 11.11 m		
		8/9 Mainmast	= 37.94 English ft		
			= 11.56 m		
1719	Allard	7/8 Mainmast	= 45.21 Dutch ft	No Formula Given	
			= 12.80 m		
1746	Bouguer	2 1/4 Beam, or	= 33.75 French ft	1/39 Foremast	= 10.38 French in
		Mainmast - 10%	= 10.98 m		= 28.13 cm
1748	*Marine*	7/8 Mainmast	= 34.90 English ft	No Formula Given	
	Architecture		= 10.64 m		
		8/9 Mainmast	= 35.45 English ft		
			= 10.81 m		

Date	Source	Length		Ø Diameter	
Foremast					
1756	Mountaine	8/9 Mainmast	= 35.56 English ft = 10.84 m	And thickness proportional	
		7/8 Mainmast	= 40.01 English ft = 12.20 m		
Fore Topmast					
1627	Smith	No formula given.			
1644	Manwayring	1/2 Foremast	= 15.37 English ft = 4.68 m	1 in per yard tall	= 5.12 English in = 13.00 cm
1667	Miller	1/2 Foremast	= 17.78 English ft = 5.42 m		
1670	SH 144	2/3 Foremast - 3 ft	= 18.67 French ft = 6.07 m	2/3 Foremast Ø - 8/12 in	= 6.55 French in = 17.75 cm
1670	Dean	17/19 Main Topmast	= 29.73 English ft = 9.06 m	15/16 in per yard	= 9.29 English in = 23.60 cm
1695	Dassié	2/3 Foremast	= 25.50 French ft = 8.29 m	2/3 Foremast Ø - 1 in	= 5.78 French in = 15.66 cm
1705	Love	5/9 Foremast	= 23.71 English ft = 7.23 m	1 in per yard tall	= 7.90 English in = 20.07 cm
1707	*Seaman's* Vade Mecum	2/3 Foremast	= 30.01 English ft = 9.15 m	No Formula Given	
1711	Davis	1 3/7 Beam	= 22.86 English ft = 6.97 m	No Formula Given	
		5/9 Foremast	= 21.08 English ft = 6.43 m		
1719	Allard	7/8 Foremast	= 39.56 Dutch ft = 11.20 m		
1746	Bouguer	1 3/8 Beam	= 20.63 French ft = 6.71 m	1/43 Fore Topmast	= 5.76 French in = 15.61 cm
1748	*Marine Architecture*	3/5 Foremast	= 20.94 English ft = 6.38 m = 21.27 English ft = 6.48 m		
1756	Mountaine	3/5 Foremast	= 21.34 English ft = 6.50 m		
		7/8 Main Topmast	= 22.86 English ft = 6.97 m		

Date	Source	Length				ø Diameter			
Main Topmast									
1627	Smith	No Formula given.							
1644	Manwayring	1/2 Mainmast	=	19.21	English ft	I in per yard tall	=	6.40	English in
			=	5.86	m		=	16.26	cm
1667	Miller	1/2 Mainmast	=	20.01	English ft	No Formula Given			
			=	6.10	m				
1670	SH 144	2/3 Mainmast - 3.5 ft.	=	22.50	French ft	2/3 Mainmast Ø - 1 in	=	7.67	French in
			=	7.32	m		=	20.79	cm
1670	Dean	19/31 Mainmast	=	33.23	English ft	15/16 in per yard tall	=	10.38	English in
			=	10.13	m		=	26.37	cm
1695	Dassié	2/3 Mainmast	=	28.33	French ft	2/3 Mainmast Ø - 1 in	=	7.11	French in
			=	9.21	m		=	19.27	cm
1705	Love	5/9 Mainmast	=	26.67	English ft	1 in per yard tall	=	8.89	English in
			=	8.13	m		=	22.58	cm
						5/8 in per yard tall	=	5.56	English in
							=	14.12	cm
1707	*Seaman's* Vade Mecum	2/3 Mainmast	=	32.01	English ft	No Formula Given			
			=	9.76	m				
1711	Davis	1 3/5 Beam - 1 ft	=	24.61	English ft	No Formula Given			
			=	7.50	m				
		5/9 Mainmast	=	23.71	English ft				
			=	7.23	m				
1719	Allard	7/8 Mainmast	=	45.21	Dutch ft	No Formula Given			
			=	12.80	m				
1746	Bouguer	1 1/2 Beam	=	22.50	French ft	1/43 Main Topmast	=	6.28	French in
			=	7.32	m		=	17.02	cm
		Equals Bowsprit	=	22.50	French ft		=	6.28	
			=	7.32	m		=	17.02	
1748	*Marine Architecture*	3/5 Mainmast	=	23.93	English ft				
			=	7.29	m				
1756	Mountaine	3/5 Mainmast	=	24.01	English ft				
			=	7.32	m				
		4/7 Mainmast	=	26.13	English ft				
			=	7.96	m				

