OCS Study
MMS 2006-072

Mica Shipwreck Project

Deepwater Archaeological Investigation of a 19th Century Shipwreck in the Gulf of Mexico

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

OCS Study
MMS 2006-072

Mica Shipwreck Project

Deepwater Archaeological Investigation of a 19th Century Shipwreck in the Gulf of Mexico

Authors

A.D. Atauz
W. Bryant
T. Jones
B. Phaneuf

Prepared under MMS Cooperative Agreement
1435-01-01-CA-31178
by
Texas A&M University
Department of Oceanography
College Station, Texas 77843

Published by

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

New Orleans
December 2006

DISCLAIMER

This report was prepared under contract between Minerals Management Service (MMS) and Texas A&M University. This report has been technically reviewed by the MMS and it has been approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the MMS, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. It is, however, exempt from review and compliance with the MMS editorial standards.

REPORT AVAILABILITY

Extra copies of this report may be obtained from the Public Information Unit (Mail Stop 5034) at the following address:

U.S. Department of the Interior
Mineral Management Service
Gulf of Mexico OCS Region
Public Information Unit (MS 5034)
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Telephone: (504) 736-2519 or
1-800-200-GULF

CITATION

Suggested citation:

Atauz, A.D., W. Bryant, T. Jones, and B. Phaneuf. 2006. *Mica shipwreck project: Deepwater archaeological investigation of a 19th century shipwreck in the Gulf of Mexico.* U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-072. 116 pp.

ABOUT THE COVER

The cover art shows photographs of the Submarine NR1 (upper left), the research/support vessel *Carolyn Chouest* (upper right), side scan sonar image of the Mica shipwreck (lower left), a view of the Mica Shipwreck (lower center) and a view from the control room of the NR1 (lower right).

ACKNOWLEDGMENTS

The authors wish to acknowledge those organizations and individuals that make this research project possible: Exxon-Mobil, Inc. and the Texas A&M SeaGrant Program provided funding, the Minerals Management Service-Social Sciences Division (New Orleans, LA) provided project oversight with special thanks to Jack Irion, David Ball and Rik Anuskiewicz. Kevin Crisman (Nautical Archaeology Program, Texas A&M University) provided invaluable guidance in the conduct of field operations and Toby Jones provided the foundation of this report which is in part based on his master's thesis.

Special thanks belong to the United States Navy for providing through the Naval Oceanographic Office (NAVOCEANO - Stennis, MS) a remotely operated vehicle (ROV) and personnel in support of field operations and for providing the Submarine Support Vessel (SSV) Carolyn Chouest and the Nuclear Research Submarine, NR1 for the duration of our mission at sea, the authors would like to thank in particular the Officer-in-Charge of the NR1, Dennis McKelvy and the Executive Officer, Rob Hanna for their outstanding work and esprit de corps.

Thanks also go to Brett Phaneuf, the project manager, who oversaw all stages of project development, planning, teambuilding, and fieldwork.

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

1.0: INTRODUCTION

The Mica Shipwreck site lies in the Gulf of Mexico, Mississippi Canyon area, located 65 kilometers (40 miles) southeast of the Mississippi River mouth. This is an area that experienced heavy maritime traffic especially from the late 17th century onwards, as the importance of the Mississippi River and the Louisiana ports increased within the new communication, transportation and trade network developing in North America at the time.

The wreck was discovered on February 16, 2001, by Exxon-Mobil Corporation during a routine post-installation inspection of an oil and gas pipeline. The Minerals Management Service, the federal agency whose duties include managing offshore cultural resources with respect to oil and gas exploration and development, was notified upon discovery and further scientific visits were scheduled to determine the date and importance of the site.

Subsequent archaeological visits and surveys conducted at the site produced data and artifacts that helped to determine the provenance and function of this ship. The depth of the site (807.7 meters or 2,650 feet) presented technical difficulties in surveying the wreck in detail. However, specialized equipment for work at depth was utilized and its use in archaeological surveying was tested. In many ways, this project has been an exercise of adapting existing deep-sea survey equipment for archaeological use, and developing specialized tools to work in conjunction with the available technologies.

The shipwreck remains are preserved to a length of approximately 19.8 meters (65 feet) and the hull lies on the bottom evenly on its keel (Figure 1). The vessel sits upright on the seafloor, approximately two meters (6.6 feet) high in the bow, and three meters (9.8 feet) in the stern. The distance between the stem and the sternposts is 20.5 meters (67 feet) along the keel. Based on these measurements, the overall length of the vessel is estimated to be 21.9 meters (72 feet). The estimated original dimensions of the wreck and an examination of the general hull form suggest that the Mica vessel was most likely a two-masted vessel, most likely a schooner (see section 4.1.5. for identification of the rig). Research among similar sized vessels indicate that the ship was probably a 110-120 ton vessel (see section 3.6 for tonnage estimation). The interior of the vessel is covered by a thick layer of sediment that makes it difficult to observe the hull structure and the artifacts that may be preserved. No trace of upper works or deck structure survived.

Analysis conducted on the wood samples collected from the hull indicate that the sacrificial hull-planking was eastern white pine, which suggests that the vessel was probably built along the Northeastern coast of North America (see Section 4.1.1 for details). While it is possible that this protective layer of planking may have been applied later on the ship, or the sampled portion may have been a repair section, it is more likely that the ship was built in the Northeast America. The general size and design of the ship, the use of the copper sheathing, and analysis carried out on the limited artifact assemblage suggest that the Mica vessel possibly dated to the first half of the 19th century (see Chapter 4 for dating).

The initial reason for the development of the schooner rig configuration was to answer the demand for fast pleasure ships for European monarchs in the late 17th century (Marquardt 2003: 13). Around the late 1820s and early 1830s, the schooner rig developed into what is referred to as the topsail schooner configuration, which can be described as a blending of the two late seventeenth century gaff rigs: the standing gaff with the additional square topsail for the fore or schooner mast and the running gaff with boom for the mainmast (Marquardt 2003: 21). This configuration provided the ship with maximum speed and capacity options available at the time. Thus use of topsail schooners was subsequently adopted by naval and commercial shipbuilders and spread to the continent of America (Marquardt 2003:13-26). The fact that a topsail schooner could sail very close to the wind, needed a relatively smaller handling crew, and had considerable cargo capacity made it the most popular vessel for merchants, slavers, and privateers in addition to its naval use, especially by coastguard vessels and gunboats that also required high speed (Marquardt 2003:27-128).

Based on an analysis of the Ship Enrollment Records for New Orleans for the first two decades of the 19th century (see Appendix 5), schooner rig was widely used in the Gulf of Mexico at the time. Designed and built in the Americas, these types of vessels filled a variety of roles, making them a valuable commodity as well as a practical method of transporting cargoes. The utility of these vessels contributed to their popularity placing them in high demand in the 19th century as illustrated by the increasing numbers that were built (Piston 1988:166).

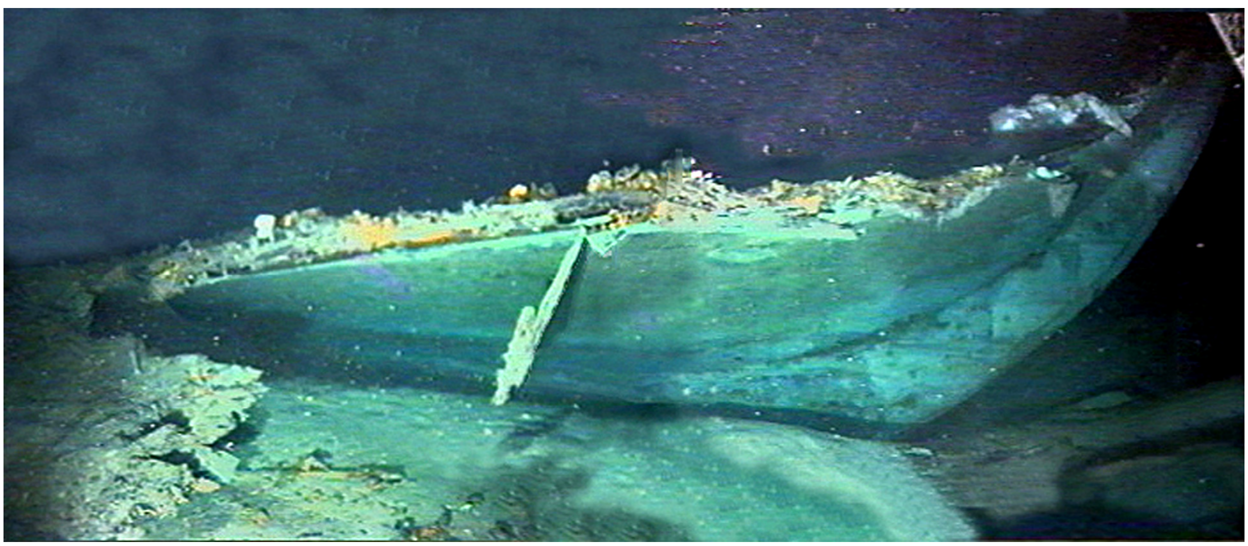

Figure 1. A view of the Mica Shipwreck from the starboard side of the bow. Photomosaic by Dave Ball.

For this study, data gleaned from the Mica Shipwreck is presented with comparisons of other similar vessels and archaeological investigations of sites in the Gulf of Mexico dating to the same period. An analysis of the Mica Shipwreck site improves our understanding of the commercial navigation in the Gulf of Mexico during the early 19th century. This is the period when the United States economy began to develop, and small vessels like the Mica shouldered the burden of initiating commercial connections between the burgeoning ports of the Gulf of Mexico, Caribbean and the Atlantic coast of the present-day United States.

Studying and researching the economic, military, social and cultural history of the Gulf of Mexico is necessary to accomplish the goal of placing the Mica Shipwreck in its proper context. However, because the Gulf is a large geographic area and the subject is expansive, the following chapters that describe the geographical, geophysical and historical background for the Mica site include the general outline of the major events in the area, but emphasize the aspects that are especially important for the northern Gulf coast and especially for the present-day Louisiana coast, and concentrate on the aspects of these subjects that directly affect the way this shipwreck site is analyzed.

2.0: GEOGRAPHICAL, GEOPHYSICAL AND HISTORICAL BACKGROUND

The physical location of the Mica Shipwreck, in the Gulf of Mexico is the most significant factor in assessing its geographical, geophysical and historical context. In order to view this site within its environment, it is necessary to introduce the background information about the surrounding geographical and cultural landscape in a historical framework.

Geographical and geophysical conditions described below, as well as the information about prevalent wind and current patterns in the Gulf of Mexico summarized in the following section affected the development of settlements, and the navigation routes. While it is known that climatic variations and winter temperatures fluctuated on a predictable pattern every decade (data is available through late 19th century), the general wind and current patterns (in terms of direction and prevalence) have not changed significantly since the late 18th century (Slowey and Crowley 1995: 2345-2348). Thus, it is safe to assume that the general information summarized in sections 2.1. and 2.1.1. below represents the historic conditions as far back as late 18th century.

2.1. Geographical and Geophysical Background

The Gulf of Mexico is a semi-enclosed basin that covers about 1,813,000 sq km (ca. 700,000 square miles). It stretches more than 1,770 km (1,100 miles) from west to east and about 1,290 km (800 miles) from north to south. The Sigsbee Deep (3,875 m /12,714 ft), the Gulf's deepest part, lies off the Mexican coast. The coast is generally characterized by low, sandy, and marshy lands with many lagoons and deltas, especially in the north where the coastal plains and the continental shelf are the widest (Bryant et al. 1991: 13). The major rivers that flow into the Gulf are the Mississippi, Alabama, Brazos, and Rio Grande. They annually discharge about 3,237,485 square kilometers (1,250,000 square miles) of water into the Gulf, which represents a body of water of about 2,330,013 cubic kilometers (559,000 cubic miles) (Bryant et al. 1991:13-20).

2.1.1. Winds and Currents in the Gulf of Mexico

The Gulf of Mexico is a semi-enclosed basin that opens into the Atlantic Ocean through the Yucatan Channel and the Florida Straits. The clockwise surface current known as the Loop Current is the dominant circulation, transporting warm Caribbean water to the north of the Gulf. In essence, the Loop Current is a result of the effects of the Yucatan Current, flowing from northern Honduras through the Yucatan Channel to the central eastern portion of the Gulf and the Florida Current, which flows out through the Florida Straits (Hoffmann and Worley 1986). Surface circulation is also affected by tides, winds, and freshwater inflow.

With the exception of the summer months (e.g. June, July and August) a counter clockwise circulation dominates the Texas- Louisiana shelf (Cochrane and Kelly 1986). During the summer months, the coastal currents reverse, flowing northward along the lower Texas coast and eastward along the upper Texas and Louisiana coasts to Calcasieu Pass, Louisiana. Eastward flow on the outer shelf is weaker during the summer. The inner side of the shelf is characterized by a coastal flow driven by the easterly winds that carries the discharge from the Mississippi and

Atchafalaya rivers towards Mexico. There is an easterly counter flow along the outer shelf and shelf-break.

The wind and current pattern of the Gulf determined the development of the navigation routes. Historic documentation suggests that Spanish navigators recognized the easterly flow along the outer shelf as early as 1519, and took advantage of it when sailing from Veracruz to the east of the Gulf (Salvador 1991: 2). The necessity to follow the loop current and to sail along the prevalent winds determined the course of the Spanish fleets. Ships entered the Gulf through the Yucatan Channel and rode the prevailing wind and current westward to the port of Veracruz. The nature of this navigation cycle is reflected in the trade patterns (See Section 2.2.1.). The return route of these early fleets usually followed the northern coast of the Gulf, and east into the Straits of Florida and the Bahama Channel.

Summer months are characterized by a frequent commercial traffic in the Gulf. This navigation, especially in the northwest, is made possible by the prevalence of the easterly winds characterized by a southwesterly flow. This changes into a northeasterly direction in winter and the transition occurs between September and October. Scientific data shows that the winter storms can generate waves up to seven meters (McGrail and Carnes 1983). In Spanish documents, "Nortes" are mentioned due to their impact on Spanish fleets as early as 1566 (Garrison et al. 1989).

Tropical storms and hurricanes create the most extreme wave and current conditions in the Gulf. Generated either in the eastern Atlantic Ocean, the Caribbean Sea, or the Gulf itself, hurricanes regularly damage the Gulf shore during the months of June to November. Even though the dangers of sailing during the hurricane season were well known to captains and ship owners alike, the great profits to be acquired from a successful journey during the hurricane season often led them to take their chances. Sailing schedules for merchant ships in the 18th and 19th centuries were not as strict as one might imagine. Sometimes, delay of a cargo, or other unforeseen impediments also inadvertently pushed departures into the hurricane season (Pearson and Hoffman 1995: 14).

2.1.2. Brief History of Commercial Navigation in the Gulf of Mexico

The coastal configuration, as well as the wind and current patterns in the Gulf of Mexico had to be mastered by the first explorers and subsequent mariners of the following centuries that engaged in the trade with the colonies around the basin. Construction and rigging configuration of the merchant vessels in this period between the 16th and the early 19th centuries prevented them from comfortably sailing into the wind. Thus, this knowledge of local winds, currents, storm patterns, and cartographical information was of crucial importance, not only because they helped safe sailing, but also because they dictated the navigation, and thus the development of the trade routes (Hoffman 1980).

Commercial routes from the eastern coast of the Gulf to the west followed the wind directions but ran along the northern coast, and therefore against the Loop Current. Due to the annual occurrence of the hurricanes in specific times of the year, the bulk of this commercial traffic occurred between March and June. Commercial navigation during the winter was considered highly risky and avoided (Pearson and Hoffman 1995: 8-14).

2.1.2.1. Development of Navigation Routes in the Gulf

First navigation and commercial transportation of goods on board sea-craft in the Gulf of Mexico began during the pre-Columbian era (Diaz del Castillo 1955; Davis 1984). Our knowledge regarding these early commercial navigation patterns is limited to a few finds and lacks precise details. However, written and archaeological evidence from the periods that follow the European discovery of the American continent are relatively complete.

It is not clear who were the first Europeans to discover the Gulf of Mexico, but it is generally accepted that the exploration parties landed on the southeastern coast of the Gulf in the late 15th century. The first European to report the existence of a large body of water beyond Cuba was Sebastián de Ocampo, a Spaniard who circumnavigated Cuba in 1508-09 (Weddle 1985). Subsequently, the Gulf served as a primary approach to the North American mainland. Following this route, the leader of the following expedition, in 1513, Juan Ponce De León became the first European to make landfall within the Gulf of Mexico. The most significant contribution of this exploratory cruise is that Ponce De León's crew noted the existence of a strong current on the east coast of Florida, which represents the first record of the Gulf Stream (Gore 1992: 15).

The next three voyages between 1517 and 1519, led by Francisco Hernández de Córdoba, Juan de Grijalva, and Hernán Cortés, respectively, were destined to the southern coast of the Gulf (Gore 1992: 22-23). In 1519, another expedition led by Don Alonzo Álvarez de Pineda sailed from Jamaica to explore the west coast of Florida and the northern coast of the Gulf of Mexico. The purpose of Álvarez de Pineda's voyage was to explore the coast between the discoveries of De León on the Florida peninsula and those made on behalf of Velázquez along the southern Gulf, and more specifically, to find a passage to the Pacific Ocean in this area (Weddle 1985). The map titled "Traza de Costas de Tierra Firme y las Tierras Nuevas," (1519) which is also known as the "Pineda Map," was a product of this journey. It is the first cartographic representation of the northern Gulf area, and the river named "Rio del Espiritu Santu" is likely to be the first representation of the Mississippi. On this map the coastline is described as "low-lying and subject to flooding." The navigators are warned against dangerous obstacles such as dunes, sandpits, bays, marshes, and oyster beds as well as the lack of secure anchorages along the coast. The information provided by the descriptions and the outline of the coastline provided by the map reflect the level of information that existed at the time. The map is located at Archivo de Indias in Seville, Spain, and the information summarized above is directly written on it.

Explorations and the majority of navigation in this initial period of the Gulf's commercial exploitation have mainly been carried out by the Spanish with the objective of exploring the commercial route along this coast, and to help the ships that used this route to transport treasure from Mexico and Peru to Spain. Understanding the geography was of crucial importance as this route took advantage of the Loop Current and southeasterly winds. Creating a detailed map of the possible anchorages along the route was also important to provide safe havens to these precious cargo carriers (Hoffman 1980).

In addition to acquiring information about the route, the Spanish also wanted to explore the territory that lay to the north of the Gulf and its economic potential, but this did not become a primary objective until the French colonization of Louisiana in 1699. French explorers and settlers of the northern Gulf coast, *la Louisiane*, were there for the sole purpose of exploiting the land and the commercial potential of the ports. Thus, exploration and mapping gained new importance and the charts were much more substantial and detailed than the earlier examples. An important historical event, La Salle's attempt to establish a colony in the Mississippi delta in 1684, generated renewed interest for both France and Spain; the Spanish now struggling to maintain control of this area and to explore the northern Gulf coast. Spanish voyages seeking La Salle's settlement led to the realization of the first complete circumnavigation of the Gulf by the Rivas-Iriarte expedition in 1686-87 (Weddle 1987: 139-142).

It was not until 1719 that a precise map of the northern Gulf of Mexico was produced. French geographer Guillaume de L'Isle re-charted the area including the east Texas and Louisiana coasts and the southern Mississippi bayous. Another Frenchman, Bernard de la Harpe produced charts for the area from the Louisiana bayous to the Yucatan Peninsula. In 1742, Jacques Nicolas Bellin conducted a survey of the Louisiana coast, the course of the Mississippi River and Pensacola Bay. He published the results of this survey in 1754, in his map of the Gulf. Thus, by mid-18th century, these precise maps were available especially for the French ships that frequented the area (Gore 1992: 26).

It is possible to generalize the ships used in this early period leading to the French colonization of the northern coast of the Gulf of Mexico. In the first category, are the large merchant ships -the most typical of which being the *galleon*- of long distance trade in bulk. The majority of the shipping in the Gulf in this period was on board Spanish vessels. Spain initiated a different system in the early 17th century, and instead of having a standing navy, they regulated the size of transatlantic merchant ships so that they could be used as warships when and if need arose. Spanish merchantmen generally sailed in convoys (*flotas*) and were capable of sailing without frequent stops for victuals. The second general category of ships frequently used in the Gulf in the 16th and 17th centuries are the small craft used for charting and exploration –the most typical of which being the *caravel* (Pearson and Hoffman 1995: 8-14).

In summary, during the period between the first European discovery of the Gulf of Mexico and the development of the US interests in the Gulf, the main navigation routes consisted of (1) the Spanish convoy route between Vera Cruz and Havana, and (2) the French routes established after the early 18th century reaching the northern ports of New Orleans, Mobile and Biloxi.

With the Peace of Paris, in 1763, France ceded Louisiana to Spain. This marked the end of French commercial and political presence in the area and led to a decrease in the number of French ships frequenting the Gulf ports. The new geopolitical situation in the Gulf included an increased Spanish presence, along with the European ships from Britain, France, and Netherlands. But the most important of all were the ships used and built by the emerging nation of the United States that began to frequent the Gulf ports (Gore 1992: 25). Development of US interests in the Gulf affected the dynamics of trade and navigation, and transformed the nature of commercial transactions as the new country grew, increased its territory and organized its inland commerce along the rivers, and along the Atlantic, Pacific and Gulf coasts.

2.1.3. Commercial Harbors and Ports of the Gulf in the 19th Century

The major commercial ports of the early Spanish trade in the Gulf region were Vera Cruz and Havana. Vera Cruz, and its harbor, San Juan de Ulua, developed as the principal port for gold and silver extracted from the mines of central Mexico and the loot gathered by the conquistadors. Havana developed as a port along the treasure route through the Straits of Florida and became the principal assembly point for the New Spain and Terra Firma fleets.

Ports to the north of the Gulf were mostly developed by the French, around natural harbors along the coastline. Figure 2 shows the locations of these settlements and the approximate and/or generally accepted dates for their establishment as commercial ports.

Figure 2. Major commercial harbors around the Gulf of Mexico (with an emphasis on the north coast), with the generally accepted dates for their foundation. Information based on Gore 1992: 25.

The majority of these shallow ports were difficult to access by the larger commercial vessels. The geographical characteristics of the ports had an effect on the types of ships that were used in this area, and for the type of trade that involved the shipping of goods among the Gulf ports, as well as long distance trade between the Gulf and the Caribbean, Europe and North America. For example, large brigs that sailed to these ports were eventually replaced by smaller ones and schooners. There are several smaller types of vessels that developed from the specific requirements of these ports and the nature of the cargoes being traded. This aspect will be discussed in section 2.2.2.

Furthermore, it was not until the realization of the economic potential of the Mississippi that the ports along the northern coast of the Gulf gained commercial importance. After La Salle's initial exploration, the flow of commercial goods to the Gulf coast began slowly and led to a gradual development of the ports that re-distributed these goods, and provided upriver, inland areas with European goods and raw materials in return. Increasing trade between the French, English, Spanish, and later the US, attracted pirates and privateers to prey on these cargoes that frequented the Gulf.

2.2. Historical Background

2.2.1. Geopolitical Situation, Economic Conditions, and Commercial Navigation in the Gulf of Mexico in the First Half of the 19th Century

From a geopolitical point of view, 18th and 19th centuries constitute a period of transition for the countries around the Gulf of Mexico. The general political climate of early 18th century Europe is characterized by major developments with significant long-term consequences in North America and the Gulf of Mexico: the Enlightenment leading to the French revolution and, more importantly the American Revolution created a completely new environment. After the Seven Years' War, Spanish power underwent a slow and steady decline both in Europe and in America, and especially the lands surrounding the Gulf of Mexico. The major reasons for this can be summarized as piracy, overextension of territories, and the debilitating economic effects of sustained warfare. With the Treaty of Paris (1763) Louisiana passed from France to Spain. Spain ceded the Florida parishes of Louisiana to the British in 1763, only to gain control over this territory again in 1783. Ultimately, the decline in power of Spain prevented the retention of the Florida Parishes and it was ceded, briefly to France, and then to the U.S.

The period between the beginning of Spanish rule in Louisiana, (1763) which transformed the Gulf into a Spanish lake, and the addition of the Gulf-States into the United States (e.g. Louisiana in 1812, Mississippi in 1817, Alabama in 1819, Florida and Texas in 1845) is the most colorful period in the political history of the Gulf. The Expansion of the US to the south, to include the coastal territories, was a crucial one. By the early 1800's the Mississippi River had assumed a dominant role in U.S. commerce, connecting the interior of the country to the Gulf and to the rest of the world via shipping lines accessible through the ports such as New Orleans, Mobile and Pensacola (Gore 1992: 45). In addition to the long-distance international trade that was conducted mainly by the British, coastal trade within the Gulf of Mexico also improved in this period (Gore 1992: 45).

The effects of the industrial revolution reached the Gulf of Mexico almost immediately. The establishment of the commercial networks and navigation routes in the basin, during this period during which the commercial activities in North America intensified, was mainly due to a few major industrial developments. Eli Whitney's Cotton gin was invented in 1793, and its widespread use enabled cotton farming to become more efficient and the farmers to profit largely. Now that the south had developed the farming of an economically efficient crop – to replace the revenue lost from the recessing tobacco production in the north – a farming system to ameliorate this production was necessary. Thus, the plantation system, which also originated in the tobacco economy of the 17th-century Chesapeake colonies, was adopted in the cotton and sugar growing lands to the north of the Gulf of Mexico, mainly, between 1790s and 1860 (Rehder 1999: 54-55).

In the late 18th and early 19th centuries, these developments impacted navigation and maritime trade in the Gulf in two major ways. First, developing textile industries in the North of the U.S. and in Britain led to a substantial increase in the shipping volume from the Gulf region, and especially from the ports of New Orleans and Mobile. Second, the thriving cotton economy brought an extraordinary increase in the volume of slavery. Increasing numbers of slaves were needed to man the large-scale and labor-intensive plantations. Thus, these people became the new "cargo" of the ever-increasing number of ships frequenting the ports of the northern Gulf of Mexico. More ports developed to accommodate lumber, grain, cotton, and sugar trade along the coasts of Louisiana, Florida and Texas.

The two decades between 1830 and 1850 was a lucrative period for the merchant marine of the United States. In this period, there was an increased demand from the east coast and Europe for the cotton that grew along the northern coast of the Gulf, or reached the ports in this area via rivers. New navigation routes developed to form a shipping triangle connecting the Gulf ports to the ports on the northeast coast of North America and Europe (Garrison et al. 1989).

In the first half of the 19th century, the products that were shipped down the Mississippi to New Orleans were exported to markets throughout the world. Ships frequented between the European ports including France, England, Prussia, Netherlands, Spain, Italy, as well as the major markets of the Caribbean, Mexico and South America and New Orleans. In addition, the major part of seaborne commercial traffic took place between ports in the United States coastal regions facing the Atlantic Ocean, as well as the Gulf coasts of Florida, Alabama, Mississippi and Texas. Major exports from New Orleans consisted of food and grain that came down the Mississippi from the hinterlands to be shipped to the Caribbean and South America. Sugar and pork appear as the most valuable commodities exported to domestic ports, while cotton was largely exported to Europe and was the leading export by value in European markets (Redard 1985). Archival sources indicate that in exchange for cotton and food, New Orleans imported what can mostly be categorized as "luxury goods": glassware, soap, textiles, hardware, and candles (Redard 1985).

Additional historical data collected from the issues of the New Orleans *Bee*, a daily newspaper published in New Orleans between 1827 and 1925, provides a better understanding of the commercial traffic and the ships. The pattern of ship arrival and departures in 1828 (the year is roughly in the middle of the period of interest for the study of the Mica shipwreck, and a hurricane-free year) show that 42 percent of the ships that had a commercial cargo that arrived at

New Orleans were from U.S. ports on the Atlantic coast of North America (namely, Baltimore, Boston, Charleston, and the majority of them were from New York and Philadelphia), 27 percent were from Europe (Amsterdam, Belfast, Bordeaux, Marseilles, Le Havre, and Liverpool), and 15 percent were from Caribbean ports (Havana and Port au Prince). Sixteen percent of the incoming ships came from ports within the Gulf, 13 percent were from ports to the south and east (Campeche, Tampico and Vera Cruz) and only three percent were from the north (Mobile). As for the departures, 46 percent of the ships returned to the ports on the Atlantic coast of North America (Baltimore, Boston, New Haven, New York, Philadelphia, and Richmond), 19 percent brought an overwhelming majority of cotton cargoes to European ports (Le Havre and Liverpool) and nine percent returned to Havana and Port au Prince. Twenty six percent of the ships returned to the ports around the Gulf (11 percent to Mobile and Pensacola and 15 percent to Vera Cruz, Tampico, Tabasco and other minor destinations in Mexico). In all, the numbers from the arrival and departure records are in accordance with the historical information. Most of the commercial traffic was between Northeastern U.S. ports, and especially New York and Philadelphia. Overseas destinations made up the second largest category, and the traffic among the Gulf ports was the next to follow. Markets along the southern coast of the Gulf appear to have sent more ships into New Orleans, and those ships seem to go through Florida ports on their return journeys, which is surprising as they would be sailing against the Loop Current.

A random sampling of ship arrivals and departures between 1820 and 1850, which were advertised or printed in the New Orleans *Bee*, reveals that while about 50 percent of the ship types were not specified, about 60 percent of the specified ships were brigs, and 20 percent were specified as schooners. The remaining 20 percent of the ships were larger types, such as barques, and smaller ships.

3:0 THE MICA SHIPWRECK PROJECT: OBJECTIVES, METHODOLOGY AND TECHNOLOGY

3.1. Description of the Archaeological Site

The Mica Shipwreck site is 810.4 meters (2660 feet) deep and is located in the Mississippi Canyon Area in the Central Gulf of Mexico. Measurements taken during the various visits to the site show the wreck to have an overall length of approximately 20.4 meters (67 feet). The Mica Shipwreck is bisected by a pipeline (about 20 cm/ 8 in diameter). The site is in exceptional state of preservation, with the exception of the damage caused by the accidental installation of the pipeline.

The pipeline has almost perfectly bisected the vessel across the midships section. The pressure exerted by the pipeline on the longitudinal members of the ship caused the bow and stern of the vessel to lift approximately one foot above the sediment (Jones 2004: 14). Although the extremities of the ship remains were lifted off the bottom, no structural timbers of the ship were broken, possibly due to the waterlogged, and thus flexible nature of the wood. However, the port and the starboard sides of the vessel, at the locations where the pipe is exerting weight on these timbers, are splayed outward. The external starboard aft quarter of the vessel represents the best-preserved portion of the site. In this location, large sections of intact copper sheathing is still covering the hull planking.

A detailed study of the inside of the hull and its contents is hindered by the nature of the seafloor in this area: the Mica Shipwreck Site lies on a bed of fine silt, a typical feature of this part of the Gulf coast. The sediment particles are continuously discharged from the Mississippi River into the Gulf of Mexico. As a result, the hull of the Mica shipwreck, which sits upright on its keel, is completely filled with fine sediment, and the continued discharge of silt decreases visibility. During the field investigation, it was observed that sediment that had already been deposited on the wreck is easily disturbed, and could remain suspended for several minutes (Jones 2004: 5). While the current direction seemed variable, it was usually under half a knot and did not greatly assist in improving working visibility and general working conditions.

3.2. Summary of Fieldwork Activities Prior to the Main Field Season

The Mica Shipwreck project was carried out in several field seasons. The sections below describe the goals, activities and the results of these field seasons, followed by a basic description of the tools and technical means employed to collect and recover this information. In summary, the initial scientific visit to the site identified the site and determined its scientific and historic value. Subsequent visits and fieldwork conducted resulted in the information presented in section 3.6., and analyzed in section 4 below.

3.2.1. Research Goals and Scientific Objectives

The Texas A&M University Department of Oceanography, Deep Tow Research Group (DTRG) and Nautical Archaeology Program (NAP) had originally planned to carry out the study of this shipwreck in two phases. General goals, objectives and methodology of these phases are presented in Table 1 below.

Sections 3.3. and 3.4. describe the actual work and the equipment used for the project. Differences between the original work design submitted to the MMS and the actual tasks carried out during the fieldwork are due to equipment availability and technical failures of certain components. This report will not include a discussion of technical failures, problems and malfunctions encountered during the field season. Instead, the accomplishments and the results will be described, discussed and analyzed in detail in sections 3.4. and 4.

Table 1

Planned Objectives and Methodology for the Main Field Season of the Mica Shipwreck Project

(Source: Internal document titled: "Proposal to Use the RV *Carolyn Chouest* and the Submarine NR1 to study the Mississippi Canyon Shipwreck (MC001)." Pp. 1-3.)

	Scientific Objectives	Methodology
Phase I	Task 1: Deep Tow imaging system will be deployed from the RV *Carolyn Chouest* to survey a 180 square kilometer area centered on the shipwreck site. Objective: To determine the limits of the archaeological site.	The sonar system will be set for a 1000 meter swath with 50% overlap on adjacent survey transects spaced 750 meters apart. Estimated time: 5 days
Phase II	Task 1: NR1 will survey a 1 square kilometer area centered on the wreck site prior to excavation. Objective: Verifying the limits of the archaeological site.	High-resolution side-scan sonar array, part of technical equipment of the NR1 will be employed. Estimated time: 1/2 day
	Task 2: Collection of photographic data of the wreck site and immediate surroundings	Documentation of the site and possibly creation of a photomosaic map, using NR1 cameras. Estimated time: 1/2 day

Table 1

Planned Objectives and Methodology for the Main Field Season of the Mica Shipwreck Project (continued)

(Source: Internal document titled: "Proposal to Use the RV *Carolyn Chouest* and the Submarine NR1 to study the Mississippi Canyon Shipwreck (MC001)." Pp. 1-3.)

	Scientific Objectives	Methodology
Phase II (contd.)	Task 3: A venturi dredging system will be deployed from the NR1 to excavate portions of the interior hull in the bow, stern and along the mishaps section of the wreck.	The venturi dredge system will be deployed with the NR1 manipulator arm, requiring the vessel to keep station above the shipwreck site. Small artifacts collected in the dredge system will be stored in "baskets" integrated into the dredge system to allow for the periodic segregation of archaeological material into discreet units. Estimated time for tasks 3, 4, 5 and 6 (total): 5 days
	Task 4: An ROV will be deployed from the NR1 during excavation to capture small artifacts not collected in the dredge system.	TBD
	Task 5: 15 test pits (about 50 cm deep) will be excavated around the exterior of the site to determine the extent of the artifact scatter	The venturi dredge system will be used for this task. Estimated time for tasks 3, 4, 5 and 6 (total): 5 days
	Task 6: recovery of a section of the sternpost of the wreck, along with miscellaneous wood samples from the keel, keelson, frames and other structural elements.	NR1- manipulator arm. Estimated time for tasks 3, 4, 5 and 6 (total): 5 days

3.2.2. First Scientific Visit to the Site

The Mica Shipwreck site was first visited by an archaeological team from the Minerals Management Service on 23 February 2001. Dr. Jack Irion, Dr. Richard Anuskiewicz, and Mr. David Ball, from the Social Sciences Unit, mobilized on 23 February 2001, and investigated the wreck using a work-class ROV. The major outcome of this initial visit was the retrieval of wood and metal samples from the hull of the shipwreck. The samples consisted of five small pieces of metallic sheathing, several fragments of wood from the outermost layer of planking, and a large lead hawse-pipe. A detailed visual documentation of the site was also performed for future analysis.

Analysis conducted on the wood samples indicated that the material used for the sacrificial planking, where the samples were collected, was northern white pine, an American species that grows widely in eastern North America (for details of wood analysis see section 4.1.1). After further analysis of the visual data and an initial inspection of the copper samples, the Minerals Management Service team identified the vessel as a ship that sank in the first half of the 19th century and one of historical significance, potentially eligible to be listed on the National Register of Historic Places.

Because the site had significant historic value, the Minerals Management Service formulated four options for the protection of the site: (1) Lifting and re-routing the pipeline around the wreck to prevent further damage to the site; (2) Constructing a sandbag bridge over the wreck; (3) Cutting and re-routing the pipeline around the wreck; (4) Leaving the pipeline in place, and conducting a limited data recovery program for an archaeological study of the site (Anuskiewicz et al. 2002: 80).

The depth of the wreck, engineering difficulties involved with working at this depth in order to re-route or elevate the pipeline without causing further damage to the site, and a comparison of the cost figures involved with each option indicated that the most feasible option was to conduct a data recovery program. Funding for the project was supplied by the pipeline operator under the Archaeological and Historic Preservation Act of 1974, as amended (16 U.S.C. 469-469c-2) also known as the Moss-Bennett Act, which allows government agencies to collect funds from a private source to apply towards salvage archaeology.

Upon developing a research design, the Minerals Management Service determined that the data recovery program would require the use of a suitable ROV or submersible (1) to excavate a representative portion of the interior of the wreck, (2) recover diagnostic artifacts, (3) excavate up to 15 test units outside the wreck to determine if a scattering of artifacts exists outside the wreck, and (4) obtain high quality video and digital images for full documentation of the site (Anuskiewicz et al. 2002: 80-81).

The Minerals Management Service then contacted Texas A&M University about entering in a joint partnership to investigate the site. Scientists from the Department of Oceanography and archaeologists from the Nautical Archaeology Program in the Department of Anthropology worked together to draft a cooperative agreement with the Minerals Management Service. The joint proposal called for the investigation and possible partial excavation of the Mica shipwreck. The proposal recommended the use of several sophisticated research tools designed specifically for use in the deep ocean, including the United States Navy's nuclear-powered research submarine, NR-1, as well as Texas A&M University's Deep-Tow underwater remote sensing system. The plan also called for the use of several remotely operated vehicles, tasked specifically with photographing and retrieving selected artifacts. The proposal was reviewed and accepted by the Minerals Management Service, and the Texas A&M University Research Foundation, which administered the accounts related to the Mica shipwreck excavation.

3.2.3. Second Scientific Visit to the Site

C&C Technologies of Lafayette, Louisiana, performed a survey of the shipwreck area using an autonomous underwater vehicle (AUV). The torpedo-shaped un-tethered robot surveyed the wreck flying over the site at regular width intervals and at a preset altitude (Figure 3). The goal of the survey was to determine the extent of the shipwreck site and detect any geohazards that might complicate the investigation (Figure 4).

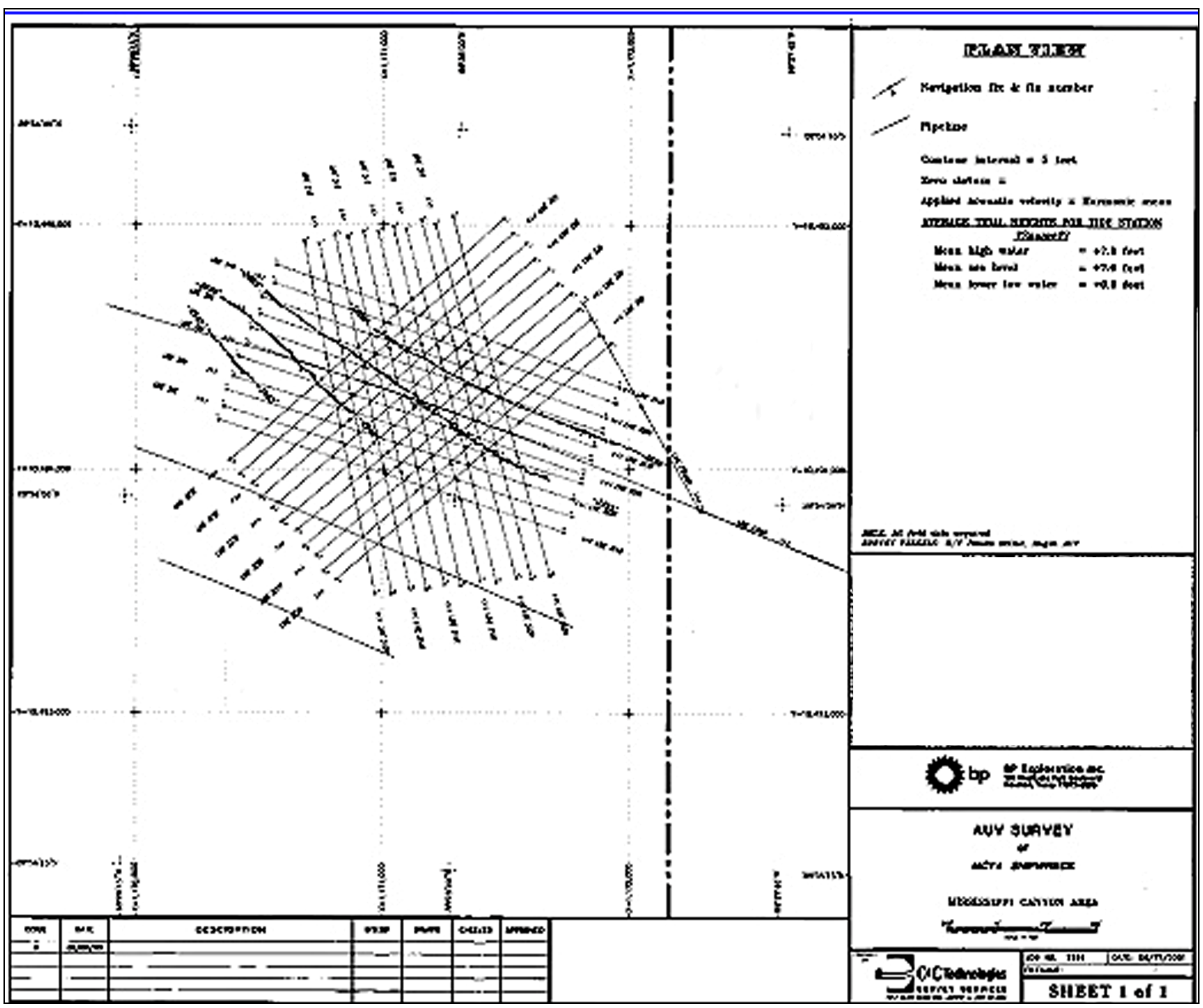

Figure 3. Survey route of the Hugin Autonomous Underwater Vehicle. The vehicle was equipped with multi-beam and side scan sonar systems (Image courtesy of C&C Technologies).

Data collected with the C&C Technologies AUV system provided a detailed image of the seafloor surrounding the Mica Shipwreck but did not provide any further diagnostic information about the site itself. The survey did, however, show that there was no significant component of the site in the immediate area that was not associated with the main area of wreckage adjacent to the pipeline.