Date	*Source*	*Length*		*ø Diameter*	
Bowsprit					
1627	Smith	Equals Foremast	= 30.73 English ft = 9.37 m	1 in per yard tall	= 10.24 English in = 26.01 cm
1644	Manwayring	Equals Foremast	= 30.73 English ft = 9.37 m	1 in per yard tall	= 10.24 English in = 26.01 cm
1667	Miller	Equals Foremast	= 35.56 English ft = 10.84 m	No Formula Given	
1670	SH 144	2/3 Mainmast - 2 ft	= 24.00 French ft = 7.80 m	Foremast Ø - 1 in	= 9.83 French in = 26.64 cm
1670	Dean	2/3 Mainmast	= 36.14 English ft = 11.02 m	15/16 in per yard tall	= 11.29 English in = 28.68 cm
1695	Dassié	Foremast - 15 ft	= 23.25 French ft = 7.56 m	Equals Foremast Ø	= 10.17 French in = 27.56 cm
1705	Love	8/9 Mainmast	= 42.68 English ft = 13.01 m	1 in per yard tall	= 14.23 English in = 36.14 cm
1707	*Seaman's* Vade Mecum	Equals Foremast	= 45.01 English ft = 13.72 m		
1711	Davis	1 2/3 Beam	= 26.67 English ft = 8.13 m	No Formula Given	
1719	Allard	A little less than the mizzen mast	= 37.75 Dutch ft = 10.69 m	No Formula Given	
1746	Bouguer	1 1/2 Beam	= 22.50 French ft = 7.32 m	1/27 Bowsprit	= 10.00 French in = 27.10 cm
1748	*Marine Architecture*	2/3 Mainmast	= 26.59 English ft = 8.10 m	9/10 Mainmast Ø	= 9.57 English in = 25.93 cm
		3/4 Foremast	= 26.59 English ft = 8.10 m		= 8.97 English in = 24.31 cm
1756	Mountaine	8/9 Foremast	= 31.61 English ft = 9.63 m		
		3/5 Mainmast	= 27.44 English ft = 8.36 m	Mainmast Ø - 1 in	= 11.00 English in = 27.94 cm

Date	Source	Length			Ø Diameter		
Mizzen Mast							
1627	Smith	1/2 Mainmast	=	19.21 English ft	1 in per yard tall	=	6.40 English in
			=	5.86 m		=	16.26 cm
1644	Manwayring	1/2 Mainmast	=	19.21 English ft	1 in per yard tall	=	6.40 English in
			=	5.86 m		=	16.26 cm
1667	Miller	Equals Main Topmast	=	26.00 English ft	7/8 in per yard tall	=	7.58 English in
		from the Quarter Deck	=	7.92 m		=	19.25 cm
1670	SH 144	3/4 Mainmast	=	29.25 French ft	2/3 Mainmast Ø	=	8.67 French in
			=	9.51 m		=	23.50 cm
1670	Dean	25/27 Mainmast	=	50.19 English ft	15/16 in per yard tall	=	15.68 English in
			=	15.30 m		=	39.83 cm
1695	Dassié	Main Topmast + 8 ft	=	36.33 French ft	Main Topmast Ø	=	7.11 French in
			=	11.81 m		=	19.27 cm
1705	Love	3/4 Foremast	=	32.01 English ft	1 in per yard tall	=	10.67 English in
			=	9.76 m		=	27.10 cm
		4/5 Foremast (if stepped in the hold)					
1707	*Seaman's* Vade Mecum	Equals Main Topmast	=	32.01 English ft			
			=	9.76 m			
1711	Davis	2 1/4 Beam - 1 ft	=	35.01 English ft	No Formula Given		
			=	10.67 m			
		2 Beam (gun deck)	=	32.01 English ft			
			=	9.76 m			
		2 1/3 Beam (hold)	=	37.34 English ft			
			=	11.38 m			
1719	Allard	6/7 Foremast	=	38.75 Dutch ft	No Formula Given		
			=	10.97 m			
1746	Bouguer	1 3/4 Beam	=	26.25 French ft	7/16 Beam	=	6.56 French in
			=	8.54 m		=	17.78 cm
1748	*Marine Architecture*	2/3 Mainmast	=	26.59 English ft	2/3 in per yard tall	=	5.91 English in
			=	8.10 m		=	15.01 cm
1756	Mountaine	3/4 Mainmast	=	30.01 English ft			
			=	9.15 m			
		2/3 Mainmast	=	30.49 English ft			
			=	9.29 m			

Date	*Source*	*Length*		*ø Diameter*	
Fore Yard					
1627	Smith	4/5 Main Yard	= 32.01 English ft = 9.76 m	No formula given, but I assume the main yard proportion: 3/4 in per yard long	= 8.00 English in = 20.32 cm
1644	Manwayring	4/5 Main Yard	= 32.01 English ft = 9.76 m	No formula given, but I assume the main yard proportion: 3/4 in per yard long	= 8.00 English in = 20.32 cm
1667	Miller	8/9 Main Yard	= 30.48 English ft = 9.29 m	No Formula Given	
1670	SH 144	2 Beam + 4.5 ft	= 32.50 French ft = 10.57 m	1/48 Foreyard	= 8.13 French in = 22.03 cm
1670	Dean	25/28 Main Yard	= 43.56 English ft = 13.28 m	5/8 in per yard long	= 9.08 English in = 23.06 cm
1695	Dassié	2 Beam	= 30.00 French ft = 9.76 m	1/4 in per yard long	= 7.50 French in = 20.33 cm
1705	Love	8/9 Main Yard 6/7 Main Yard	= 35.56 English ft = 10.84 m = 29.39 English ft = 8.96 m	1 in per yard long	= 11.85 English in = 30.10 cm = 9.80 English in = 24.89 cm
1707	*Seaman's* Vade Mecum	6/7 Main Yard	= 30.87 English ft = 9.41 m		
1711	Davis	1 4/5 Beam 6/8 Foremast	= 28.81 English ft = 8.78 m = 28.46 English ft = 8.67 m	No Formula Given	
1719	Allard	Main Yard - 1/7	= 36.91 Dutch ft = 10.45 m	No Formula Given	
1746	Bouguer	2 Beam	= 30.00 French ft = 9.76 m	(5/8 Beam)/12	= 9.38 French in = 25.42 cm
1748	*Marine Architecture*	7/8 Main Yard	= 30.54 English ft = 9.31 m		
1756	Mountaine	No formula given 7/8 Main Yard	 = 28.01 English ft = 8.54 m		

Date	Source	Length		Ø Diameter	
Main Yard					
1627	Smith	5/6 Keel	= 40.01 English ft = 12.20 m	3/4 in per yard long	= 10.00 English in = 25.40 cm
1644	Manwayring	5/6 Keel	= 40.01 English ft = 12.20 m	3/4 in per yard long	= 10.00 English in = 25.40 cm
1667	Miller	6/7 Mainmast	= 34.29 English ft = 10.45 m	No Formula Given	
1670	SH 144	2 Beam + 5 ft	= 33.00 French ft = 10.73 m	1/48 Main Yard	= 8.25 French in = 22.36 cm
1670	Dean	Equals Foremast	= 48.79 English ft = 14.87 m	5/8 in per yard long	= 10.16 English in = 25.81 cm
1695	Dassié	Foreyard + 8 ft	= 38.00 French ft = 12.36 m	1/4 in per foot long	= 9.50 French in = 25.75 cm
1705	Love	Beam + 1/2 Keel 5/7 Mainmast	= 40.01 English ft = 12.20 m = 34.29 English ft = 10.45 m		
1707	*Seaman's* Vade Mecum	2/3 Mainmast + 1/12 Mainmast	= 36.01 English ft = 10.98 m		
1711	Davis	2 Beam + 2 ft 6/8 Mainmast	= 34.01 English ft = 10.37 m = 32.01 English ft = 9.76 m	No Formula Given	
1719	Allard	2 Beam + Depth	= 43.06 Dutch ft = 12.19 m	No Formula Given	
1746	Bouguer	2 1/6 Beam	= 32.50 French ft = 10.57 m	2/3 Beam / 12, or 1/39 Main Yard	= 10.00 French in = 27.10 cm
1748	*Marine Architecture*	7/8 Mainmast	= 34.90 English ft = 10.64 m		
1756	Mountaine	3 Beam + 1/2 Beam 7/10 Mainmast	= 56.01 English ft = 17.07 m = 32.01 English ft = 9.76 m		