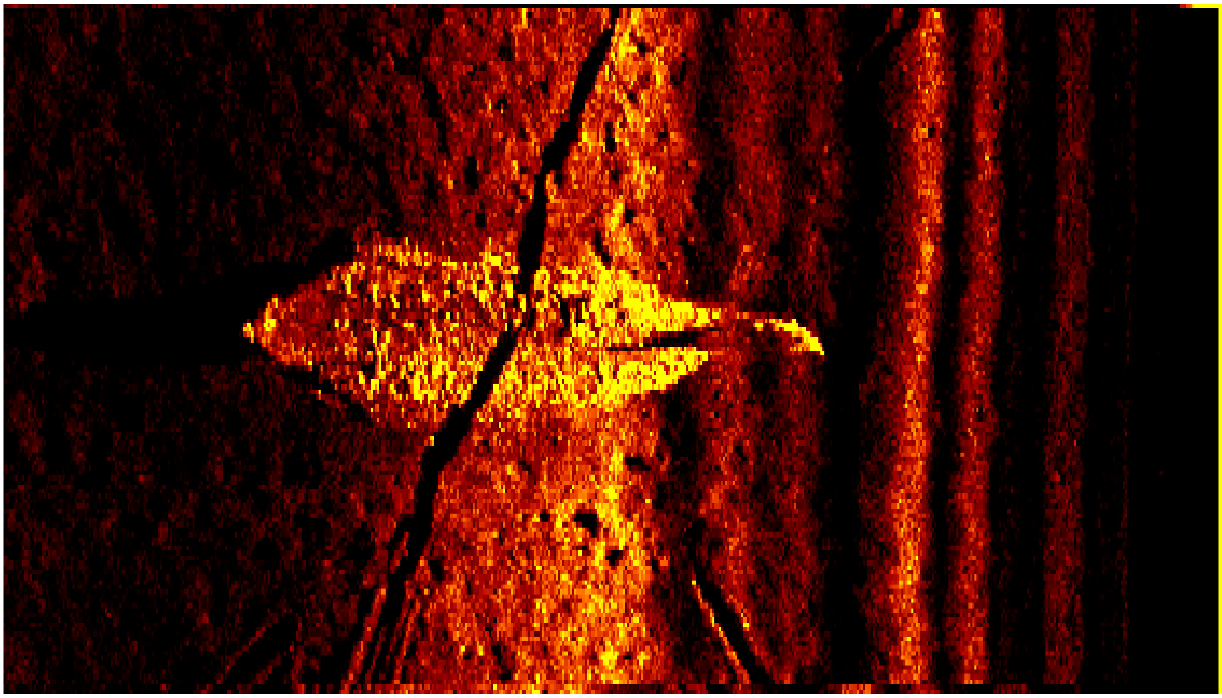

Figure 4. Side scan sonar image of the Mica shipwreck (Image courtesy of C&C Technologies).

3.3. Scientific Investigation Tools Used in the Main Field Season

3.3.1. Underwater Positioning

Underwater positioning for the NR-1 was provided by an ultra-short baseline (USBL) acoustic tracking system, coupled with a doppler-velocity log (DVL) on board the submarine. This provided highly accurate positional data when the vessel was within 180 meters (about 600 feet) of the seafloor, however during the descent to the Mica shipwreck site, the NR-1 would dead-reckon from a logged GPS position captured while surfaced. The surface support ship would track the NR-1 by USBL during their descent to the seafloor and once on the bottom, the submarine would update its calculated position via acoustic telephone. While working in proximity to the seafloor the NR-1 utilized the DVL to calculate velocity, altitude, depth, and relative motion from their most recently updated GPS/USBL position.

3.3.2. NR-1

The main tool used for the study of the Mica Shipwreck site was the nuclear powered submarine NR-1 (Figure 5). The submarine was designed, built, and operated by the United States Navy. The 45.72 meter (150 foot) submarine was launched in 1969 and is capable of diving to 914.4 meters (3000 feet). It has numerous unique features that make it a valuable asset to marine archaeologists. The submarine is equipped with a large manipulator arm and 14 digital video cameras that have zoom, pan and tilt features. Numerous lights are attached to the hull of the submarine, providing ample illumination in the otherwise pitch-black environment. There is a work module attached to the external hull of the submarine, located immediately in front of the manipulator arm, which contains various tools. These tools are used by the manipulator arm, and include soil coring devices as well as gripping and cutting attachments. There are three view ports on the lower bow surface of the hull, directly behind the manipulator arm. From this vantage point it is possible to observe the actions of the manipulator arm as well as directly observe the wreck site without the use of cameras.

Figure 5. The United States Navy Submarine *NR-1* surfaces during the investigation (Photograph by Toby Jones).

3.3.3. SSV *Carolyn Chouest*

SSV *Carolyn Chouest* is the surface support vessel for NR-1 (Figure 6). The 72.5 meter (238 foot) vessel has a beam of 15.9 meters (52 feet) and a draft of 5.2 meters (17 feet). The surface vessel tows NR-1 between work areas, as well as serving as a floating supply warehouse and quarters for the extra crewmembers. During the Mica shipwreck investigation, the scientists were housed in staterooms on the SSV *Carolyn Chouest*, and used this vessel as the main work platform.

Figure 6. SSV *Carolyn Chouest*, the surface support vessel for *NR-1*. The vessel was docked at Pensacola Naval Air Station, Pensacola, Florida (Photograph by Toby Jones).

3.4. Activities of the Main Field Season

Activities of the main field season will be presented and described in Table 2 below, followed by a discussion of results and an overview of the information gathered. Sections 4 and 5 concentrate on a detailed archaeological discussion and interpretation of the results presented in sections 3.4. and 3.5.

Table 2

Activities of the Main Field Season of the Mica Shipwreck Project

Archaeologist	Date	Activities and observations	Methodology/technical information
	24 July 2002	Research vessel departed Biloxi, Mississippi.	
Toby Jones	24 July 2002	NR-1 re-located the shipwreck site	
Toby Jones	24 July 2002	Data required to create a side scan mosaic of the site was collected.	A grid was established to maintain necessary coverage. High-resolution 600 kHz side scan sonar images of the wreck site were collected from an altitude of 4.6 meters (15 feet) above the seafloor.
Toby Jones	24 July 2002	Close examination of the artifacts, copper sheathing, nailing patterns, a search for makers'-marks on the copper sheaths, and a general study of other construction features of the hull.	
Toby Jones	25 July 2002	Inspection of a side scan sonar target near the main shipwreck site, which appeared to be modern debris.	Examination of the object performed using the NR1 cameras.
Toby Jones	25 July 2002	NR-1 surfaced and returned the scientists to the *Carolyn Chouest* for a meeting regarding the findings, and to make decisions about how to proceed.	Duration of the first dive: 21 hours and 13 minutes. [Decision to surface: poor visibility]

Table 2

Activities of the Main Field Season of the Mica Shipwreck Project (continued)

Archaeologist	Date	Activities and observations	Methodology/technical information
Toby Jones	25 July 2002	Second dive of the NR1 to the site.	Duration of the second dive: 3 hours. [Short dive due to technical reasons]
Richard Anuskiewicz	26 July 2002	Third dive of the NR1 to the site.	
Richard Anuskiewicz	26 July 2002	Visual inspection of artifacts and recovery attempts.	Manipulator arm on the NR-1 was used to nudge artifacts, and recover them. However, the manipulator arm is not designed for such detailed work and this task was aborted.
Richard Anuskiewicz	26 July 2002	Investigation of the wooden elements of the wreck beneath the sediment.	NR-1's forward maneuvering thrusters were used to gently clear the sediment on site.
Richard Anuskiewicz	26 July 2002	NR-1 surfaced and returned the scientists to the *Carolyn Chouest.*	Duration of the third dive: 16 hours. [Decision to surface: poor visibility]
Kevin Crisman	27 July 2002	Closer inspection of the hull and the stone ballast in the hold. Keelson bolts were observed in the areas adjacent to the pipeline.	A systematic documentation of the site was made possible as the NR1 has flown over the site from the stern to the bow, allowing for the inspection of the necessary details.

Table 2

Activities of the Main Field Season of the Mica Shipwreck Project (continued)

Archaeologist	Date	Activities and observations	Methodology/technical information
Kevin Crisman	27 July 2002	Visible artifacts in the hold were metal spikes that may have been loose in the ship, or may have fallen out of disintegrated structural components of the hull and the base of a glass bottle and a rod-like object that may have been part of a chain-plate.	
Kevin Crisman	27 July 2002	Rigging elements: deadeye strap on the port side + two chain-plates on the starboard side were photographed in the bow area near the cant frames.	
Kevin Crisman	27 July 2002	Structural elements: large structural timber that may have been part of the keelson. This section of the keelson did survive around a copper bolt that prevented its biological degradation.	
Kevin Crisman	27 July 2002	Attempt to recover the upper end of the sternpost, including a gudgeon.	The post was removed, and allowed to fall on the bottom, which was than picked up using the NR-1's manipulator arm.
Kevin Crisman	27 July 2002	Due to a technical problem, the manipulator arm of the NR-1 failed during the ascent of the submarine, causing it to lose its grip on the upper end of the sternpost. The artifact sank back to the bottom.	The technical team was unable to repair the problem, and recover this piece of the sternpost. Duration of the fourth dive: 15 hours. [Decision to surface: poor visibility]

Table 2

Activities of the Main Field Season of the Mica Shipwreck Project (continued)

Archaeologist	Date	Activities and observations	Methodology/technical information
Kevin Crisman	27 July 2002	The mechanical failure of the NR-1's manipulator, coupled with the destruction of the ROV due to technical malfunctions, left our team without means of recovering artifacts from the wreck site. Considering that enough visual and acoustic data was already collected, fieldwork was concluded.	

3.5. Fourth Scientific Visit to the Site

In January 2003, Deep Marine Technology, Incorporated, an offshore services company based in Houston, Texas, donated four days of ship time to Texas A&M University to visit the Mica Shipwreck and complete the previous year's work. The surface support vessel *Rylan T*, a MaxRover ROV, and several trained pilots were made available along with an artifact retrieval basket designed, built, and deployed by Deep Marine Technology. The company also brought along a DeepWorker one-man submersible.

The site was surveyed by the ROV. It was covered with approximately a 5 centimeter (1.96 inches) thick layer of sediment since the last visit, six months prior. Two rows of copper spikes, protruding 0.15 meters (0.5 feet) from the seafloor, were found approximately eight meters (26.3 feet) west of the wreck, running parallel along the port edge. The spikes could have been used to fasten external hull planking or wales to the upper hull frames (Jones 2004: 48). An entire sheet of metallic sheathing from the port midships section of the ship was selected for recovery, but the ROV only succeeded in removing a small sample, with no visible identification marks. The MaxRover vehicle surveyed the port stern quarter of the vessel, and the archaeologists noted that the metallic sheathing had been peeled away, making it easier to remove with the manipulator arm. However, before the vehicle could obtain a sample of sheathing in that area, the main power supply cable failed, causing the pilots to lose telemetry with the MaxRover. The remotely operated vehicle was winched to the surface, but the artifact retrieval basket, containing samples of the metallic sheathing, remained adjacent to the port side of the hull on the seafloor (Jones 2004: 48).

3.6. Results

The bow of the ship is easily recognizable by the presence of the cant frames (Figure 7). The frames protrude through an estimated two meters (6.6. feet) of sediment that fills the foremost part of the hull and seem to be in a poor condition due to the damage caused by marine organisms. The lead hawse pipe seen in figure 15 and described in detail in section 4.1.3 was retrieved from this area.

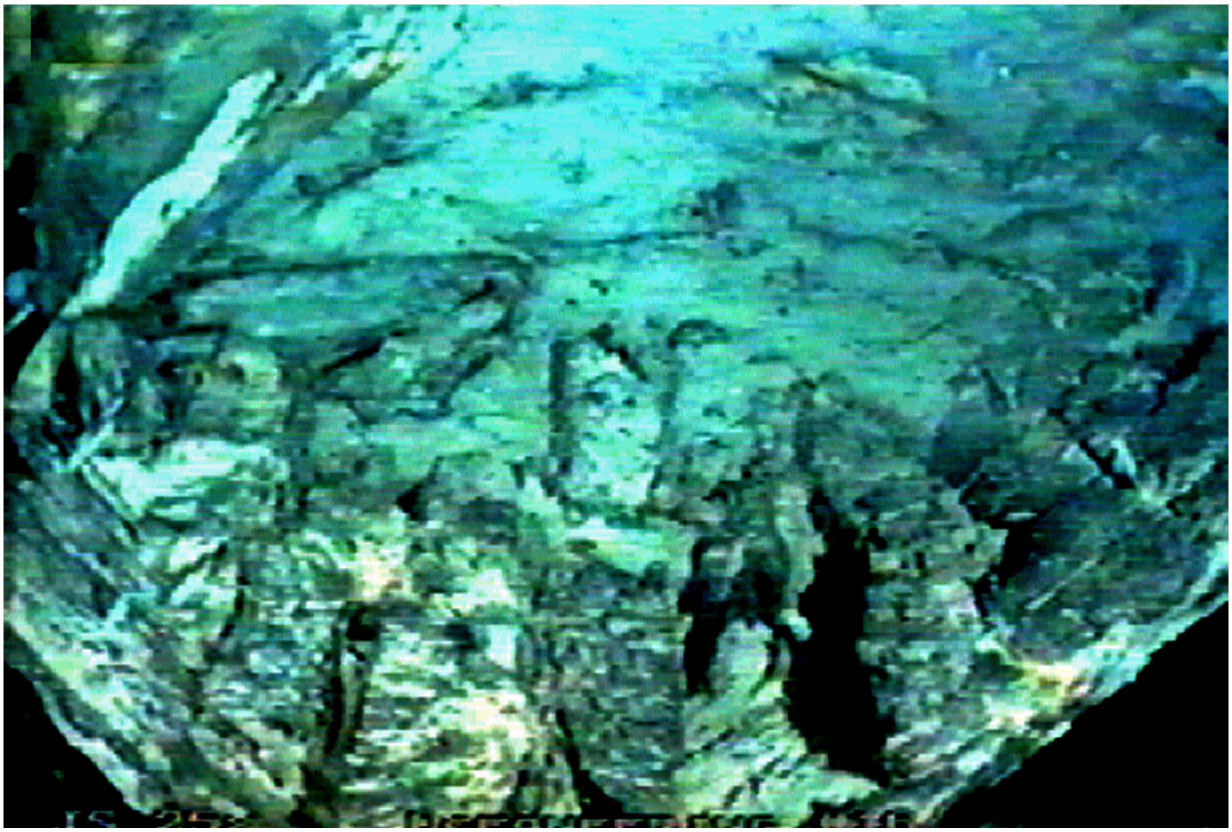

Figure 7. Bow area of the Mica shipwreck, note the cant frames. No scale. (Photograph courtesy of the United States Minerals Management Service and ExxonMobil Corporation).

The outside part of the stem of the ship is copper sheathed, easily identified by virtue of the green patina it developed over time. Each sheet of metal overlapped and was fastened to the hull with copper nails or tacks that also had a dull green patina. There were nails fastened in evenly spaced diagonal rows across the face of each piece of sheathing (Figure 8).

Figure 8. Detail of the starboard stern quarter of the Mica shipwreck. Note the dense nailing around the edges and the quincunx pattern in the middle of each sheet. No scale. (Photograph courtesy of the United States Minerals Management Service and ExxonMobil Corporation).

In the midship section, the frames and attached planking appear to have fallen away and out, but still are attached to the keel at their bases (Figure 9). The planks of the midship section reveal an interesting feature of the ship: a second layer of planking between the standard planking that was nailed to the frames and the metallic sheathing. This layer, known as sacrificial planking, is generally found on vessels that were not sheathed with metal. The apparent use of two different types of sheathing on the same vessel seems redundant, and there are no other known shipwreck sites exhibiting this strange practice. However, it is conceivable that the widening use of copper sheathing on ships might have inspired the owners of this vessel to adopt this new technology perhaps to encourage potential customers, merchants and passengers. In this period, the fact that a ship was copper sheathed was advertised as an indication of its sturdiness, and it is conceivable that the copper sheathed ships had fewer difficulties finding more profitable cargos for carriage (see appendix 6:0).

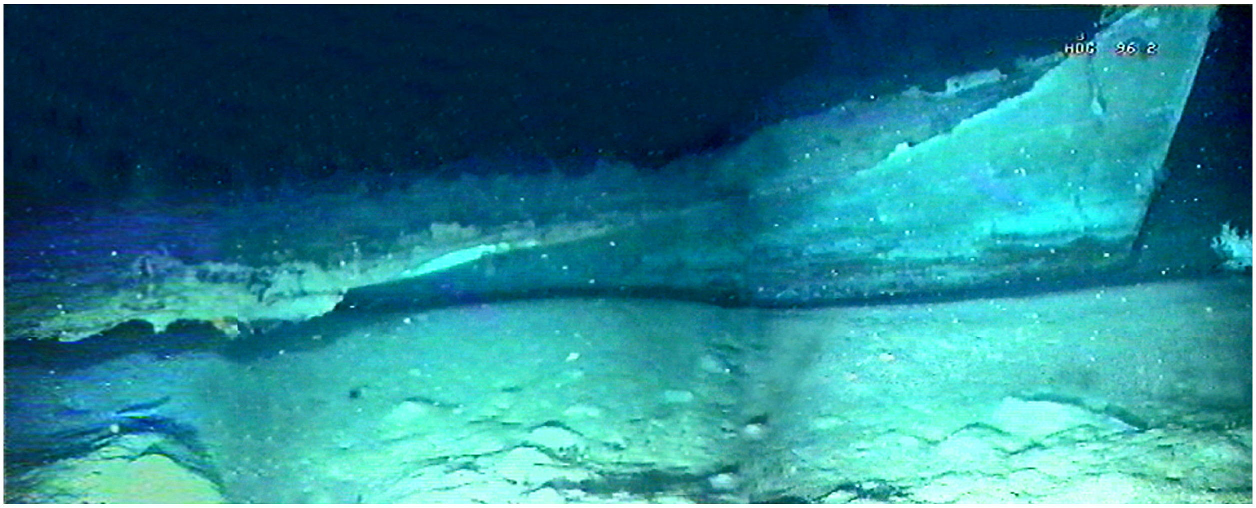

Figure 9. Profile view of the port stern quarter of the Mica shipwreck. The thin sacrificial planking can be seen attached to the copper sheathing. The laying of the pipeline caused the gunwales of the vessel to spread outward near amidships (Photograph courtesy of the United States Minerals Management Service and ExxonMobil Corporation).

After a few hours of work with the submarine NR-1, and particularly its forward maneuvering thrusters, enough sediment was removed from the shipwreck site to uncover frames and possibly ceiling planking in the section of the shipwreck pushed down by the weight of the pipeline. A line of keelson bolts was also visible running down the centerline of the vessel near amidships. The bolts appeared to fasten the degraded keelson to the floor timbers and keel. A fragment of the keelson was visible immediately aft of the pipeline along the centerline of the wreck. Moving aft, a pile of large spikes, probably copper alloy, were seen near the port stern quarter of the wreck. The spikes, which were too large to attach metallic sheathing to the hull, might have fastened the exterior planking to the frames. The pile is likely to have been formed by the slow disintegration of a frame that contained numerous spikes (Figure 10).

The stern section of the vessel is also sheathed in copper. The most important features in this section were the sternpost, two gudgeons, and skeg. There was no evidence of the rudder itself, which might have become unattached during the sinking of the ship. The rudder may be in the general area of the shipwreck site but the brief search for it did not yield any results and the soft seafloor sediment may conceal it from view permanently. The top portion of the sternpost was removed, leaving the wreck site with one intact gudgeon and the skeg available for future research. Unfortunately, a technical malfunction of the submarine led to the loss of the portion that was removed from the site for analysis purposes. The technical malfunction caused the manipulator arm to loose its grip on the sampled wooden component, which sank to the bottom and was not recovered.

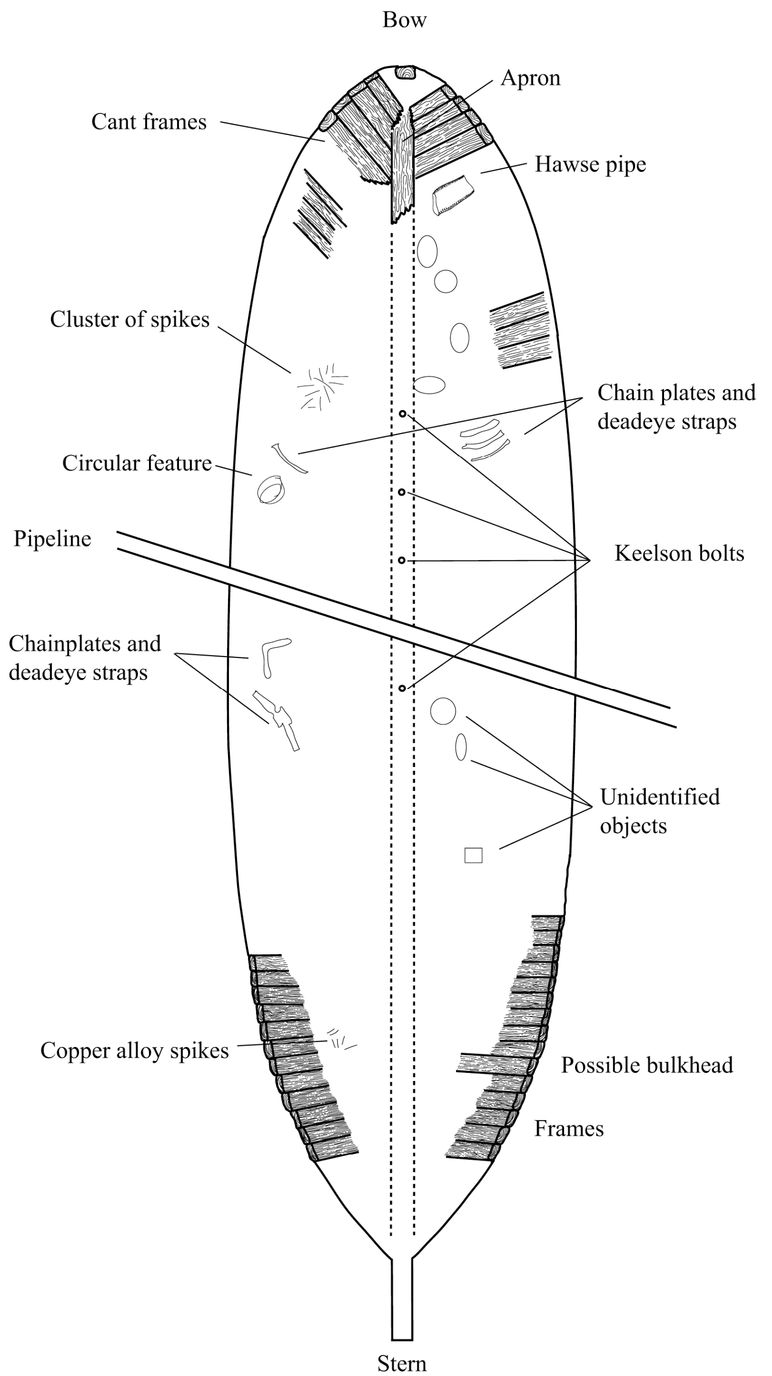

Figure 10. A sketch drawing of the Mica shipwreck site showing the approximate positions of the artifacts and major features of the wreck site. (Sketch drawing - no scale. Sketch by Ayse Devrim Atauz).

The thick layer of sediment lining the inside of the shipwreck made it difficult to observe any remains of the ship's rigging. There were numerous objects resembling blocks scattered about the surface of the wreck, however. It is possible that these were clams or concretions, or other objects covered-over by sediment. During the exploration of the site, no rigging elements or specific evidence of rig type or sail arrangement were identified or recovered. However, the positions of the masts could be identified through a study of chain-plates and deadeye straps. Three possible groups of chain-plates and deadeye straps were found, one on the port side of the wreck just aft of amidships and one on either side of the vessel several meters aft of the bow, indicating that the vessel had at least two masts (Figure 11). Since no sign of guns, gun ports, or other armament was discovered, it is safe to assume that the Mica vessel was a merchant ship. Sailing merchantmen of this period, and of this particular tonnage (110-120 tons - see below), were likely to be rigged as schooners. Based on the positions of the preserved rigging elements on the hull, we identified the ship as a schooner (see section 4.1.5.). The reason the majority of small to medium tonnage merchant vessels preferred this type of rigging is due to the relatively small size of the crew required to operate the sails and the maneuverability provided by this sail configuration in the hazardous coastal waters of the Gulf (Chapelle 1935: 133).

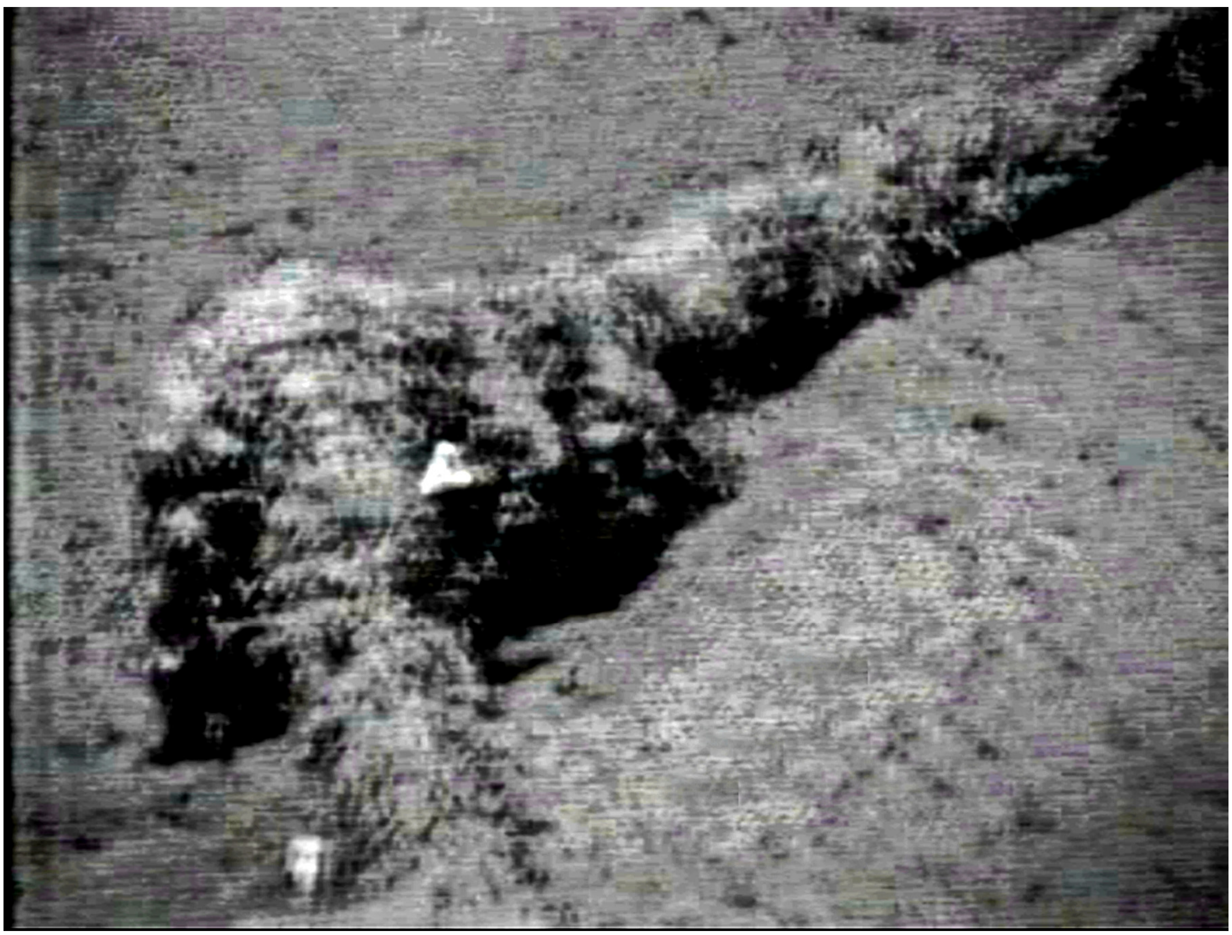

Figure 11. Chain-plate or deadeye strap seen aft of amidships on the port side. No scale. (Photograph courtesy of the United States Minerals Management Service and ExxonMobil Corporation).

As mentioned in the introduction, the shipwreck remains are preserved to a length of approximately 19.8 meters (65 feet). Based on this measurement, the overall length of the vessel is estimated to be 21.9 meters (72 feet). Table 3 shows a list of ships about the same size as the Mica Shipwreck, selected from the Ship Registers and Enrollments of New Orleans, Louisiana. Two-masted schooners between 65' and 75' of length were selected for review, based on the size of the shipwreck remains and other information gathered through analysis of rigging elements. Based on this comparative data, it is possible to estimate that the Mica vessel was likely to have been a 110-120 ton ship, based on the calculation of an average of similar sized and rigged vessels.

Table 3

A Comparative Analysis of Two-masted Schooners in the Mica Vessel's Size Range for Tonnage Estimation Purposes.
Data from: Ship Registers and Enrollments of New Orleans, Louisiana: Vols. I-IV.

Date	**Name**	**Ship Type**	**Home Port**	**Construction place**	**Tonnage**	**Length**	**Breadth**	**Depth**	**Rig**
1804	*Alleghany*	schooner	Pittsburg PA	Pittsburg PA	104	72' 9"	20'	9'	1 deck, 2 masts
1812	*American Hero*	schooner	Wareham MA	Hallowell MA	128	73'	23'	8' 11.5"	1 deck, 2 masts
1814	*Ann*	schooner	Cohasset MA	Cohasset MA	91	67' 3"	19' 9"	7' 11"	1 deck, 2 masts
1815	*Ann*	schooner	Portsmouth NH	Portsmouth NH	86	66.8'	17.6'	8.4'	1 deck, 2 masts
1818	*Arringdon*	schooner	Gardiner MA	Hallowell MA	110	70'	21' 6"	8' 6"	1 deck, 2 masts
1796	*Bee*	schooner	Norfolk VA	Newburyport MA	75	66' 9"	20' 1"	6' 6.5"	1 deck, 2 masts
1807	*Betsey*	schooner	Fairhaven PA	Saco MA	83	65' 6.5"	21' 1"	7' 1"	1 deck, 2 masts
1807	*Betsey*	schooner	Barnstable MA	Barnstable MA	94	67' 10"	19' 11"	8' 10.25"	1 deck, 2 masts
1803	*Betsy*	schooner	Wareham MA	Scituate MA	74	65' 3.5"	29' 5"	6' 6.5"	1 deck, 2 masts
1805	*Caty Ann*	schooner	New Orleans	Lyme CN	133	70' 10"	21' 2"	10' 4"	1 deck, 2 masts
na	*Celeste*	schooner	New Orleans	na	131	68' 6"	20' 6"	10' 10"	1 deck, 2 masts
1806	*Centurion*	schooner	New Orleans	Saybrook CN	133	80' 9"	20'	9' 7"	1 deck, 2 masts
1814	*Chance*	schooner	New Orleans	Manchester MA	104	70'	19' 10"	8' 7"	1 deck, 2 masts
1815	*Charles*	schooner	Salem MA	Westbrook MA	109	68' 4"	21' 5.5"	8' 9.25"	1 deck, 2 masts
1806	*Charlotte*	schooner	New Orleans	Norfolk Co. VA	100	70' 6"	20' 4"	8'	1 deck, 2 masts

Table 3

A Comparative Analysis of Two-masted Schooners in the Mica Vessel's Size Range for Tonnage Estimation Purposes (continued).
Data from: Ship Registers and Enrollments of New Orleans, Louisiana: Vols. I-IV.

Date	**Name**	**Ship Type**	**Home Port**	**Construction place**	**Tonnage**	**Length**	**Breadth**	**Depth**	**Rig**
1804	*Conquest*	schooner	Pittsburg PA	Pittsburg PA	112	68'	20' 4"	9' 5"	1 deck, 2 masts
1814	*Criterion*	schooner	New Orleans	Dorchester Co. MD	76	67' 9"	20' 6"	6'	1 deck, 2 masts
1819	*Cygnet*	schooner	Hallowell MA	Pittston MA	135	72' 10"	22' 6"	9' 9"	1 deck, 2 masts
na	*Dolores*	schooner	New Orleans	na	123	75' 8"	21'	8' 10.5"	1 deck, 2 masts
1805	*Enterprize*	schooner	Hampden MA	Hampden MA	99	71' 8"	21' 3"	7' 6"	1 deck, 2 masts
1815	*Farmers Fancy*	schooner	Richmond VA	Cabbin Pt. VA	147	75' 8"	24' 1"	9' 6"	1 deck, 2 masts
1813	*Favorite*	schooner	Worchester Co. MD	Glastonbury CN	102	68'	21' 9"	8' 2"	1 deck, 2 masts
1810	*Flora*	schooner	New Orleans	Duxbury MA	141	72' 10"	21' 10"	10' 6"	1 deck, 2 masts
1816	*Free Town*	schooner	Boston MA	Bristol MA	116	72' 11"	22' 8"	8' 2.5"	1 deck, 2 masts
1798	*George Clinton*	brig	New Orleans	New York NY	97	66' 2"	21' 8"	8'	1 deck, 2 masts
1811	*Good Hope*	schooner	Charleston SC	Dorchester Co. MD	116	72'	22' 9"	8' 5"	1 deck, 2 masts
1801	*Hannah*	schooner	Newburyport MA	Frankfort MA	111	65' 4"	20'	10'	2 decks, 2 masts
na	*Huntress*	schooner	New York NY	na	128	70' 8"	22' 9"	9' 5"	1 deck, 2 masts
1818	*James Monroe*	schooner	Sandwich MA	Sandwich MA	116	70'	21' 6.5"	9'	1 deck, 2 masts
1819	*Little William*	schooner	Boston MA	Bangor MA	121	72' 4"	22' 1"	8' 10"	1 deck, 2 masts
1804	*Louisiana*	schooner	New Orleans	Baltimore MD	74	70' 6"	22' 4"	5' 7"	1 deck, 2 masts
1815	*Mary and Eliza*	schooner	Boston MA	Bangor MA	82	65' 2"	19' 6.5"	7' 6.5"	1 deck, 2 masts
1815	*Mediterranean*	schooner	New Orleans	Dorchester Co. MD	75	70' 6"	20'	6' 2"	1 deck, 2 masts
na	*Mississippi*	schooner	New Orleans	na	72	68' 3"	17' 8"	6' 9"	1 deck, 2 masts
1816	*Morgiana*	schooner	Duxbury MA	Duxbury MA	120	73' 10"	21' 9"	8' 7.5"	1 deck, 2 masts
1815	*Mount Vernon*	schooner	New Orleans	St. Mary Co. MD	65	65'	18' 2"	6' 4"	Flush Deck, 2 Masts

Table 3

A Comparative Analysis of Two-masted Schooners in the Mica Vessel's Size Range for Tonnage Estimation Purposes (continued).
Data from: Ship Registers and Enrollments of New Orleans, Louisiana: Vols. I-IV.

Date	**Name**	**Ship Type**	**Home Port**	**Construction place**	**Tonnage**	**Length**	**Breadth**	**Depth**	**Rig**
1818	*Mulberry*	schooner	Annapolis MD	West River MD	75	71'	19' 6"	6' 2"	1 deck, 2 masts
1810	*Ohio*	schooner	Beverly MA	Ohio Co. VA	109	71' 3"	21' 2"	8' 5"	1 deck, 2 masts
1801	*President*	schooner	New York NY	Surrey MA	98	69' 2"	22'	7' 6"	1 deck, 2 masts
1818	*Ranger*	schooner	Hallowell MA	Pittston MA	123	73'	21' 6.5"	9'	1 deck, 2 masts
1800	*Rebecca*	schooner	New Orleans	Mathews Co. VA	120	68' 7"	20' 9.5"	9' 11"	1 deck, 2 masts
1817	*Retrieve*	schooner	Hallowell MA	Hallowell MA	102	66' 7"	21' 4"	8' 4"	1 deck, 2 masts
1811	*Sally*	schooner	Philadelphia PA	Steuben MA	77	65' 3"	20' 5.5"	6' 9.5"	1 deck, 2 masts
1805	*Saturn*	schooner	New Orleans	Marshfield MA	107	66' 11"	20' 2.5"	9' 2.5"	1 deck, 2 masts
1814	*Solon*	schooner	Boston MA	North Yarmouth MA	93	69' 11"	20' 7"	7' 5"	1 deck, 2 masts
na	*Sperry Baker*	schooner	New Orleans	na	90	65' 3"	18' 8"	8' 9"	1 deck, 2 masts
1795	*Suckey and Polly*	schooner	New Orleans	Jerusalem VA	67	57'	18'	7' 9"	1 deck, 2 masts
1817	*Three Brothers*	schooner	Monhegan MA	Monhegan MA	79	65'	19' 6"	7' 2.25"	1 deck, 2 masts
1812	*Three Sisters*	schooner	Snow Hill MD	Worcester Co. MD	73	65'	19' 5.75"	6' 8.75"	1 deck, 2 masts
na	*Two Sisters*	schooner	New Orleans	na	119	67' 6"	20' 9"	9' 11"	1 deck, 2 masts
1816	*Two Sisters*	schooner	Boston MA	Westbrook MA	130	66'	21'	8' 6"	1 deck, 2 masts
1802	*Union*	schooner	Dartmouth MA	Barnstable MA	94	68'	20' 10"	7' 10.5"	1 deck, 2 masts
1811	*Venus*	schooner	New York NY	Woodbridge NJ	111	66' 4"	18' 11"	10' 2"	1 deck, 2 masts
1812	*Washington*	schooner	Charleston SC	Pittstown MA	149	75' 6"	23' 10.5"	9' 9"	1 deck, 2 masts
1807	*William*	schooner	Newport RI	Frankfort MA	127	75' 6"	22' 9"	8' 7"	1 deck, 2 masts
1816	*William and Emeline*	schooner	Hallowell MA	Hallowell MA	118	69' 10"	21' 11"	9'	1 deck, 2 masts
1802	*William Wright*	schooner	New Orleans	Mathews Co. VA	79	67' 5"	18' 4"	7' 4"	1 deck, 2 masts
1811	*Zephyr*	schooner	Warren RI	Warren RI	133	75' 6"	21' 11"	9' 3"	1 deck, 2 masts

Possibly diagnostic artifacts that were noted inside the hull include a ceramic or glass bottle base protruding from the sediment near the stern. This white pottery vessel bears a possible decoration: a thin dark green line. Unfortunately the quality of the video footage prevents us from capturing an image of this artifact and learn know about its diagnostic characteristics. The information about the existence of this artifact and the presence of a green line on it comes from the field logs, during which archaeologists were able to view the site through the port holes. The artifact is otherwise invisible in the video record, due to the fact that the camera resolution available on the NR1 was low.

4:0 ANALYSIS

4.1. Artifacts

4.1.1. Wood Samples

Wood samples were collected from the site in order to identify the construction material and possibly the shipyard's location. As mentioned above, all samples were collected by an archaeological team from the MMS in 2001, and they were pieces from the sacrificial planking that was between the planking of the ship and the copper sheathing. The original location of all samples was in the bow of the ship, where the preservation was better, and the position of revealed timbers was relatively easy to access by the ROV without damaging the rest of the hull (Figure 12). All wood and sheathing samples that were attached to them were collected from fragments that have fallen off from the hull onto the sediment, in order to avoid permanent damage to the site. They were collected from the port side of the bow.

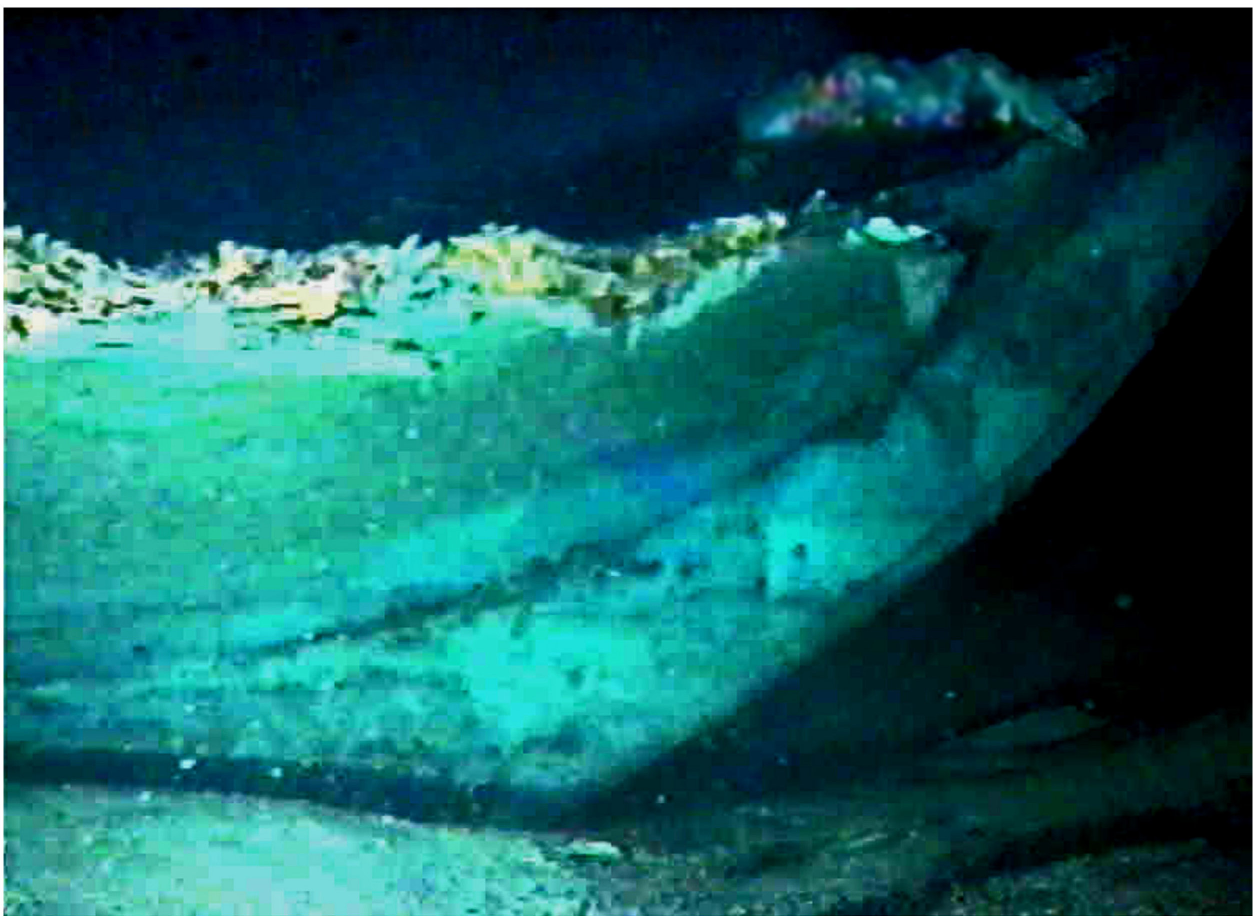

Figure 12. Starboard side of the bow across from where the wood samples were collected (Photograph courtesy of the United States Minerals Management Service and ExxonMobil Corporation).

Samples were analyzed by two independent tree identification laboratories. While the sizes of the samples were too small for dendrochronological analysis, scientists were able to determine the tree types and the geographical area in which they grew. Analysis by both laboratories, the Center for Archaeological Investigations at Southern Illinois University at Carbondale, and the College of Forestry at Mississippi State University, revealed that the wood was *Pinus strobus*. This type of tree is an American species known as Eastern White Pine or Northern White Pine that grows in Eastern North America. While it is not a perfect material for shipbuilding due to its mild resistance to rot and degradation, the *pinus strobus* of North America is known to have been largely harvested for shipbuilding purposes from the 18th century onwards. Several New England forest lands were reserved for exploitation by the Royal Navy and after American Independence most of the wood was harvested for commercial and naval shipbuilding.