Date	Source	Length			Ø Diameter		
Fore Topsail Yard							
1627	Smith	1/2 Fore Yard	=	16.01 English ft	1/2 Foreyard Ø	=	4.00 English in
			=	4.88 m		=	10.16 cm
1644	Manwayring	No formula given.			No Formula Given		
1667	Miller	1/2 Fore Yard (inside cleats)	=	15.24 English ft	No Formula Given		
			=	4.65 m			
1670	SH 144	1/2 Fore Yard + 4.5 ft	=	21.00 French ft	1/48 Fore Topsail Yard	=	5.25 English in
			=	6.83 m		=	14.23 cm
1670	Dean	13/16 Main Topsail Yard	=	22.73 English ft	5/8 in per yard long	=	4.74 English in
			=	6.93 m		=	12.04 cm
1695	Dassié	1/2 Foreyard + 4 ft	=	19.00 French ft	1/2 Foreyard Ø + 1 in	=	4.75 French in
			=	6.18 m		=	12.87 cm
1705	Love	No formula given.			1 in per yard long		
		4/7 Fore Yard	=	16.79 English ft		=	5.60 English in
			=	5.12 m		=	14.22 cm
1707	*Seaman's* Vade Mecum	1/2 Fore Yard	=	15.44 English ft	No Formula Given		
			=	4.71 m			
1711	Davis	1 1/7 Beam	=	18.29 English ft	No Formula Given		
			=	5.57 m			
		8/9 Fore Topmast	=	18.74 English ft			
			=	5.71 m			
1719	Allard	1/2 Fore Yard	=	18.46 Dutch ft	No Formula Given		
			=	5.23 m			
1746	Bouguer	1 1/6 Beam	=	17.50 French ft	7/15 Foreyard Ø	=	4.38 French in
			=	5.69 m		=	11.87 cm
1748	*Marine Architecture*	5/9 Fore Yard	=	16.97 English ft			
			=	5.17 m			
1756	Mountaine	1/2 Fore Yard	=	No Fore Yard formula given.			
		7/8 Main Topsail Yard	=	18.67 English ft			
			=	5.69 m			

Date	Source	Length			ø Diameter		
Main Topsail Yard							
1627	Smith	1/2 Main Yard	=	20.01 English ft	1/2 Main Yard Ø	=	5.00 English in
			=	6.10 m		=	12.70 cm
		3/7 Main Yard	=	17.15 English ft			
			=	5.23 m			
1644	Manwayring	3/7 Main Yard	=	17.15 English ft	No Formula Given		
			=	5.23 m			
1667	Miller	1/2 Main Yard	=	17.15 English ft	No Formula Given		
		(inside the cleats)	=	5.23 m			
1670	SH 144	1/2 Main Yard + 5 ft	=	21.50 French ft	1/48 Main Topsail	=	5.38 French in
			=	6.99 m	Yard	=	14.58 cm
1670	Dean	16/19 Main Topmast	=	27.98 English ft	5/8 in per yard long	=	5.83 English in
			=	8.53 m	Yard	=	14.81 cm
1695	Dassié	1/2 Main Yard + 4 ft	=	23.00 French ft	1/2 Main Yard Ø	=	5.75 French in
			=	7.48 m	+ 1 in	=	15.58 cm
1705	Love	No formula given.			1 in per yard long		
		4/7 Main Yard	=	19.59 English ft		=	6.53 English in
			=	5.97 m		=	16.59 cm
1707	*Seaman's*	1/2 Main Yard	=	18.01 English ft			
	Vade Mecum		=	5.49 m			
1711	Davis	1 1/4 Beam	=	20.00 English ft	No Formula Given		
			=	6.10 m			
		8/9 Main Topmast	=	21.08 English ft			
			=	6.43 m			
1719	Allard	1/2 Main Yard	=	21.53 Dutch ft	No Formula Given		
			=	6.10 m			
1746	Bouguer	1 1/4 Beam	=	18.75 French ft	1/2 Main Yard Ø	=	5.00 French in
			=	6.10 m		=	13.55 cm
1748	*Marine*	5/9 Main Yard	=	19.39 English ft			
	Architecture		=	5.91 m			
1756	Mountaine	1/2 Main Yard	=	28.01 English ft			
			=	8.54 m			
		2/3 Main Yard	=	21.34 English ft			
			=	6.50 m			