4.1.2. Metallic Sheathing and Fasteners

Since the double planking and the metal sheathing was a unique feature of the hull, samples from the copper sheathing were also collected for identification and analysis. Sheathing samples were attached to the wood samples described above and were collected from near the port bow section of the ship. In order to avoid intrusions to the site's integrity all samples were taken from features that have already fallen off the hull. The samples were attached to the wood samples mentioned above and were collected from the bow area. Metal samples were removed from the edges of sheathing plates that were in poor condition to allow the shredding of a small sample. The largest of the samples has two corners, comprising the edge of a 36-centimeter (14 inch) wide sheet (Figure 13). The amount of sheathing overlap, 4 centimeters (1.5 inches), was determined from a study of this piece. The sheathing overlaps on the lower edge of each sheet, in the same manner as roofing is applied today. This method indicates that the vessel was sheathed beginning at the keel and moving upwards toward the gunwale (Jones 2004: 67).

There were no maker's marks or gauge stamps detected that would indicate the location and possibly the date of the sheathing's manufacture. However, the mere existence of copper sheathing on a vessel this size indicates that the ship was most likely built in the first half of the 19th century. The application of copper sheathing on wooden hulls is a practice that first begun on naval ships to protect these expensive hulls. Its use on commercial ships began in the early 19th century, but it was exclusive to the large ships involved in trade with the warm climate areas such as the Indian Ocean. The use of copper sheathing did not become a widespread practice on smaller vessels, until the second half of the 19th century (for a detailed analysis of the development and use of the metal sheathing practices see Appendix 1).

Another historical development that is of great significance for the interpretation of the copper analysis results from the Mica shipwreck was the development of copper alloys as sheathing materials. Appendix 1 provides a detailed study of this technological progress. In summary, the use of a popular copper alloy known as the Muntz metal (50 percent copper and 50 percent zinc) after about 1850 was of significance. We have little archaeological data about when this alloy became widespread in America, but the possibility of finding it on the Mica shipwreck would have provided us with a *terminus post quem*.

Figure 13. Largest fragment of metallic sheathing recovered from the Mica shipwreck (Photograph by Toby Jones).

The composition analysis of the metallic sheathing samples from the Mica shipwreck were performed using a refracting electron microprobe and an atomic absorption mass spectrometer in Texas A&M University laboratories. The refracting electron microprobe composition analysis was performed on a Cameca SX50 electron microprobe using energy dispersive spectroscopy on four spectrometers by Dr. Renald Guillemette, director of the Electron Microprobe Laboratory in the Department of Geology and Geophysics in the College of Geosciences. The atomic absorption mass spectrometer tests were performed by the Office of the Texas State Chemist at Texas A&M University (See Appendix 3 for details and original reports of metal analysis).

Results of both testing processes are highly accurate. The atomic absorption mass spectrometer test requires less sample preparation than the refracting electron microprobe but it requires the complete destruction of the sample by dissolving it in acid. The electron microprobe, on the other hand, uses x-rays to analyze the artifacts in a non-destructive manner. This analysis can determine the grain structure of the metal as well as the frequency of any impurities.

In order to analyze samples on the refracting electron microprobe, small pieces of sheathing were bedded on edge in epoxy (Figure 14). The face of the block was polished to expose a fresh surface of metal, and coated with a fine layer of pure, powdered carbon. By focusing the x-rays on a freshly cut edge, the probe could avoid areas where superficial corrosion had altered the structure and composition of the metal. While the sheathing fragments were not

Figure 14. The refracting electron microprobe sample carrier. It contains pieces of metallic sheathing awaiting analysis (Photograph courtesy of Dr. Renald Guillemette).

destroyed, they remained permanently embedded in the clear epoxy carrier. The electron microprobe allowed more in-depth and varied analyses, however, it was also more labor-intensive and slightly more expensive to use when running a small number of samples.

The second group of samples from the Mica shipwreck site consisted of the fasteners used to attach the metallic sheathing to the sacrificial planking. The reason why these samples were collected and analyzed is related to another aspect of the historical development of metal sheathing technologies: use of dissimilar metals for constructional features that would physically touch each other in salt water would cause a process called electrochemical corrosion. Therefore, in order to prevent the preferential corrosion of one metal, both pieces (in this case, the sheathing and the fasteners) had to be made of materials in similar metallic composition. Because pure copper fasteners would have been too weak to be driven into the planking, they were either alloyed with small amounts of harder metals or they were mechanically strengthened during the manufacturing process by rolling them through grooved rollers or by a process used since antiquity, called annealing, which involved controlled heating and cooling of the metal to improve the grain structure.

The metallic sheathing and fasteners from the Mica shipwreck were tested using refracting electron microprobe and an atomic absorption mass spectrometer, as described above. Results of both tests were nearly identical: the vessel was sheathed with copper sheets that were an alloy of 99.5 percent copper, with traces of arsenic (complete metallic sheathing analysis results can be found in Appendix 6:0). The nails were made of a brass alloy containing 84.7 percent copper, alloyed with 5.3 percent tin and 7.8 percent zinc. The fasteners contained traces of lead, arsenic, and bismuth (see Appendix 3 for original analysis results). After being mechanically cleaned, the fasteners were a yellow brass color, noticeably different from the reddish-yellow color of the copper sheathing. Their appearance and the results of the tests show that the nails on the Mica shipwreck obtained their strength from their alloy composition, not from annealing or rolling. The nails have irregularly shaped heads and shaft lengths. Surfaces of the nails appear porous, and that suggests that they may have been cast, as opposed to being cut or hand wrought, which were all methods that were in use in the first half of the 19th century (see Appendix 1).

Study of metal artifacts from the Mica Shipwreck provided a third type of information: the absence of machine-punched holes on the copper sheets, to allow the fasteners to go through to attach them to the planking. Historical data suggests that the machine developed by John Gray (patented in 1830) to create pre-punched copper sheets, became of widespread use in the second half of the 19th century (Gray 1830: 173). Use of this method expedited the sheathing process, shortening the duration and decreasing the labor cost of such work. The fact that no such machine was used to perform the sheathing of the Mica vessel is understood through a visual analysis of the holes on the sheathing samples. Firstly, the holes are not of a uniform size and shape. Secondly, they were not punched at regular intervals, nor in straight lines. This information might indicate that the Mica ship was built sometime before the advent of mechanical manufacturing processes for metallic sheathing. However, such remarks are difficult to make since we know very little about how widespread the use of such machines was, and to which category of ships it was applied. Besides, the non-mechanical method of punching of sheathing holes might have survived well into the end of the practice of copper-sheathing (Jones 2004: 65). Therefore, this analysis was concluded not to be indicative of a specific date for the Mica vessel.

For a comparative analysis of the sheathing samples collected from the Mica shipwreck with those from other contemporary vessels see Appendix 7.

4.1.3. Lead Hawse Pipe

The lead hawse pipe recovered from the site measures 17 centimeters (6.8 inches) in diameter and 41 centimeters (16.2 inches) long (Figures 7 and 15). The thickness of the hawse pipe wall is about 2 centimeters (0.5 inches). An examination of the pipe shows that it was built by joining eight long pieces of lead to form a cylindrical shape. The seams can be observed on both the internal and external surfaces. The average width between the seams is 7 centimeters (2.5 inches). Based on the wear patterns, it is possible to ascertain that the hawse pipe belongs to the starboard side of the ship. The lower outboard lip was substantially worn, probably from the rubbing of an anchor cable or chain while the vessel was riding at anchor (Jones 2004: 69) (Figure 16).

Figure 15. Forward face of lead hawse pipe from the Mica shipwreck. Casting seams are evident on the both the external (right) and internal (left) openings (Photograph by Dave Ball).

Figure 16. Interior opening of conserved lead hawse pipe from the Mica shipwreck. Note the possible cut marks on the curled-in exterior surface, visible in the lower left (Photograph by Dave Ball).

According to metallurgical analysis, the hawse pipe was composed of lead with traces of copper and bismuth (for analysis results see Appendix 3). The almost pure composition of the hawse pipe was an expected result due to the metallurgical characteristics of lead that makes it an easy metal to smelt, and to be free of impurities. Comparisons of the Mica hawse pipe with those of other shipwrecks as well as modern lead show that the purity and grain structure of this archaeological sample is almost identical with others. The other hawse pipes of the Mica shipwreck were not found and may be buried in the sediment inside the hull. Other small fragments of lead might have belonged to the ship's pump(s) (Jones 2004: 69).

4.1.4. Artifact Conservation

Dave Johnson of Galvetech in New Orleans, Louisiana undertook the initial conservation of the wood and metal artifacts, including the hawse pipe. Barnacles and lead carbonate covered substantial portions of the internal and external hawse pipe. The amount of conservation carried out on the hawse pipe remains unclear.

Metallic sheathing fragments were treated using desalination and electrolytic reduction. None of the sheathing fragments appeared to have been sealed, and were experiencing extensive tarnishing. These fragments were mechanically cleaned with glass bristle brushes and then immersed in benzotriazole and finally coated with Krylon 1301 clear matte acrylic spray by Toby Jones at the Conservation Research Lab at Texas A&M University (Figure 17).

Figure 17. A fragment of the copper sheathing retrieved from the Mica shipwreck. The bright spot in the lower right corner has been mechanically cleaned with a glass bristle brush (Photograph by Toby Jones).

4.1.5. Analysis of the Hull and Rigging - Identification of the Ship's Sail Arrangement

As discussed in section 2.2.2., based on a random sampling of the ships listed in the New Orleans *Bee* that frequented the port of New Orleans in the early nineteenth century, the majority of the ships with known rigs were brigs. The second category of most common rigging was the schooner rig. Ships rigged as schooners and brigs could be in the size range displayed by the remains of the Mica shipwreck. Thus, our archaeological investigation concentrated on identifying the possible rigging of the vessel.

According to Robert Brindley's contemporary description in his *A Compendium of Naval Architecture* (1832), a typical nineteenth century brig is a vessel with two square rigged masts. Later brigs might carry a fore-and-aft rig on their mizzen, but as a rule, the foremast would always carry square sails. Brindley describes a schooner as a vessel with two masts and rigged with fore and aft sails. Other possibilities for Mica would have been a brigantine, which, according to Brindley, was rigged as the aft of a schooner's, and forward that of a brig (frequently called an hermaphrodite). Therefore, the only way to differentiate these rigs would have been the rig of the vessel, which could be reconstructed based on the positions of the chain-plates.

Again, a contemporary source, David Steel's *The Elements and Rigging and Seamanship* (1794), describes the chain-plates as follows:

> "Thick iron plates bolted to the ship's sides, and to which the chains and dead-eyes that support the masts by the shrouds are connected."

On Mica, several of these elements were visible (see section 2.4., 27 July 2006) (Figure 10). The difference between how the shrouds of a square rigged vessel are attached to the hull vs. the way the shrouds of a fore-and-aft sail are attached provides us with clues regarding the sail arrangement of the ship. First, the easier indication would be that a square rigged mast would require more chainplates than a fore-and-aft rigged vessel. The fact that there are only two cahinplates visible near the bow of the Mica vessel indicates a low number of chainplates, and therefore indicates that the foremast probably carried a fore-and-aft rig. In this case, the ship could only be a schooner.

The position of the chain-plates in relation to the mast steps would indicate the rake of the masts, and provide information about how the shrouds were located in relation to the masts. Fore-and-aft rigs required more space for performing the tacking maneuvers, thus, the chain-plates for such vessels would have been located further aft of the vessel than the square-rigged ones, so that the elements of the running rigging would be free to come around, without being restricted by the shrouds. However, since the bottom of Mica's hull is covered with sediment, which hinders identification of the mast steps, it is impossible to discern the position of the chain-plates in relation to the masts. Further study of the site might reveal information to answer this question.

5:0 CONCLUSIONS

After four scientific visits to the Mica Shipwreck Site, and an analysis of all the data collected during these expeditions certain conclusions can be reached:

(1) The ship was built and lost sometime during the first half of the 19th century.

This statement is based on an analysis of the characteristics of the copper sheathing, hull form, the use of wood as the primary construction material, the vessel's general form and size, and a visual analysis of the artifact assemblage.

(2) The ship was rigged as a two-masted schooner.

The general size and form of the vessel, on-site location of rigging-related features such as chainplates and deadeye straps, and the distribution of certain elements such as blocks suggest this specific rigging arrangement (for general distribution of the elements see Figure 7).

(3) The ship was built or repaired in a shipyard on the northeastern coast of North America.

This statement is based on the results of the wood analysis: *Pinus strobus*, an American species known as Northern White Pine that grows in Eastern North America. It is possible that a new layer of sacrificial planking or repairs to the sacrificial planking was applied to the hull in North America, which may not have been the original location of construction of the ship.

These three facts do not provide much information to determine the exact identity of this shipwreck. While it is possible that further fieldwork might yield an artifact that might help to identify the shipwreck, it is also likely that this ship's loss may have never been registered. Unless an insurance claim was filed by the owner, it is unlikely that there were any survivors of the shipwreck to report the incident (the off shore location of the site makes it unlikely that anyone survived the wreck). Moreover, it is almost impossible to match this ship, based on archaeological assemblage to a vessel that might have been reported as overdue. While certain vessels appear in historical record as overdue, or possibly lost – since they fail to reach their destination – such records rarely provide details of the ship's cargo. Therefore, even if such records survived it would be impossible to identify this vessel based on such records.

It was not possible to further the historical research based on the archaeological information derived from the study described in this report. However, it is certain that the size, the rig, and probably the cargo of the Mica Ship can be considered as typical for the 19th century Gulf of Mexico. These characteristics add to the difficulty of identifying the vessel. A review of the contemporary ship enrollment records from New Orleans has yielded hundreds of vessels that fit the dimensions of the Mica wreck (see Appendix 5). To be specific, our research revealed 253 possible vessel matches in use during the first half of the 19th century (based on their construction dates). This number only includes the vessels in the size range of the Mica vessel, carrying similar rigs to Mica, and constructed in the northeastern coast of North America. It is the author's opinion that it is possible that even a full excavation of the site might fail to produce evidence to positively connect this vessel with the report of its loss, the possible insurance claim filed for it, its name, and the historical evidence that might have survived, since there are hundreds of almost identical vessels in such lists. Unless there was a survivor to report the exact location where the ship sank, the approximate areas of ship's loss would have been anywhere between its last port of call and its destination.

However, it is important to recognize the importance of these small vessels involved in the coastal trade in the 19th century-Gulf of Mexico. The following analysis provides a historical and economic context for the Mica shipwreck. Based on the general navigation patterns in the Gulf of Mexico (described in the historical background chapter), we believe that the Mica Ship's last port of call or destination must have been New Orleans, the largest commercial hub in the northern Gulf.

Based on the data gathered from the arrival and departure records published in the New Orleans *Bee*, ships that were of similar sizes to Mica generally sailed on two routes in early 19th century: (1) to European destinations (overwhelming majority frequented Liverpool and Le Havre), and (2) ports on the northeastern coast of North America (mainly New York or Philadelphia). Smaller ships generally sailed within the Gulf, and to Caribbean ports. Small ships and steamboats generally carried out the coastal trade between the Northern Gulf ports, i.e. Biloxi, Mobile, and Pensacola. The agricultural, mineral and industrial products of the hinterland were almost all gathered through the navigable rivers on board flat-bottomed wooden barges and steamboats.

A second category of information gathered from an examination of the data from the New Orleans *Bee* is about the cargoes. In general, ships that sailed to European destinations carried cotton as their main cargo. On their way back to New Orleans from Europe, these ships brought mainly luxury goods such as silks and other luxury textiles, garments, candy and chocolate, spices and herbs, gourmet foods and wines, and jewelry are among these popular items. The northbound ships that sailed mostly to New York and Philadelphia either carried cotton or they re-distributed what seems to be a portion of the non-perishable luxury goods of European origin. Typical merchandise of this type were silk and other luxury fabrics and textiles, musical instruments, jewelry, and dresses. Typical return cargoes of such ships generally included iron (from New York), candles, tobacco, and textiles and furs.

Visual analysis of the Mica shipwreck indicates that the cargo of this ship was most probably perishable and has long since disintegrated. Cargoes such as iron, metal products such as nails (one of Philadelphia's main exports in the early 19th century) or other manufactured goods of American or European origin can be eliminated based on the fieldwork results. General historical data suggest that for the size and rig of this ship it probably sailed on the trans-Atlantic route to Europe or to one of the ports of the Atlantic coast of the northern United States. However, we cannot completely eliminate the possibility that Mica was one of the ships engaged in the coffee, sugar, or flour trade of the South Gulf and/or Caribbean regions. In other words, since historical documents provide us with a good understanding of the possible cargoes of well-defined routes, we can narrow the possibilities, but cannot definitely suggest a destination, origin, a route or a cargo for this ship. However, with adequate equipment and funding, further archaeological study of this site is likely to produce important information regarding the function, destination, and origin for the Mica Shipwreck.

Removal of the sediment inside the ship might reveal diagnostic artifacts that would help with the precise dating of the site and perhaps a better understanding of provenance. Even though ballast was observed in the hold of the ship, sediment samples taken from the bilge might reveal what (if any) type of cargo the ship carried. In the event that this was an organic cargo that has disintegrated, it might be possible to identify it through micro and macro botanical analysis of the remains. Analysis of the pollen that may have been contained in the bilge sediment might help identify disintegrated perishable cargo, or what the ship carried on a regular basis. Some crops that have been introduced as commercial products into the lands surrounding the Gulf of Mexico (i.e. sugar, cotton, coffee etc.) might indicate or suggest certain routes or nationalities, which, in turn, might help with historical research.

Historical research about the Mica Shipwreck is limited as of now, mostly due to the fact that the limited nature of archaeological investigation hindered the leads. Historic research could best be carried out after further field work that would provide: (1) A better understanding of the artifact assemblage, (2) organic remains, (3) accurate calculation of the ballast, which would help us understand whether or not there was cargo on board (only possible after all sediment is removed from the hold of the ship), and (4) a detailed analysis of the structural elements of the ship, which would lead to a better understanding of the rig of the ship (i.e. mast steps, their location, scantlings etc.). Further work at the site is also necessary to acquire a detailed photomosaic of the site that would be used to create a site map.

In summary, the Mica Shipwreck site has great archaeological potential. Not only that it is a contained site, which would certainly reveal considerable information if the sediment inside the hull could be removed, but also, because the state of preservation of the hull remains is excellent. Developing technology that makes archaeological work at depth more cost efficient and less technologically challenging will certainly provide us with chances to study these deep and well-preserved sites with greater efficiency in the future. We are looking forward to a chance of returning to the Mica Shipwreck when funds and equipment become available.

6:0 APPENDIX A: A BRIEF HISTORY OF THE USE OF METALLIC SHEATHING ON WOODEN SAILING SHIPS by Toby Jones

The most important artifacts recovered during the Mica shipwreck investigation were fragments of metallic hull sheathing. Because hull sheathing underwent rapid technological evolution, it was possible to create a chronology of sheathing development. This was achieved by analyzing historical documents, patent records, and period sheathing advertisements and by performing composition analysis on sheathing fragments from shipwrecks of known provenience. By examining the sheathing on the Mica wreck and placing it within the sheathing chronology, the archaeologists were able to date the wreck. The entire process will be explained below, after presenting a brief history of sheathing development.

This section will briefly explore the transition from organic sheathing (wood, fiber, and pitch/resins) to the more durable metallic sheathings (lead, copper, copper alloy, zinc, tin, and iron), looking specifically at mixed-metal or composition alloy sheathings (The terms mixed-metal, composition, and alloyed metallic sheathing are used interchangeably. Types of metals discussed in this chapter and their elemental symbols: Iron (Fe), Copper (Cu), Lead (Pb), Zinc (Zn), Tin (Sn), Antimony (Sb), Bismuth (Bi) and Mercury (Hg)). The development of different sheathing alloys and their relative effectiveness will be evaluated, through analysis of firsthand accounts and patent reports. An analysis of the initial success and subsequent precipitous decline of the Milled Lead Company of England will be explored. It will be shown that the technological evolution of ship sheathing was not linear and progressive, but alternated between new innovations and old standbys. The patent specifications will be discussed chronologically, but it is necessary to note that there was often a substantial overlap in the acceptance of a new sheathing technology and the discarding of an older method. It is also important to remember that the date of a patent did not always represent the date that the new sheathing technology was created by the inventor or utilized by the industry. The development of new sheathing materials was a dynamic process that resulted in few instances of overnight changes to the status quo.

Preventing leakage as well as damage caused by marine organisms such as *Teredo navalis* and *Limnoria terebranshas*, was a necessary priority of the builders and owners of wooden ships. The damage caused by marine borers became increasingly acute in the early to middle 16th century, as European mariners began to routinely sail into tropical waters in both the Old and New Worlds, warm water being the preferred home of the destructive organisms. In the 15th and 16th centuries, the most common methods of protecting a ship's hull from the damage caused by marine organisms included charring, double planking, coating with chemical concoctions, and covering with hammered or cast sheet lead. A brief description and examples of each barrier are discussed below, along with a comparison of the advantages and disadvantages of each method.

Burning the surface of the external hull planking created a thick layer of charcoal, which was sealed with pitch and then smoothed over with tallow. A letter written to a French technological journal in 1666 proved most insightful concerning the methods and problems associated with charring a hull, as the following extract illustrates: "The Portugals scorch their ships, insomuch that in quick works there is made a coaly crust of about an Inch thick. But as this is dangerous, it happening not seldom, that the whole vessel is burnt." (Royal Society of London 1665/6: 190).