Date	Source	Length				ø Diameter			
Spritsail Yard									
1627	Smith	4/5 Main Yard (= Crossjack Yard)	= =	32.01 9.76	English ft m	1/2 in per yard long	= =	5.34 13.56	English in cm
1644	Manwayring	Equals Crossjack Yard (no formula for the crossjack yard given)				1/2 in per yard long			
1667	Miller	1/2 Mizzen Yard	= =	14.74 4.49	English ft m	No Formula Given			
1670	SH 144	Equals Main Topsail Yard	= =	21.50 6.99	French ft m	Fore Topsail Yard Ø	= =	5.25 14.23	French in cm
1670	Dean	Equals Fore Topmast	= =	29.73 9.06	English ft m	5/8 in per yard long	= =	6.19 15.72	English in cm
1695	Dassié	Main Topsail Yard + 4 ft	= =	27.00 8.78	French ft m				
1705	Love	5/8 Main Yard	= =	25.01 7.62	English ft m	1 in per yard long	= =	8.34 21.18	English in cm
		5/8 Main Yard	= =	21.43 6.53	English ft m		= =	7.14 18.14	English in cm
1707	*Seaman's* Vade Mecum	2/3 Bowsprit	= =	30.01 9.15	English ft m				
1711	Davis	1 2/6 Beam + 1 ft	= =	22.34 6.81	English ft m	No Formula Given			
		1 2/7 Beam + 2 ft	= =	22.58 6.88	English ft m				
1719	Allard	Bowsprit - 1/4	= =	28.31 8.02	Dutch ft m	No Formula Given			
1746	Bouguer	1 1/4 Beam	= =	18.75 6.10	French ft m	1/3 Beam/12	= =	5.00 13.55	French in cm
1748	*Marine Architecture*	5/7 Foreyard	= =	21.81 6.65	English ft m				
1756	Mountiane	No formula given							

Date	*Source*	*Length*			*ø Diameter*		
Spritsail Topsail Yard							
1627	Smith	1/2 Spritsail Yard	=	16.01 English ft	1/2 Spritsail Yard Ø	=	2.67 English in
			=	4.88 m		=	6.78 cm
1644	Manwayring	No formula given.					
1667	Miller	1/2 Spritsail Yard (inside cleats)	=	7.37 English ft	No Formula Given		
			=	2.25 m			
1670	SH 144	Main Topgallant Yard + 1 1/4 ft.	=	12.00 French ft	1/48 Spritsail Topsail Yard	=	3.00 French in
			=	3.90 m		=	8.13 cm
1670	Dean	1/2 Spritsail Yard	=	14.87 English ft	5/8 in per yard long	=	3.10 English in
			=	4.53 m		=	7.87 cm
1695	Dassié	1/2 Spritsail Yard	=	13.50 French ft			
			=	4.39 m			
1705	Love	Illegible.					
1707	*Seaman's* Vade Mecum	1/2Spritsail Yard	=	15.01 English ft			
			=	4.58 m			
1711	Davis	3/4 Beam	=	12.00 English ft	No Formula Given		
			=	3.66 m			
1719	Allard	1/3 Bowsprit	=	12.58 Dutch ft	No Formula Given		
			=	3.56 m			
1746	Bouguer	3.4 Beam	=	11.25 French ft	7/16 Spritsail Yard Ø	=	2.19 French in
			=	3.66 m		=	5.93 cm
1748	*Marine Architecture*	1/2 Spritsail Yard	=	10.91 English ft			
			=	3.33 m			
1756	Mountaine	No formula given.					

Date	Source	Length			Ø Diameter		
Mizzen Yard							
1627	Smith	Equals Mizzen Mast	=	19.21 English ft	1/2 in per yard long	=	3.20 English in
			=	5.86 m		=	8.13 cm
1644	Manwayring	No formula given.					
1667	Miller	Shorter than the Fore Yard	=	29.48 English ft	No Formula Given		
			=	8.99 m			
1670	SH 144	2 Beam	=	28.00 French ft	Main Topmast Ø + 3/4 in	=	8.42 French in
			=	9.11 m		=	22.82 cm
1670	Dean	Equals Fore Yard	=	43.56 English ft	5/8 in per yard long	=	9.08 English in
			=	13.28 m		=	23.06 cm
1695	Dassié	Equals Fore Yard	=	30.00 French ft	Main Topsail Yard Ø	=	5.75 French in
			=	9.76 m		=	15.58 cm
1705	Love	No formula given.					
		Medium between Fore and Main Yards	=	31.84 English ft	1 in per 6 ft long	=	5.31 English in
			=	9.70 m		=	13.49 cm
1707	*Seaman's* Vade Mecum	Equals Fore Yard	=	30.87 English ft			
			=	9.41 m			
1711	Davis	1 8/9 Beam + 1 ft	=	31.23 English ft	No Formula Given		
			=	9.52 m			
		6/8 Foremast	=	28.46 English ft			
			=	8.67 m			
1719	Allard	Mizzen Mast + 1 or 2 ft	=	39.75 Dutch ft	No Formula Given		
			=	11.26 m			
1746	Bouguer	2 Beam	=	30.00 French ft	1/3 Beam / 12	=	5.00 French in
			=	9.76 m		=	13.55 cm
1748	Marine Architecture	Equals Fore Yard	=	30.54 English ft	1/2 in per yard long	=	5.09 English in
			=	9.31 m		=	12.93 cm
1756	Mountaine	No formula given.					
		Medium between Main and Fore Yards	=	30.01 English ft			
			=	9.15 m			

APPENDIX C

LA BELLE'S MAST AND SPAR, AND RIGGING PLANS

Table 4. *La Belle*'s hull dimensions.

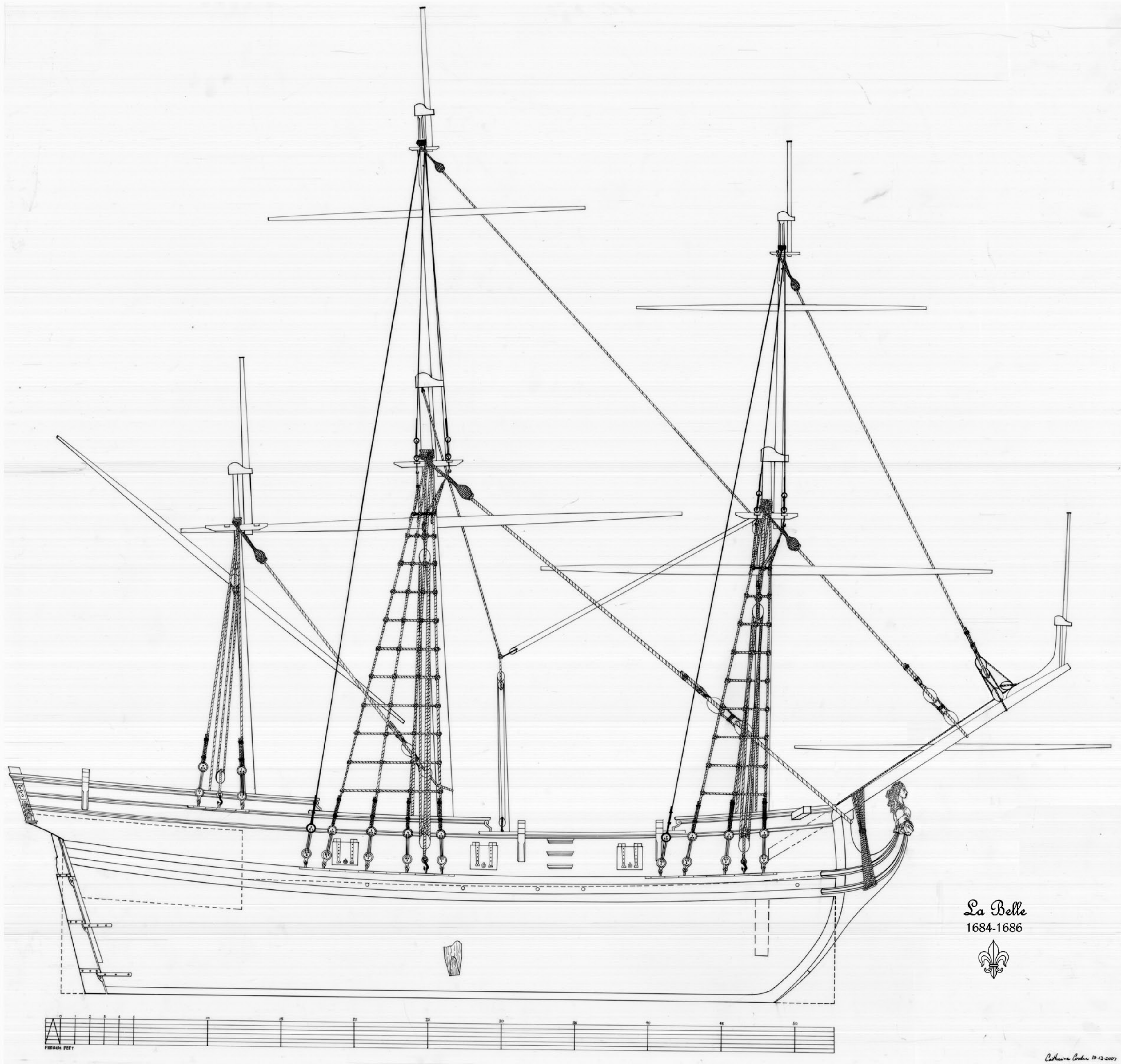
Dimension	*Meters*	*French feet*
Keel Length	14.63	45.00
Beam	4.88	15.00
Depth of Hold	2.44	7.50