It was thought that the worms were unable to digest the charcoal, which prevented them from boring further into the planking. In 1622, Richard Hawkins wrote that this was the most common method for protecting the hull of a vessel, and concerning its effectiveness, he wrote that "this is not bad." (Hawkins 1933: 81).

Double planking, also known as sacrificial planking, yacht planking or deal, was used by many nations (Petty 1691: 5). William Petty of England related how wood sheathing was typically defined and applied before 1682:

> "First, That only competent and allowable Defense against the Worm, before this of Lead-Sheathing, was the paying of the Hulls from the Waters edge downwards with Stuff, and laying the inside of a Sheathing-board (from inch and quarter to three quarters thick) all over with Tar and Hair, to be brought over the forementioned Stuff, and being well nailed, Graving or Paying the outside of the said Board all over with another Composition of Brimstone, Oyl, and other Ingredients, which is called Wood-Sheathing." (Petty 1691: 36-37)

Hawkins related his belief that the borers were unable to digest the animal hair. He wrote that the most desirable wood for sheathing was elm, because it was more durable than oak, and conformed to the contour of the ship better. He also stated that the typical thickness of a double plank was 0.01 meters (0.5 inches), with the thinner planking performing better. The manner of covering the boards was similar to the way mentioned by Petty above, with generous amounts of tar and hair being sandwiched between the two layers of wood. For attaching the boards to the hull, Hawkins said that nails, presumably of iron, should be no more than a hand span apart, with the most effective sheathing being the most densely nailed (Hawkins 1933: 81-82). The opinion held by Hawkins was that wood sheathing was the most cost-effective method of protecting a vessel against the ravages of the borers.

Wood sheathing was indeed economical and long-lasting compared to other sheathing materials (chemical concoctions and lead), but it was not without its drawbacks. The scarcity of locally available timber was a major concern, especially in times of war, when hostile nations might have been the only source of the desired planking. Petty listed another disadvantage, namely that unprotected wood sheathing was prone to rapid fouling, which affected speed and handling characteristics of the sailing vessel, meaning that the wood could not be employed alone. He also complained that the numerous nail heads protruding from the hull planking created excessive drag (Petty 1691: 38-39). Sheathed hulls had to routinely be brushed clean to remove the accumulated algal colonization and barnacle growth, because of the drag they created. Petty relates how long-handled scrubbing brushes were used to clean the sides of the ship while at sea (Petty 1691: 39). These brushes could nearly reach the keel, lessening the need for frequent careening. However, the scarcity of suitable sheathing timber, and the fact that it was only effective at slowing, and not stopping, the progress of the marine borers, necessitated the development of a new sheathing material.

Mixtures of rosin, sulfur, tar, oil, and other substances, including crushed glass and hair, were often employed in the protection of hull planking (Hawkins 1933: 81-82). These substances could be used in conjunction with sacrificial planking, or applied directly to the external surface of the hull planking (Hawkins 1933: 81-82. See also Petty 1691: 36-37). The use of white stuff was common in the 15th and 16th centuries, and consisted of a blend of train oil (fish or whale oil), sulfur, and rosin. This mixture was mildly successful, but the expense of the rosin spurred investigation into cheaper alternatives. A mixture called "black stuff" was invented sometime in the 17th century. This compound consisted of two parts pine pitch to one part tar, and was heated and spread on the hull. To make it more effective, it could be mixed with crushed glass or other substances that would have a detrimental effect on the borer's progress (Hawkins 1933: 82).

For the most part, the sheathing methods discussed above were merely hindrances to the marine borers. The sailors of the period were in dire need of a durable and impregnable barrier against the voracious shipworm. Some inventors began turning their attention towards metals, specifically lead and copper. Ships sheathed with cast lead, and to a lesser extent, hammered lead, were used during the 16th and mid to late 17th centuries, alongside ships sheathed with the abovementioned techniques.

LEAD SHEATHING

The use of lead as a sheathing material was not a technological innovation of the post-medieval era. Vessels in ancient times, for example the third century B.C. Kyrenia wreck and the first century A.D. Nemi barges were sheathed with hammered lead. However, the sheathing probably served a different purpose in antiquity. Because shipworms were not a widespread problem in the Mediterranean at that time, it has been hypothesized that the primary purpose of the hammered lead sheathing was to prevent leakage in the edged-jointed hull planking (Hocker 1989: 197-198). Yet, hand-pounded lead was expensive, of inconsistent thickness, and generally lacking in durability, making it likely to be employed on seldom-used royal ships, old vessels prone to leaking, or for emergency repairs.

In Europe, the use of lead as a sheathing material was revived in the 16th century, but it was needed for a different purpose. Instead of preventing water from entering the vessel, the sheathing was designed to provide a barrier between the hull planking and marine borers. Although hammered lead was still in use, a better method of casting the lead was discovered. Molten lead was poured into thin sheets, which were lighter and of a more consistent thickness than hammered lead. However, this new manufacturing process failed to produce sheathing that was long-lasting, with Hawkins commenting that "some sheath their Shippes with Lead; which besides the cost and waight, although they use the thinnest sheet-lead that I have seene in any place, yet it is nothing durable, but subject to many casualties." (Hawkins 1933: 81). This lack of durability was caused by the inconsistent thickness across each sheet. The sheets would heat and cool unevenly, causing cracks to form along the transitions between thick and thin areas on the same sheet (Hale 1695). These cracks, often invisible to the naked eye, allowed access of the minute shipworm larvae, which according to Hawkins, entered the hull planking no larger than the diameter of a Spanish needle, and soon grew to be larger around than a man's finger (Hawkins 1933: 81). Hammered and cast lead had many problems, but inventors continued to refine the manufacturing process, in an effort to make the sheathing durable.

The invention of milled lead in the third quarter of the 17th century was seen by many as the long awaited solution to the shipworm problem. In 1670, a patent for the manufacturing process and marketing of the "New Invention of Mill'd Lead" was granted to Sir Philip Howard and Sir Francis Watson (Petty 1691, 5). This act led to the formation of the Patent Milled Lead

Company, which had a relatively brief and highly controversial existence. The manufacturing process called for the lead to be cast into thin ingots, and then rolled between drums, producing a uniform sheet of any desired thickness. The new sheets were denser, smoother, and not subject to cracking because of their consistent thickness (Bulteel 1672: 6193). In a period advertisement, Thomas Hale, an agent of the Milled Lead Company, stated that milled lead was, on average, 22 percent cheaper then the equivalent amount of cast lead (Hale 1695: 2). He compared the initial costs of wood sheathing (10 pence per square foot), to that of milled lead (15 pence per square foot). The savings of using milled lead could be found in the reduction in annual maintenance costs, since the lead-sheathed hull required no graving, an expense of 40 pounds a year on a 600 ton merchant vessel (Hale 1695: 4). When a ship finally needed to be stripped of its old sheathing, the ship owners were paid more by recyclers for the used milled lead, both because it was of a higher purity than cast lead, and because it was less corroded compared to the same amount of cast lead. Concerning performance, Hale claimed that milled lead made a ship stiffer, and kept the hull cool and dry, whereas wood sheathing absorbed water, which caused the oakum caulking to rot quickly (Hale 1695: 4).

The Royal Navy, seeing the strategic advantages of a long-lasting and impenetrable hull sheathing, ordered 20 ships to be sheathed with milled lead. Phoenix was the first ship which was fully sheathed with milled lead in March 1670. That vessel was soon followed by Dreadnought, Henrietta and 17 other warships. Phoenix, having completed two voyages to the Straits of Magellan, was inspected by King Charles II during a routine careening in 1673 (Bulteel 1672, 6192). The king was so impressed that, in December of 1673, he ordered all Royal Navy vessels to be sheathed exclusively with lead (Petty 1691, 6-7). Bulteel enthusiastically added that the sheathing "was found to be in as good condition, as at first doing." (Bulteel 1672: 6192). By 1675, the trials had been deemed successful, with the Admiralty granting the Milled Lead Company a 20-year contract for the exclusive sheathing of English naval vessels.

The celebration at the Milled Lead Company was, however, short-lived. Reports of major problems began to trickle in from ships based in distant ports. All the descriptions shared similarities with the following excerpt:

> From abroad, of a quality discovered in our Lead-sheathing, tending (if not timely prevented) to the utter Destruction of his Majesties Ships, namely, That of the Eating into, and wasting their Rudder-Irons and Bolts underwater, to such a degree, and in so short a space of time, as had never been observed upon any unsheathed or Wood-sheathed Ships. (Petty 1691: 9).

Among the officers of the affected vessels, there was a consensus that the iron hull fasteners, especially the rudder irons and bolts, were experiencing accelerated corrosion. The cause or process was unknown, but the common connection was that the increased corrosion was occurring exclusively on lead-sheathed vessels. The officers brought several complaints to the attention of the Admiralty. In April 1678, the Admiralty opened an official inquiry into the effectiveness of milled lead sheathing and its purported negative effects on iron fasteners. This action set off a contentious debate between the Milled Lead Company and the officers of the Royal Navy.

Neither the Milled Lead Company nor the Royal Navy officers were objective in their treatment of the corrosion problem. It is important to briefly identify the motives driving each party. The Milled Lead Company was a commercial venture that had risked its existence on the viability of one product, and as such, they expounded its harmless nature, even in the face of overwhelming evidence to the contrary. Some of the officers held financial stakes in companies whose materials were no longer being utilized by the Royal Navy for sheathing (Petty 1691: 61). Other officers wanted to absolve themselves of blame, as the corrosion of the rudder hardware could be mistaken for poor maintenance of a vessel, which would tarnish their service records. The Admiralty would, of course, side with the officers, but they also had to accommodate King Charles II, who had enthusiastically approved the use of milled lead.

The inquiry opened with the officers relating vivid descriptions of the accelerated corrosion on 13 vessels, which they believed was due to the lead sheathing. The third rate HMS Dreadnought, sheathed in 1671, was inspected in 1676, with her rudder irons, pintles and gudgeons being routinely replaced. During a subsequent inspection 18 months later, the iron fasteners were found to be "very much eaten and consumed, and not to be trusted at Sea." (Petty 1691: 45). The afflicted hardware was replaced, and the ship was inspected again on October 8, 1682, when it was discovered that nearly all of the iron fasteners in the stern were completely dissolved, with the hull being held together by rust and dirt (Petty 1691: 45). HMS Lyon was sheathed with lead in 1672, and inspected in October 1677. The iron bolts under the sheathing were found to be badly corroded, "insomuch that some were gotten out by the Caulkers with their Spike-irons…the like whereof the Officers at Portsmouth say, they have never found in any Ship not sheathed with Lead." (Petty 1691: 45-46). The vessel subject to the fastest corrosion was HMS James Gally. After being sheathed in October 1676, she was inspected five months later, when her rudder irons were found to be completely dissolved. These were replaced, and a follow-up examination in October 1677 found them to be again dissolved into numerous pieces (Petty 1691: 47).

It seemed clear to the Royal Navy that the presence of the lead sheathing was having a deleterious effect on the iron hardware. In light of these accusations and strong supporting evidence, the Admiralty was poised to recommend that the use of lead as a sheathing material be discontinued until the corrosion problems could be addressed.

The burden of proof fell squarely on the Milled Lead Company, and they were prepared to fight for their continued existence. They began to systematically challenge the conclusions reached by the officers and the Admiralty. It is important to remember that their arguments, briefly discussed below, demonstrated the current knowledge of chemistry. Yet some of their arguments were contradictory to each other and occasionally sounded desperate (Petty 1691).

The Milled Lead Company opened its defense by accusing the naval officers of bringing suit against the company in an effort to distract the Admiralty from the supposed true cause of the vessel hardware corrosion, namely dereliction of duty by the officers, specifically when it came to routine hull maintenance (Petty 1691: 55). The company also claimed that the problems with the lead sheathing were being fabricated or exaggerated by those officers who held a financial stake in the companies that dealt with the previously used sheathing materials like wood and 'stuff' (various mixtures of rosin, tar, sulfur and oil) (Petty 1691: 61). The companies using the older technologies were now prevented, by Royal decree, from sheathing naval vessels, although the vastly larger merchant fleet still required hull protection.

When that argument failed to persuade the Navy Board, the Milled Lead Company tried a case-by-case refutation of the charges, saying that the corrosion of the iron fasteners was an intrinsic characteristic of the hardware. They meant that the blacksmiths who made the hardware and fasteners were improperly mixing or tempering the iron, causing it to corrode at an unusually high rate (Petty 1691: 23). However, it is highly unlikely that all of the lead-sheathed ships were receiving poorly manufactured hardware, while the unsheathed and wood-sheathed vessels were supplied with only quality ironwork.

Perhaps the strongest argument placed forth by the Milled Lead Company was the fact that unsheathed, wood-sheathed, and lead-sheathed vessels all experienced some corrosion of the iron hardware. It was known that iron corroded in the presence in saltwater, but that fact didn't account for the differing rates of corrosion according to sheathing types. The company argued that if the lead sheathing was responsible for the accelerated iron corrosion, then all the iron on a lead-sheathed vessel would be uniformly corroded. In support of this, they showed that certain vessels, both lead-sheathed and wood-sheathed, had some fasteners that were heavily corroded, while nearby fasteners were as solid as the day they were put in.

Although contradictory to the claim that all of the lead-sheathed ships received faulty hardware, the Milled Lead Company expanded upon the argument that the difference in corrosion rates could be accounted for by the amount of saltwater a fastener was exposed to. They claimed that a properly prepared fastener, meaning one that had been sealed, or parceled, with tar and hair, was impervious to the saltwater, and therefore, the associated corrosion (Petty 1691: 25).

The reason the iron fasteners were subject to accelerated corrosion when in the presence of lead sheathing was not a coincidence, and can be determined by analyzing the arguments listed above. If the iron fasteners corroded when they came into contact with saltwater on an unsheathed vessel, it meant that the iron was reactive with the saltwater. If the iron fasteners corroded at an accelerated rate when in the presence of lead sheathing and saltwater, it meant that the lead acted as a sort of catalyst for the reaction between the iron fasteners and the saltwater (Petty 1691).

What was not known during this period was the chemical reaction known as electrochemical corrosion. The reaction is based on the fact that some metals are more noble than others, and when the metals are placed in proximity to one another, along with the presence of an electrolyte, the less noble metal will sacrifice electrons to the more noble metal, causing the decomposition of the less noble metal (Table 1). Iron is less noble than lead, and saltwater was an ideal electrolytic solution. In the twentieth century, chemists have proven that these reactions were the underlying cause of the accelerated corrosion of iron hardware in the presence of lead hull sheathing. However, this information was not known during the 17th century. The reasons supplied by the Milled Lead Company claiming that the lead sheathing was not the cause of the severe iron deterioration were mostly plausible, given the contemporary state of knowledge concerning chemical reactions.

Table A1

The Relative Electromotive Force of Selected Metals (After Hamilton 22 February 2004, Online Conservation Research Laboratory Manual).

Noble Metals (More Cathodic) (Gain Electrons)
Gold [Aurous (+1), and Auric (+3)]
Silver (+1)
Copper [Cuprous (+1)]
Copper [Cupric (+2)]
Hydrogen (+1) (Neutral)
Lead [Plumbous (+2), Plumbic (+4)]
Tin [Stannous (+2), Stannic (+4)]
Iron [Ferrous (+2)]
Iron [Ferric (+3)]
Zinc (+2)
Base Metals (More Anodic) (Lose Electrons)

However, the Admiralty determined that lead sheathing was indeed detrimental to the iron fasteners, though the causes were unknown. The Milled Lead Company was unable to find a tenable solution to the corrosion problem, and was powerless to convince the Admiralty of the harmless nature of milled lead as a sheathing material. They began instead to market their product for use on the roofs of buildings (Hale 1695: 1). The use of milled lead as a sheathing material was discontinued by the end of the 17th century. Various forms of wooden planking and chemical coatings were used until the advent of a new metallic sheathing material, copper.

When problems were detected with new sheathing materials, builders tended to regress towards a previous, and often less-effective technology. There were numerous practical (and expensive) experiments with sheathing materials, with trials taking precedent over theory, which was understandable in a time when a swift solution was required to mitigate the growing damage caused by shipworms. Some of the hastily developed technologies, like milled lead sheathing, were rushed into production without extensive testing (Hale 1695). While the long-term effects of these innovations were unknown, they would not remain so. The initial success and subsequent failure of milled lead prompted even more new innovations in sheathing materials and manufacture, but, unfortunately, the lessons learned from the abandoned technology were ignored when copper was used as an experimental sheathing material nearly a century later.

COPPER SHEATHING

The answer to hull protection lay in copper sheathing, which was first suggested as a ship sheathing material in 1708 by Charles Parry (Knight 1976: 293). However, the Royal Navy Board deemed use of pure copper too expensive and the idea was shelved. The Crown continued covering vessels with wooden sheathing, while research into other protective materials continued.

One of these experimental methods of protecting a vessel from shipworm attack was called filling (Figure A1). Iron or copper nails with large heads were driven into a hull plank so close to each other that their heads were touching. This created a mechanical barrier of rust or corrosion product, yet the massive amount of nails needed to fill a significant portion of the hull made the treatment prohibitively expensive. This method was used sporadically through the end of the 18th century, and was often the only practical way to protect the false keel, where thin sheathing would be ripped off upon the slightest contact with the seafloor (Bingeman et al. 2000: 219-220). Wood remained the dominant method of sheathing, for the widespread acceptance and manufacture of pure copper sheathing was still a half-century away.

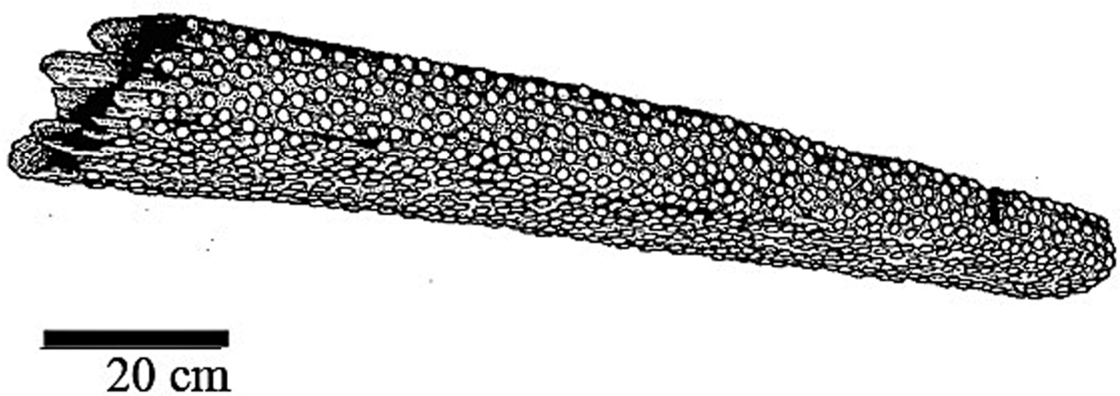

Figure A1. The false keel from *Invincible*, lost in 1758. Example of "filling" a false keel with nails to protect it from marine organisms. The nails and their corrosion products formed a physical barrier that prevented the *Teredo navalis* from boring through the wood (After Bingeman et al. 2000, 219, Figure 1).

The first known experiment with copper sheathing in the Royal Navy occurred in 1759, when *Panther* and *Norfolk* had their false keels clad in copper. The trial was deemed successful, and in 1761, *Alarm*, a thirty-two gun frigate, became the first Royal Navy vessel to be entirely sheathed in copper (The first American vessel sheathed with copper was the warship *Alliance* in 1781. See Laidlaw 1952: 213-214). The ship was clad in extremely light 12 gauge sheathing that was fastened with copper nails (Metallic sheathing is described by the number of ounces in a square foot of sheathing. Hence, 12 gauge means 12 ounces per square foot, and 32 gauge refers to sheathing that weighs 32 ounces per square foot). After a two-year patrol through the West Indies, *Alarm* returned to England and was thoroughly inspected by the Admiralty. The results were quite satisfactory, and the Navy Board ordered several more ships to be clad in heavier copper sheathing. The use of fasteners remained problematic, as some ships were being sheathed with copper or copper alloy fasteners and others with iron. The copper fasteners experienced the least electrochemical corrosion, being closest to the sheathing composition on the electromotive force scale. The differing rates of corrosion between sheathing fastened with copper or composition alloy nails must have been noted, but there remained no standardization concerning fastener use until 1783 (Bingeman et al. 2000: 221-2).

The use of copper sheathing to protect the hulls of vessels continued to grow in the 1770s. While the copper barrier seemed to solve the problem of marine borers damaging the hull, several of the sheathed vessels experienced accelerated corrosion of iron hull fasteners, similar to what had afflicted ships sheathed with lead nearly a century before. The electrochemical corrosion occurred when the less noble iron decayed in the presence of the more noble copper, with the saltwater serving as the electrolytic solution. Since the fasteners were often in concealed places, the problem did not come to the attention of the Admiralty until a catastrophe occurred in Canada. In late 1782, several Royal Navy warships foundered in a storm off Newfoundland, sinking with an enormous loss of life. The ships' iron fasteners were said to have corroded completely, allowing the ships to fold in on themselves in the rough weather. The Admiralty ordered a temporary moratorium on sheathing new vessels until a solution to the electrochemical corrosion problem could be formulated (Harris 1966: 554-5). It was eventually noticed that when the iron fasteners were insulated from the saltwater and other metals (namely the sheathing and sheathing nails), they would remain unharmed. The iron fasteners were then insulated with a variety of organic barriers, which met with some success. Thick brown paper was placed between the copper sheathing and the wooden hull planking, in an attempt to isolate the metals from each other (Winfield 1997: 76). However, the copper nails holding the sheathing still penetrated into the hull, coming into close proximity with hull fasteners of different alloy compositions. Although the rate of corrosion was diminished, it was not eliminated. A new solution was required to eliminate the electrochemical corrosion problem between the metallic sheathing and fasteners.

Sacrificial planking could be used in lieu of thick paper to provide a barrier between the dissimilar fasteners. The thin wood planking, like that found on the Mica wreck, could also serve another purpose, namely as a spacer. By nailing the hull planks to the frames, then nailing the sacrificial planking to the hull planks, and finally nailing the sheathing to the sacrificial planking, there would be no nail holes that penetrated completely through all three layers. This arrangement would prevent leaks if the outer fasteners fell out, while preventing interior fasteners from working loose. The sacrificial planking may also have been placed on the vessel while it was being re-sheathed. In order to avoid driving sheathing nails through preexisting holes, the ship owner may have had sacrificial planking placed on the hull to give the nails a better hold. An example of sacrificial planking being applied can be seen in a contemporary photograph of a whaling ship being sheathed (Figure A2).

Figure A2. Carpenters applying pine sheathing before the application of metallic sheathing (From Church 1938, Figure 17).

The copper sheets were also corroded from internal electrochemical reactions. Impurities within the copper could preferentially corrode out of the sheet, leaving it weak and porous, but at the same time, a certain amount of impurities seemed necessary to make a sheet that lasted decades instead of just a few years. George Pattison observed that even if the copper sheathing came back from a voyage clean with a light patina, the fasteners, in this case made of an alloy containing copper, zinc and tin, would each be home to a barnacle. He described the effect "as ornamental white studs upon a green ground." (Pattison 1829: 94).

The Royal Navy realized that replacing the iron bolts with copper fasteners would help mitigate the differing electromotive forces that caused the iron fasteners to corrode. However, copper bolts were too soft to be driven into the massive hardwood timbers used to frame the warships. A copper bolt had to be developed with the necessary attributes, namely hardness, to be used in place of the iron bolts. A manufacturing method, developed by William Forbes, created a hardened copper bolt that was soon used on all Royal Navy ships below the waterline (Bingeman et al. 2000: 222-3). By 1785, the problems of electrochemical corrosion between the ship's fasteners and the sheathing appeared to be at an end.

All of the problems associated with using copper, however, had not been solved. The copper sheathing was soft and subject to erosion, especially in areas of the ship where the saltwater sped over the surface, namely the bow. The area was sheathed with thicker copper, up to thirty-two ounces per square foot, but the friction of the saltwater proved a constant problem (Bingeman et al. 2000). A harder surface was needed, but the existing technology of hot rolling a metal destroyed some of the crystalline grain structure and its associated hardness. Yet cold rolling caused cracking, making the sheets inflexible, and impossible to fit to the compound curves of the hull. Cold rolling was more economical, because the additional steps of controlled heating and cooling of the metal were not necessary. However, it also took longer to roll the cold metal, because it was less malleable (Bingeman et al. 2000). Inventors and metal rollers continued their quest to find a metal or alloy that was malleable, yet hard, at low temperatures. With copper, they were on the right track, yet the ideal alloy and manufacturing process would continue to elude them for nearly another half century.

MIXED-METAL SHEATHING

A more durable metallic sheathing that did not damage the vessel's integrity was required. The answer was to be found in alloy sheathing, also known as composition or mixed-metal sheathing. The rapid evolution of mixed-metal sheathing occurred during the early 19th century. Alloys of lead, tin, copper, antimony, zinc, and mercury were created and tested. The following section provides an overview of mixed-metal sheathing development.

Zinc was considered as an alternative to copper sheathing because it was inexpensive and abundant. A patent record from 1805 relates how three inventors found the ideal combination of low heat (200-300 degrees Fahrenheit) and incremental rolling to reduce ingots of zinc into sheets of suitable gauge sheathing material (Honson et al. 1806: 251-2). To make the sheets flexible enough to fit the curvature of a vessel, they had to be annealed (heated to a low red heat) once more and then trimmed to size. Sheets were punched or bored (whether by hand or machine is unfortunately not specified) and then fastened with iron nails or spikes to the hull of a vessel. However, the use of pure zinc presented several problems for manufacturers desiring to use it as a sheathing material. It was prone to cracking and breaking into pieces if rolled cold, but when rolled at high heat it lost some of its desired metallurgical qualities, namely hardness and the associated durability (Honson et al. 1806).

The patent recommended choosing a metallic fastener that was as close to zinc as possible on the electromotive force scale, in this case, iron. Pure zinc did not have the mechanical strength to serve as a fastener. Zinc coated iron nails could also be employed to reduce the inherent galvanic corrosion caused by using dissimilar metals. While theoretically possible as a sheathing scheme, the labor and cost associated with making the composite fasteners prohibited the economic viability of zinc sheathing and fasteners. It is also necessary to note that as soon as the thin zinc plating dissolved from the iron nails, the original problem of rapid corrosion of dissimilar metals in close proximity would return (Honson et al. 1806).

I.R. Butts, author of a shipbuilding treatise first published in 1856, included a section on sheathing technologies. He agreed that zinc sheathing was effective for preventing shipworm attack and marine growth. Concerning its effectiveness, Butts wrote that "Shipmasters certify that it continues as clean as yellow metal." (Butts 1980: 145). Butts claimed that it lasted longer than copper and alloyed sheathing, while being considerably cheaper. However, he cited its use for sheathing ships as a recent introduction (Butts 1980: 77). The gap Butts alluded to, between time of patent and manufacture, was almost 40 years, indicating that there was a considerable amount of time between the application for the patent, and the actual manufacture and marketing of that product.

In 1817, William Collins applied for a patent concerning the right to manufacture a new mixed-metal sheathing. The patent claimed manufacturing rights to an alloy of 80 percent copper and 20 percent tin. The bronze alloy sheathing was hailed as superior to copper, yet offered no specifics concerning durability. Collins left his patent curiously vague, stating "I do not confine myself to any precise mixture of those metals [copper and tin], or exclude any addition of other metals, or semi metals, provided the properties of the bronze metal are preserved." (Collins 1818: 67-8). Collins appeared not to have had any specific knowledge of ship sheathing manufacture or metallurgy. His patent was a speculative attempt to grab a portion of the market for a product that lacked design parameters. Perhaps Collins was banking on another inventor unknowingly developing a sheathing that would infringe on his patent, in order to obtain royalties.

The late 1820s and early 1830s witnessed the most rapid advancements in mixed-metal sheathing technology. A range of metals and alloys were employed. The need for a durable and inexpensive sheathing was becoming more acute as naval and merchant vessels and fleets grew in size and number, sailed further, and remained away from their homeports for extended periods of time, especially whalers and explorers. By this time, Teredo worms, barnacles, and fouling weeds were nearly ubiquitous, being spread from their warm native waters to most of the world's temperate ports.

In 1829, American inventor John Revere developed a system of sheathing vessels with iron sheets. The iron, which would normally aggressively corrode in salt water, was preserved by the attachment of a sacrificial metal. Zinc, being less noble than iron, sacrificed electrons to the iron, preventing its decay. After two years at sea, the bottom of an iron sheathed hull was described as having a "clean, and even bright surface." (Pattison 1829: 94-5). There was little widespread use of iron sheathing, however, probably due to its expense and the introduction of Muntz metal several years later.

The method for sheathing a vessel in iron was identical to that for copper, with the added step of attaching a small block of zinc (5 percent of the surface area of each iron sheet). The inexpensive zinc was riveted or soldered on both the internal and external surfaces of the sheet. To attach the sheathing to the hull, the patent specifies the use of iron nails with hollow domed heads, the underside of which were filled with melted tin (Pattison 1829). They were driven through the sheathing until they were flush with the planking, with the tin flattening out to form a washer, effectively isolating the zinc and iron (Pattison 1829). The system may have been effective, but it was considerably more labor-intensive then pure copper sheathing, and hence more expensive.

In 1830, John Gray developed a new process for mechanically punching sheets of copper, allowing the heads of the spikes to be countersunk in preformed beveled holes. The countersunk depression accepted the nail and prevented the sheet from depressing around the fastener, which would normally be left proud. When driven to the proper depth, the nail was flush with the exterior surface of the sheathing. Such a technique would make a more streamlined hull, with the surface being smooth and uninterrupted by nail heads. The machine being patented contained a template, which allowed holes to be punched at regular intervals, making the sheets identical (Gray 1830: 172-3). The use of pre-punched sheathing speeded up the whole process and lessened the cost of labor for sheathing, although the manufacturer could charge more for such a convenient feature. The presence of a mechanically punched sheet of pure copper sheathing could be used as a temporal diagnostic artifact for archaeological studies.

The following year, Matthew Uzielli applied for a patent covering an alloy of one hundred parts copper and five to seven parts tin (Uzielli 1831: 137-9). He claimed the bronze alloy had superior hardness over copper and was less prone to oxidation. To make it easier to roll, Uzielli added one to two parts of lead and zinc. The alloy was smelted and then poured between two large granite slabs, which pressed the molten metal into a sheet approximately half an inch thick. The thin ingot was cut and then annealed. The ingot was heated again, cooled, and then rolled. This process was repeated twelve to fifteen times, until the sheet reached the desired thickness. The sheets were then cut or trimmed into a standard dimension. At this point the gauge or weight of the sheathing was stamped on the sheets, often near a corner.

In the same year, John Revere applied for another patent concerning an alloy that was radically different from Uzielli's creation. The alloy, 95 percent zinc and 5 percent copper, was more durable than pure zinc, and more resistant to corrosion than pure copper. There was, however, a problem in combining these two metals, as the zinc tended to combust when added to molten copper. Revere solved this problem by adding salt or pulverized charcoal to the mixture to drive off the oxygen. Without oxygen, the zinc failed to combust. With regard to the resulting brass sheathing alloy, Revere stated that, "its liability to corrode is essentially diminished (Revere 1831: 29). He included a note in the patent that called for nails to be made from the same material. If the sheathing and fasteners used to cover a vessel were of identical composition, then the galvanic action between them would be negligible, and part of the problem with electrochemical corrosion on the vessel would be solved. However, zinc is not a hard or mechanically strong metal, and when coupled with such a small amount of copper, the alloyed material would have been far too weak to be used for structural fasteners. Revere's alloy could have been used for the sheathing nails (usually one and one quarter inches in length), but the underlying problem of dissimilar metals (iron hull fasteners) in close proximity still remained (Revere 1831). To create a barrier between the iron fasteners and the sheathing, sheets of heavy tar paper or felt were laid next to the hull, with the short sheathing nails (hopefully) not coming in contact with the iron. A layer of thin planking was also used as an alternative to paper or felt.

The use of lead as a sheathing material made one last appearance before being permanently shelved. Baron Charles Wetterstadt alloyed one hundred parts of lead and ten parts of antimony to form a harder and more durable lead sheathing. The mixed-metal was then cold rolled and painted with a molten concoction of 85 percent mercury, 5 percent antimony, and 10 percent lead. The sheets were rolled once again to smooth over the finish. The result was a plated sheet of milled lead that was of a consistent thickness, flexible, and yet had a hard surface

(Wetterstadt 1832: 411-2). However, the sheathing was not adopted, likely because of the high cost of materials and the labor-intensive manufacturing process, not to mention the toxicity of the combined materials (Wetterstadt 1832).

Despite the galvanic problems with the iron fasteners (bronze fasteners had not been universally adopted), copper sheathing remained the most accepted and widely used material through the middle of the 19th century. Nearly all of the practical composites were more expensive in terms of materials and manufacturing cost. They offered an untested remedy to the problem of finding effective hull protection. Ship builders were unwilling to stake their reputation and livelihood on an unproven technology. Conservatism in technological adoption would be a formidable hurdle that the first successful, widely adopted mixed-metal sheathing would have to overcome.

A new mixed-metal sheathing appeared in 1832. The mixture of 50 percent copper and 50 percent zinc was patented by Birmingham industrialist George F. Muntz (Muntz 1833: 195-6). Zinc and copper were smelted together and then rolled either hot or cold. The fact that it could be rolled without heating resulted in a significant savings in manufacturing cost. This savings, coupled with the use of a large proportion of zinc, which was considerably cheaper than copper, resulted in a relatively inexpensive sheathing. The metal's attributes included superior flexibility and surface hardness when compared to pure copper or pure zinc sheathing. Muntz's new metal was less prone to oxidation than copper or pure zinc, yet it exfoliated just enough surface scale to inhibit the attachment of barnacles and weeds (Crothers 1997: 329). To avoid the problems associated with electrochemical corrosion, Muntz patented and produced mechanically hardened fasteners of the same composition in late 1832 (Muntz 1834: 44-5).

The new sheathing, called 'yellow metal' because of its bright golden color, seemed ideal in every respect, yet it to took more than two decades to become established. One of the difficulties plaguing Muntz was consistently mixing the exact proportions required to make the alloy. Experienced metallurgists and metal rollers were in short supply. If the new alloy varied by more than 1 percent from the stated proportions, its properties were radically altered. Muntz continued to develop the metal, finally settling on an alloy of 60 percent copper and 40 percent zinc (For a full description of the life of George Muntz and the development of his alloy, refer to Flick 1973: 70-88, and Staniforth 1985: 21-48). All of the extant Muntz metal samples tested by the author were found to contain around 62.5 percent copper and 37.5 percent zinc (Appendix 3 contains the composition analysis of selected metallic hull sheathing samples).

It was difficult to gain converts to the new sheathing technology in the early 1830s. According to a shipbuilding treaty by I.R. Butts, copper hull sheathing lasted an average of four years, zinc six, and yellow metal a mere three (Butts 1980: 83). Muntz was forced to sell the unproven technology below cost or even give it away in order to get his product out in public view. There were also initial problems with the alloy's consistency. If two ships sailed to the same distant port, and both were sheathed in Muntz metal, one might return with bright sheathing, while the other would have corroded to the point of being useless. The sheets of both ships looked identical at the time of manufacture, but a slight difference in composition made one much more susceptible to corrosion. Despite this inconsistency, Muntz's economical yellow metal slowly gained popularity through the late 1830s and 1840s, becoming nearly ubiquitous by 1855. The use of Muntz metal lasted until the advent and widespread use of iron-hulled ships.

The mixed-metal sheathing continued to be used on both large and small wooden hulled vessels into the early twentieth century.

The invention and eventual successful marketing of Muntz metal did not inhibit other inventors from continuing to submit patent applications for new mixed metal concoctions. In 1835, a bronze sheathing was created in France that consisted of six to ten percent (by weight) tin added to copper (No author 1835: 206-8). The resulting bronze alloy was hard and difficult to roll, but it claimed to be twice as durable as copper while being only two-thirds as thick (the average copper sheathing or Muntz metal was 28-32 ounces per square foot, while hard bronze was 18-20 ounces per square foot). The manufacturers claimed long-term savings because of the increased durability, but ship owners were either unwilling or unable to pay the increased manufacturing expenses up front. The makers tried unsuccessfully to target the whaling industry, which required durable sheathing for their multi-year voyages. However, after 1855, the acceptance of Muntz metal was beginning to control the ship sheathing market.

APPLICATION OF METALLIC SHEATHING

Henry Hall, a special agent for the United States Census Office, compiled a vast report on the shipbuilding in the United States for the 10th Census in 1880. He visited many shipyards along the Eastern seaboard, and filed a report concerning the application of metallic sheathing. He noted:

> The process of putting on is as follows: The bottom of the hull is first made smooth; and if it is an old vessel, the worn copper is stripped off with chisels and adzes, the sails removed, and the surface of the planking is scraped clean, the old metal and nails being sent off for sale. The hull is then either sheathed with a light planking, or is covered with cement or graved with tar and papered or felted.
>
> Sheathing was also in vogue, and is still common; but papering or felting is the new idea, and is extensively practiced, as it is claimed that worms will not go through paper. The sheets of metal are meanwhile being prepared by punching either two, three, or four rows of holes along their edges for nailing them on. The heaviest thicknesses are put on at the bow as far back as the foremast at the load-line, but no farther aft at the keel than the forefoot. The metal of the next weight goes on aft of that, the after boundary of this thickness being a line from the mainmast at the load-line to the heel of the foremast at the keel, and grows lighter yet as the men work aft along the hull. The rudder and the keel are both covered with heavy metal. The sheets lap one inch. A bark of 310 tons requires about 1,025 sheets of metal, weighing 6,300 pounds, and 770 pounds of composition nails (Hall 1884: 27).

Hall included a table detailing the amount and gauge of metallic sheathing necessary to sheath barks and schooners of various tonnages. A 130 ton schooner, similar to the Mica shipwreck, required 90 sheets of 28 gauge, 82 sheets of 26 gauge, 100 sheets of 24 gauge, 53 sheets of 22 gauge, 97 sheets of 20 gauge and 169 sheets of 18 gauge metallic sheathing. A total of 591 sheets would be required, with an aggregate weight of 1,741 kilograms (3,835 pounds) (Hall 1884: 27).

Sheathing ships was a major industry in shipyards around New York. In 1884, shipwrights removed and replaced metallic sheathing on 297 vessels. The shipwrights used 135,746 kilograms (299,000 pounds) of sheathing, with large sailing ships requiring between 10,442 to 11,804 kilograms (23,000 to 26,000 pounds) and smaller schooners using between 2,270 and 3,632 kilograms (5,000 and 8,000 pounds). Hall notes that approximately half of the metallic sheathing used was of foreign manufacture, with foreign made sheathing costing 26 cents per kilogram (13 cents per pound), and American made sheathing running 32 to 34 cents per kilogram (16 to 17 cents per pound). Metallic sheathing was also used for lining the holds of grain carriers (Hall 1884: 118).

Around New York, Hall reported that ship owners purchased the required amount of sheathing and then had it punched by machine at a local shop. In Baltimore, Hall relates how a sheathing machine was used, but discontinued after the men objected to it (the reason was unspecified), and workers returned to punching the sheets by hand (Hall 1884: 127).

Sheathing would typically be applied either while in dry dock, or when a vessel was hove down. Due to the chronic shortage of sheathing material in the United States, ships would often be built and outfitted along the Eastern seaboard and then sailed to England for their sheathing. The famous USS *Constitution* was sheathed in 1795 with copper imported from England (Laidlaw 1952: 214).

In the mid 19th century, the sheathing process began near the keel or just below the waterline (Crothers 1997). The area around the waterline was subject to increased wear from rubbing against docks, anchor lines, or other vessels, as well as being subject to the most friction from the seawater flowing past. The area was protected by thick wooden planking. The seams were caulked and then payed with tar. A layer of felt or heavy paper would then be laid down on the tar. The worn protective planking could be removed and replaced without placing the ship in a dry dock.

Metallic sheathing was applied over the bottom of the keel and then the false keel was attached and either sheathed or more likely filled or studded with nails. This was an intentional design feature. If the false keel was damaged or ripped off, the copper-sheathed keel would prevent the entrance of the marine borers (Crothers 1997: 330). The hull sheathing was overlapped so that, facing the bow, the leading edge of a sheet was always tucked under the one immediately forward. The standard overlap was 3-4 centimeters (1-1.5 inches) on both the horizontal and vertical axes. The amount would depend on where the sheathing began. If at the keel, then the top edge of a sheet would be tucked under the next highest layer. In areas of compound curves, sheets would be trimmed or overlapped a great deal. The latter obviously used more material, but was stronger and more durable. The most important consideration was sleekness, and, to this end, all leading edges were tucked under to avoid being ripped off during sailing (Crothers 1997).

Pure copper and Muntz metal sheathing was attached using copper alloy nails. Iron fasteners were used to hold certain types of metallic sheathing, namely lead. After being driven through the sheathing and into the planking, the iron formed a corrosion product that interlocked with the wood, enhancing the strength of the hold. Copper alloy fasteners tended to corrode lightly, and the corrosion products did not combine with the wood to grip the fastener. The copper alloy fasteners would eventually work loose (Whiteman 1971). A sheathing nail advertisement from 1806 revealed how inventor Samuel Guppy modified the existing copper alloy nails to perform as well as the iron fasteners (Figure A3). The patent nails had jagged or barbed surfaces which allowed the copper alloy fasteners to tightly grip the wood and not work loose (Whiteman 1971: 39).