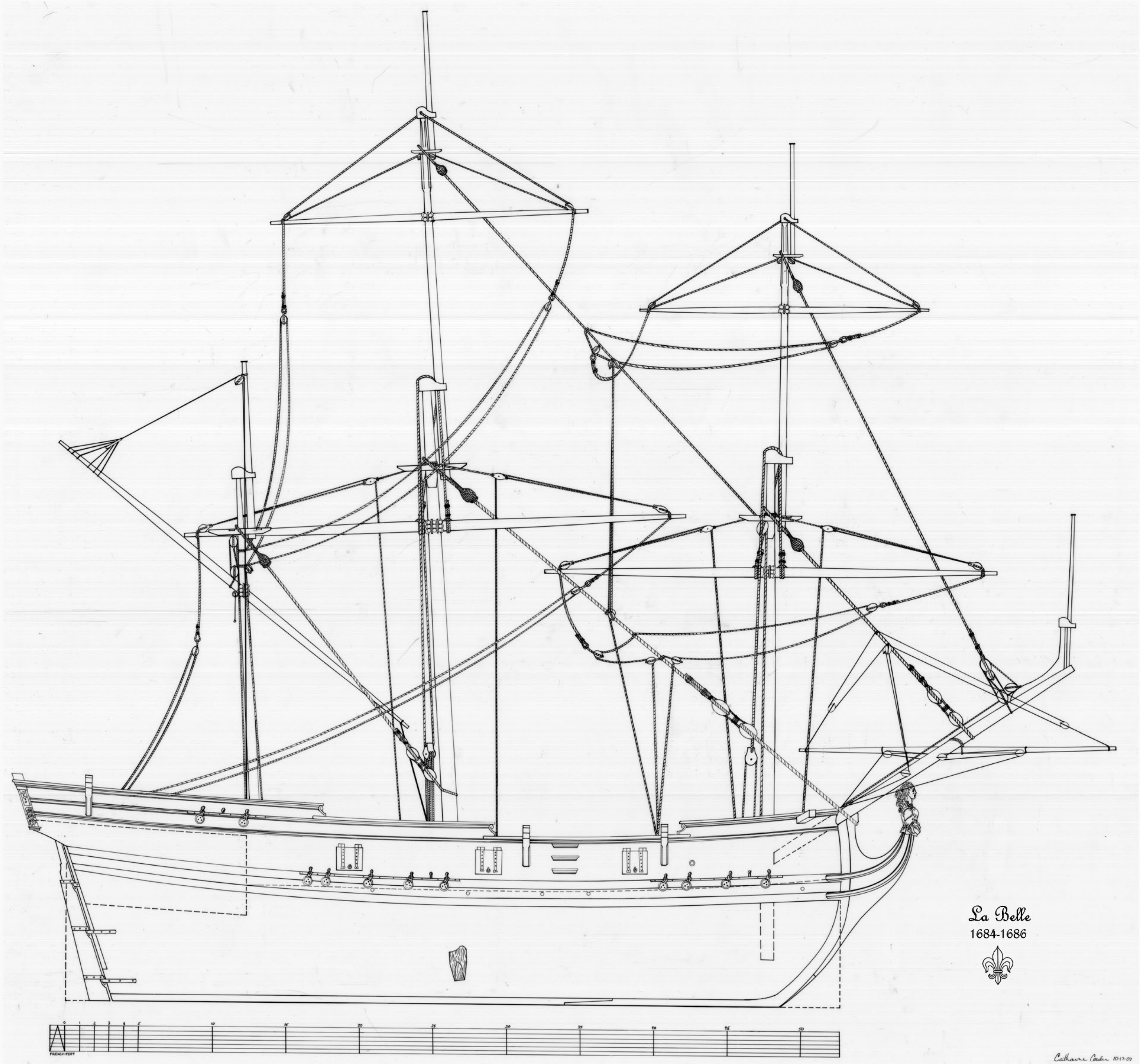
Table 5. *La Belle*'s mast and spar dimensions.

Mast/Spar	*Length (m)*	*Diameter (cm)*	*Length (Fr ft)*	*Diameter (Fr in)*
Mainmast	12.85	33.20	39.50	12.25
Foremast	11.07	27.78	34.00	10.25
Main Topmast	8.02	20.33	24.75	7.50
Fore Topmast	6.83	16.26	21.00	6.00
Bowsprit	7.32	26.42	22.50	9.75
Mizzen Mast	10.49	21.68	32.25	8.00
Main Yard	11.07	23.03	34.00	8.50
Fore Yard	9.97	20.77	30.67	7.67
Main Topsail Yard	6.99	14.57	21.50	5.37
Fore Topsail Yard	6.39	13.31	19.67	4.90
Spritsail Yard	6.99	14.44	21.50	5.33
Mizzen Yard	9.97	16.34	30.66	6.00

Table 6. *La Belle*'s rigging dimensions.

Line	***Circumference (cm)***	***Circumference (Fr in)***
Main Shrouds	10.84	4.00
Fore Shrouds	9.49	3.50
Mainstay	21.68	8.00
Forestay	17.62	6.50
Main Topmast Shrouds	5.42	2.00
Fore Topmast Shrouds	5.42	2.00
Main Topmast Stay	8.13	3.00
Fore Topmast Stay	8.13	3.00
Main Topmast Backstays	5.96	2.20
Fore Topmast Backstays	5.42	2.00
Mizzen Shrouds	5.42	2.00
Mizzen Stay	6.78	2.50
Main Tie	21.68	8.00
Fore Tie	17.62	6.50
Main Halliard	10.84	4.00
Fore Halliard	8.13	3.00
Main Lifts	12.63	4.66
Fore Lifts	10.84	4.00


La Belle
1684-1686
0
1
2
3
4
5
10
15
20
25
30
35
40
45
50
FRENCH FEET
Catherine Corder 10-13-2007


La Belle
1684-1686
0
1
2
3
4
5
10
15
20
25
30
35
40
45
50
FRENCH FEET
Catharine Corder 10-17-07

VITA

Catharine Leigh Inbody Corder

Address: 2003 Cobblestone Lane, Bryan, Texas 77807
catinbody@hotmail.com

Education:

M.A., Anthropology (Nautical Archaeology Program), Texas A&M University, 2007.

Research Fellowship, American-Scandinavian Foundation, 2002.
Research Fellowship, MSC L. T. Jordan Institute, Texas A&M University, 2002.

B.A., Classics, and Environmental Studies, Baylor University, 1999.

Professional Experience:

2007	Assistant Lecturer, European & Classical Languages & Cultures, TAMU.
2007, 2002	Assistant Lecturer, English Language Institute, TAMU.
2003–2006	Senior Proposal Administrator, Texas A&M Research Foundation.
2001–2002	Research Assistant, Nautical Archaeology Program, TAMU.
1999–2001	Graduate Assistant Teaching, European & Classical Languages & Cultures, TAMU.

Fieldwork Experience:

2002, 2000	Tektaş Burnu shipwreck excavation, and artifact recording, Institute of Nautical Archaeology, Tektaş, Turkey.
2001, 2000	Side scan sonar and magnetometer survey of Eagle Mountain Lake, Eagle Mountain Lake Police, Fort Worth, Texas.

Publications and Papers Delivered:

2005	*French Rigging in the Days of the Spritsail Topmast*, A paper delivered at the Society for Historical Archaeology annual conference, York, England.
2004	*Seventeenth-Century French Rigging Defined*, A paper delivered at the Society for Historical Archaeology annual conference, St. Louis, Missouri.
2003	La Belle, *Rigging in the Days of the Spritsail Topmast*, A paper delivered at the Society for Historical Archaeology annual conference, Providence, Rhode Island.