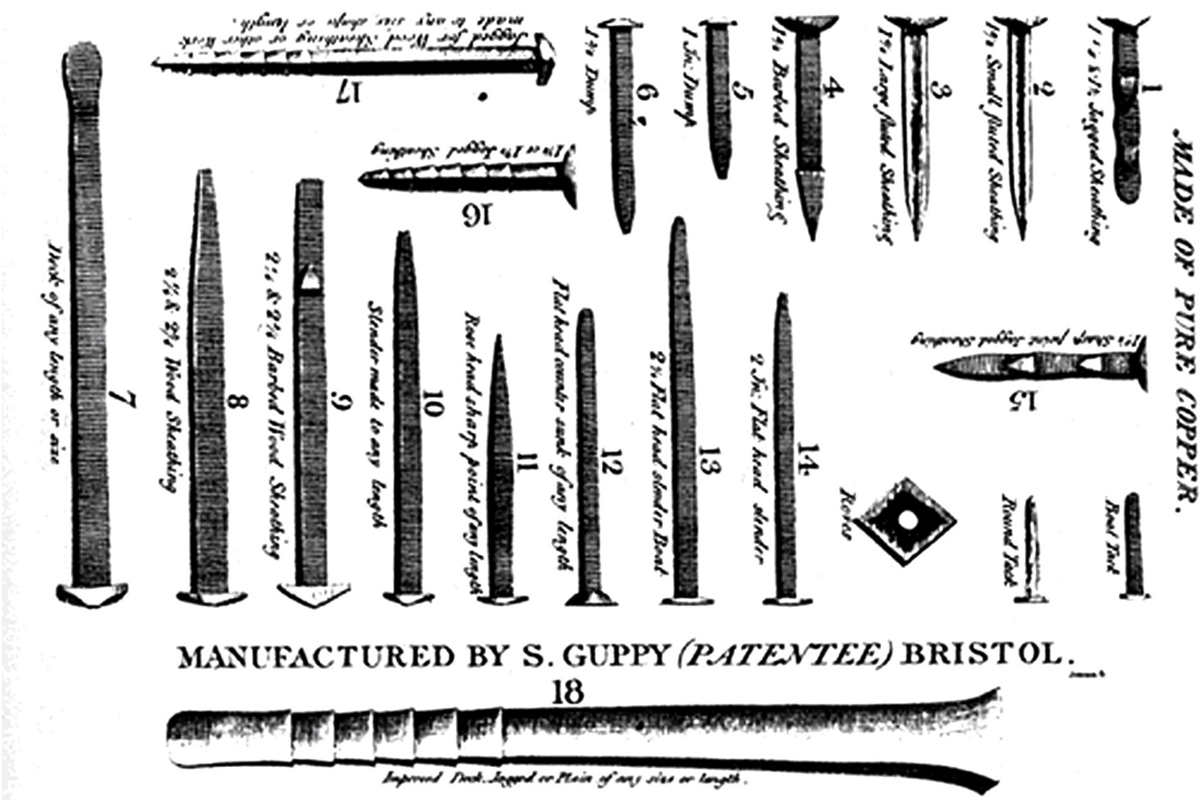

Figure A3. A sheathing nail advertisement from 1806. It revealed how inventor Samuel Guppy modified copper alloy nails to perform as well as iron fasteners (After Whiteman 1971, 39).

Besides containing details of the new sheathing nails, the Guppy advertisement listed the advantages of, and rules for, using the new hammer-hardened fasteners instead of the older, cast copper, nails. Guppy claimed that unhardened cast copper nails had an abnormally high breakage rate:

> No one need be told, the closer the Copper is fastened to the bottom the better—that a smooth surface…will last twice as long, and a ship sail much faster, than with a rough bottom, and uneven surface; and it is impossible to fasten the Copper close with cast nails, for if they are driven up, the heads of half will fly off, in

> consequence of the brittle nature of the metal; the head not being close will impede sailing, catch grass, weeds. (Whiteman 1971: 39).

Guppy claimed that his hammer-hardened nails had a breakage rate of one in a thousand. Even though the breakage rate seemed dubious, Guppy's nails used less metal than a comparable cast fastener and they lasted longer. He acknowledged that his nails were twice as expensive as cast nails, but argued that the investment would pay off in the long run. Guppy noted that, on average, 70 nails were used to attach each sheet of sheathing to the hull (Whiteman 1971: 39). There was an average of 80 nail heads visible on each of the Mica wreck's copper sheathing sheets.

The use of cast nails created larger holes in the sheathing and planking, and, because the nails lacked barbs, they could rapidly work themselves loose, causing the sheathing to separate from the hull. Guppy continued on the detrimental effects of cast copper nails:

> The injury done to ships' bottoms, as well as the copper, by the use of large cast nails, *has been the subject of great complaint; and barnacles are frequently found on the heads of each cast nail, which very much impede the ship's sailing*."(Whiteman 1971: 39) [original italics]

The barnacles increased the drag of the hull, reducing the speed and handling capabilities of the vessel. Fasteners that worked loose allowed the sheet to flex. This loose sheathing fatigued the metal around each hole, eventually causing the sheet to be ripped off the hull in rough weather (Whiteman 1971: 39).

In the fastener advertisement, Guppy offered some interesting information concerning the recycling of metallic sheathing and the method of punching and applying copper sheets to the hull. When the sheathing had to be replaced, the vessel was placed in dry dock and manually stripped of all sheathing and nails. Guppy claimed that his copper fasteners could be removed and melted with the sheathing, because they were both pure copper (Whiteman 1971: 39). The cast nails, like those found on the Mica shipwreck, were a composition of copper, tin, and zinc. The cast composition nails contained up to 20 percent impurities, lessening the value of the recycled material (zinc and tin were worth less than copper). The composition nails also had to be removed by hand from the pure copper sheets before they could be melted down, with the additional labor lessening the economic incentive to recycle (Whiteman 1971, 39).

During the period of Guppy's advertisement, the early 19th century, sheathing a new or recently stripped hull was accomplished in the following manner: The sheets were placed on a table and struck with a punch that was slightly smaller than the diameter of the fastener to be used. Punching the holes was necessary to avoid creating a depression by trying to force a nail through the copper sheet. The depressions, like the barnacles, decreased the sleekness of the hull. The sheet was then held against the hull, and a smaller punch was used to make a starter hole in the plank behind each hole in the copper sheet. This hole was necessary to prevent the fastener from cracking or splitting the underlying hull planking. Guppy said that the punch should penetrate no further than 1 centimeter (0.4 inches). Accordingly, the sheathing nails found on the Mica shipwreck were, on average, 3 centimeters (1.2 inches) in length. In areas of compound curves or external hull fittings, the sheathing had to be custom cut and punched (Whiteman 1971: 39).

THE FUTURE OF METALLIC SHEATHING RESEARCH

The study of the development of mixed-metal sheathing technology has provided archaeologists and historians with another diagnostic tool for dating shipwrecks. When a piece of sheathing is recovered, composition analysis can be performed that gives the exact amounts of the constituent elements. The accuracy of the composition tests, coupled with analysis of the metallic grain structure, can create a sort of fingerprint for each sheathing sample. The fingerprints can be used to identify two ships that were sheathed from the same lot of metal or even identify differences in sheathing origin across the hull of a single vessel. Gauge analysis can reveal patterns of thickness and identify areas where the sheathing was subject to accelerated corrosion or erosion. The fingerprints can also be compared to patent records or other known examples from precisely dated shipwrecks. It is possible to look at the fastening pattern and determine whether the sheathing was applied before or after the advent of mechanical punching. The fasteners themselves can be diagnostic. Manufacturers often stamped the heads of large nails and bolts with their company name or the patent date. Information concerning sheathing technology has been used to help identify and date several shipwrecks, and it is hoped that the trend will continue. Metallic sheathing is a complex artifact that, with continued research, will offer much new information to nautical archaeologists.

7:0 APPENDIX 2: MICA SHIPWRECK ARTIFACT CATALOG by Toby Jones

ARTIFACT 1

Description: Fragment of copper hull sheathing

Dimensions: 35.0 centimeters x 18.3 centimeters

Notes: Fragment appears to be the side edge of a sheet, as two corners are visible. 17 fastener holes visible. Sheathing overlap line along the upper edge. Largest fragment of hull sheathing retrieved.

Photograph by Cesar Arias.

ARTIFACT 2

Description: Fragment of copper hull sheathing

Dimensions: 26.5 centimeters x 12.0 centimeters

Features: 4 fastener holes visible, no edges evident

Photograph by Cesar Arias.

ARTIFACT 3

Description: Fragment of copper hull sheathing

Dimensions: 14.5 centimeters x 10.8 centimeters

Notes: One edge visible, possibly a corner fragment. 6 fastener holes visible.

Photograph by Cesar Arias.

ARTIFACT 4

Description: Fragment of copper hull sheathing

Dimensions: 8.5 centimeters x 8.2 centimeters

Notes: 2 fastener holes visible, 1 fastener, no edges.

Photograph by Cesar Arias.

ARTIFACT 5

Description: Fragment of copper hull sheathing

Dimensions: 14.5 centimeters x 7.5 centimeters

Notes: 4 nail holes, no edges.

Photograph by Cesar Arias.

ARTIFACT 6

Description: Copper alloy sheathing fasteners

Dimensions: 14.5 centimeters x 10.8 centimeters

2.8-3.8 centimeters in length

0.4 centimeter average shank diameter

Notes: Flat head, tapered shank.

Photograph by Cesar Arias.

ARTIFACT 7

Description: Lead Hawse Pipe

Dimensions: 41.0 centimeters x 7.0 centimeters x 2.0 centimeters

Notes: Casting seams, cut marks and internal wear are evident.

Photograph by Cesar Arias.

8:0 APPENDIX 3: METALLIC SHEATHING STUDY RESULTS by Toby Jones

The following appendix provides information on the elemental composition of select metallic ship sheathing and fastener samples. The original reports received from the Texas A&M University, Agriculture Program Laboratories, are presented as Figures C1 and C2.

Following tables represent a comparative analysis of the copper sheathing samples and lead artifacts with comparable archaeological examples.

The Agriculture Program

THE TEXAS A&M UNIVERSITY SYSTEM • EXPERIMENT STATION

Feed and Fertilizer Control Service • Agricultural Analytical Services

P.O. Box 3160
College Station, Texas 77841-3160
Phone 979.845.1121 Fax 979.845.1389
Web: otscweb.tamu.edu

FAXED 5/3/02

Client Code: 2002-2747
Report Date: 5/3/02

Mr. Toby Jones
Nautical Archeology/Oceanography
TAMU
College Station, Tx 77843-4352
USA

Dear Mr. Jones,

Agricultural Analytical Services reports the following results for the sample referenced below.

Reference Sample: C2002-298057 Date Received: 4/25/02

Assigned Methods	Result
252-Copper	83.8 %
284-Lead	3838 ppm ≈ 0.5 %

Sample Description/Comments:
Nail-Copper FASTENER

Remainder probably zinc, creating a brass alloy.

The analytical work reported appears on invoice 1084.

Thank you for the opportunity to be of service.

Very truly yours,

Dr. George W. Latimer, Jr.
Head, Agricultural Analytical Services

Figure C1. A copy of the original report of the metal analysis carried out on the copper nail specimens from the Mica Shipwreck.

The Agriculture Program

THE TEXAS A&M UNIVERSITY SYSTEM • EXPERIMENT STATION

Feed and Fertilizer Control Service • Agricultural Analytical Services

FAXED

P.O. Box 3160
College Station, Texas 77841-3160
Phone 979.845.1121 Fax 979.845.1389
Web: otscweb.tamu.edu

Mr. Toby Jones
Nautical Archeology/Oceanography
TAMU
College Station, Tx 77843-4352
USA

Client Code: 2002-2747
Report Date: 4/25/02

Dear Mr. Jones,

Agricultural Analytical Services reports the following results for the sample referenced below.

Reference Sample: C2002-298053 Date Received: 4/15/02

Assigned Methods	Result
213-Zinc	0.004 %
252-Copper	97.500 %
284-Lead	0.0054%

Sample Description/Comments:
Metal (Copper) SHEATHING

The analytical work reported appears on invoice 1080.

Thank you for the opportunity to be of service.

Very truly yours,

Dr. George W. Latimer, Jr.
Head, Agricultural Analytical Services

Figure C2. A copy of the original report of the metal analysis carried out on the copper sheathing specimens from the Mica Shipwreck.

Table C1.
Original Lab Analysis Results for the Archaeological Samples from Nautical Contexts Presented in
Tables C2, C3, C4 and C5. (below).

SHIPWRECK	Analysis	As (wt%)	Sn (wt%)	Pb (wt%)	Bi (wt%)	Cu (wt%)	Zn (wt%)	Fe (wt%)	Total (wt%)		As (at%)	Sn (at%)	Pb (at%)	Bi (at%)	Cu (at%)	Zn (at%)	Fe (at%)
	Pb samples																
	LLD (Lower limits of detection)	0.10	0.09	0.20	0.18	0.12	0.13	0.05									
Pilar 1619	01_pt1	0.00	0.00	99.28	0.15	0.00	0.02	0.00	99.45		0.00	0.00	99.79	0.15	0.00	0.06	0.00
Pilar 1619	01_pt2	0.01	0.00	98.78	0.11	0.04	0.05	0.00	98.99		0.04	0.01	99.55	0.11	0.12	0.18	0.00
Modern Lead	26_point1_ fixed	0.01	0.12	100.03	0.14	0.02	0.01	0.00	100.33		0.02	0.20	99.53	0.13	0.08	0.04	0.00
Mica Hawse Pipe	27_pt1	0.00	0.05	100.68	0.04	0.18	0.02	0.02	100.99		0.00	0.08	99.16	0.04	0.58	0.08	0.06
Mica Hawse Pipe	27_pt2	0.00	0.07	99.84	0.20	0.00	0.00	0.02	100.13		0.00	0.12	99.62	0.20	0.00	0.00	0.07
	Cu samples																
	LLD (Lower limits of detection)	0.03	0.07	0.13	0.12	0.12	0.13	0.04									
Mica Sheathing	02_pt1	0.28	0.00	0.00	0.00	99.32	0.00	0.02	99.62		0.24	0.00	0.00	0.00	99.73	0.00	0.03

Table C1.
Original Lab Analysis Results for the Archaeological Samples from Nautical Contexts Presented in Tables C2, C3, C4 and C5 (continued).

SHIPWRECK	Analysis	As (wt%)	Sn (wt%)	Pb (wt%)	Bi (wt%)	Cu (wt%)	Zn (wt%)	Fe (wt%)	Total (wt%)		As (at%)	Sn (at%)	Pb (at%)	Bi (at%)	Cu (at%)	Zn (at%)	Fe (at%)
Mica Sheathing	02_pt2	0.29	0.00	0.09	0.00	99.00	0.00	0.00	99.38		0.25	0.00	0.03	0.00	99.72	0.00	0.00
Mica Sheathing	03_pt1	0.12	0.02	0.01	0.00	98.92	0.00	0.01	99.08		0.10	0.01	0.00	0.00	99.87	0.00	0.01
Mica Sheathing	03_pt2	0.13	0.02	0.06	0.01	99.39	0.00	0.00	99.61		0.11	0.01	0.02	0.00	99.85	0.00	0.00
Mica Sheathing	04_pt1	0.22	0.00	0.05	0.06	99.84	0.00	0.00	100.17		0.19	0.00	0.01	0.02	99.78	0.00	0.00
Mica Sheathing	04_pt2	0.23	0.01	0.03	0.04	99.05	0.00	0.01	99.37		0.20	0.01	0.01	0.01	99.76	0.00	0.01
Mica Sheathing	05_pt1	0.26	0.01	0.03	0.08	99.78	0.00	0.00	100.16		0.22	0.00	0.01	0.02	99.74	0.00	0.00
Mica Sheathing	05_pt2	0.22	0.01	0.02	0.00	99.37	0.00	0.00	99.62		0.19	0.01	0.00	0.00	99.80	0.00	0.00
Mica Fasteners	06_pt1_ moving	0.31	5.30	0.77	0.21	84.79	7.45	0.04	98.87		0.28	2.97	0.25	0.07	88.80	7.59	0.05
Mica Fasteners	07_pt1_ moving	0.28	5.17	0.38	0.14	84.53	8.09	0.04	98.63		0.25	2.89	0.12	0.04	88.42	8.22	0.05
Mica Sheathing	08_pt1	0.14	0.02	0.00	0.02	99.91	0.00	0.01	100.10		0.12	0.01	0.00	0.01	99.85	0.00	0.01
Mica Sheathing	08_pt2	0.12	0.00	0.00	0.01	99.46	0.00	0.00	99.59		0.10	0.00	0.00	0.00	99.90	0.00	0.00
Mica Sheathing	09_pt1	0.14	0.00	0.00	0.00	100.17	0.01	0.00	100.32		0.12	0.00	0.00	0.00	99.87	0.01	0.00
Mica Sheathing	09_pt2	0.13	0.00	0.02	0.00	99.35	0.00	0.00	99.50		0.11	0.00	0.00	0.00	99.88	0.00	0.00
USS Alabama	10_pt1	0.04	0.00	0.02	0.00	100.71	0.00	0.00	100.77		0.04	0.00	0.01	0.00	99.96	0.00	0.00
USS Alabama	10_pt2	0.04	0.06	0.08	0.00	100.54	0.00	0.00	100.72		0.04	0.03	0.02	0.00	99.91	0.00	0.00
De Rosa Samples	11_pt1	0.04	0.00	0.57	0.00	62.75	37.08	0.07	100.51		0.03	0.00	0.18	0.00	63.33	36.38	0.08
De Rosa	11_pt2	0.02	0.02	0.00	0.06	62.49	37.95	0.07	100.61		0.01	0.01	0.00	0.02	62.81	37.07	0.08

Table C1.
Original Lab Analysis Results for the Archaeological Samples from Nautical Contexts Presented in Tables C2, C3, C4 and C5 (continued).

SHIPWRECK	Analysis	As (wt%)	Sn (wt%)	Pb (wt%)	Bi (wt%)	Cu (wt%)	Zn (wt%)	Fe (wt%)	Total (wt%)		As (at%)	Sn (at%)	Pb (at%)	Bi (at%)	Cu (at%)	Zn (at%)	Fe (at%)
Samples																	
De Rosa Samples	12_pt1	0.02	0.00	0.00	0.01	62.90	37.22	0.08	100.23		0.02	0.00	0.00	0.00	63.42	36.47	0.09
De Rosa Samples	12_pt2	0.03	0.02	0.04	0.03	63.03	37.13	0.09	100.37		0.02	0.01	0.01	0.01	63.49	36.35	0.10
Robert	13_pt1	0.02	0.04	0.00	0.00	62.13	37.19	0.06	99.44		0.02	0.02	0.00	0.00	63.15	36.74	0.07
Robert	13_pt2	0.01	0.00	0.00	0.04	62.94	36.92	0.08	99.99		0.01	0.00	0.00	0.01	63.62	36.27	0.09
De Braak Sheathing	14_pt1	0.54	0.00	0.00	0.04	98.69	0.00	0.02	99.29		0.46	0.00	0.00	0.01	99.51	0.00	0.02
De Braak Sheathing	14_pt2	0.65	0.00	0.01	0.00	99.29	0.03	0.00	99.98		0.55	0.00	0.00	0.00	99.41	0.03	0.01
De Braak Sheathing	15_pt1	0.64	0.01	0.07	0.01	98.82	0.00	0.03	99.58		0.55	0.01	0.02	0.00	99.39	0.00	0.03
De Braak Sheathing	15_pt2	0.58	0.00	0.06	0.08	99.41	0.00	0.00	100.13		0.49	0.00	0.02	0.02	99.47	0.00	0.00
De Braak Sheathing	16_pt1	0.67	0.00	0.00	0.02	99.24	0.00	0.00	99.93		0.56	0.00	0.00	0.01	99.43	0.00	0.00
De Braak Sheathing	16_pt2	0.69	0.00	0.01	0.00	97.73	0.00	0.00	98.43		0.59	0.00	0.00	0.00	99.40	0.00	0.00
De Braak Sheathing	17_pt1	0.68	0.00	0.00	0.00	99.48	0.00	0.01	100.17		0.57	0.00	0.00	0.00	99.41	0.00	0.02
De Braak Sheathing	17_pt2	0.67	0.00	0.06	0.00	99.23	0.00	0.00	99.96		0.57	0.00	0.02	0.00	99.41	0.00	0.00

Table C1.
Original Lab Analysis Results for the Archaeological Samples from Nautical Contexts Presented in Tables C2, C3, C4 and C5 (continued).

SHIPWRECK	Analysis	As (wt%)	Sn (wt%)	Pb (wt%)	Bi (wt%)	Cu (wt%)	Zn (wt%)	Fe (wt%)	Total (wt%)		As (at%)	Sn (at%)	Pb (at%)	Bi (at%)	Cu (at%)	Zn (at%)	Fe (at%)
De Braak Sheathing	18_pt1	0.58	0.00	0.00	0.03	99.15	0.00	0.01	99.77		0.49	0.00	0.00	0.01	99.49	0.00	0.01
De Braak Sheathing	18_pt2	0.56	0.00	0.08	0.00	99.19	0.02	0.00	99.85		0.47	0.00	0.03	0.00	99.48	0.02	0.00
De Braak Sheathing	19_pt1_ fixed	0.43	0.00	0.03	0.11	95.77	0.00	0.02	96.36		0.38	0.00	0.01	0.03	99.55	0.00	0.02
De Braak Sheathing	19_pt2_ moving	0.70	0.00	0.19	0.20	96.25	0.00	0.01	97.35		0.61	0.00	0.06	0.06	99.26	0.00	0.01
De Braak Sheathing	20_point1_ fixed	0.54	0.00	0.05	0.03	98.04	0.00	0.00	98.66		0.47	0.00	0.02	0.01	99.51	0.00	0.00
De Braak Sheathing	21_point1_ fixed	0.68	0.00	0.04	0.00	97.55	0.00	0.00	98.27		0.59	0.00	0.01	0.00	99.40	0.00	0.00
De Braak Sheathing	22_point1_ fixed	0.64	0.01	0.09	0.01	97.67	0.00	0.01	98.43		0.56	0.00	0.03	0.00	99.40	0.00	0.01
De Braak Fasteners	23_pt1_ moving	0.23	8.30	0.84	0.08	87.74	1.34	0.02	98.55		0.21	4.73	0.27	0.03	93.35	1.39	0.03
De Braak Fasteners	24_pt1_ moving	0.58	8.25	0.54	0.03	88.78	0.98	0.03	99.19		0.52	4.66	0.18	0.01	93.60	1.01	0.03
De Braak Fasteners	25_pt1_ moving	0.26	9.27	0.77	0.09	87.58	0.62	0.01	98.60		0.24	5.30	0.25	0.03	93.53	0.64	0.01

Table C2.

A Comparative Analysis of the Archaeological Copper Sheathing Samples from Nautical Contexts*

Ship/Wreck, Dates**	Composition	Trace Elements
De Braak Sheathing 1798	98.5 percent Cu	As***
De Braak Fasteners 1798	88.0 percent Cu, 8.6 percent Sn, 1.0 percent Zn	As, Pb
Mica Sheathing	99.5 percent Cu	As
Mica Fasteners	84.7 percent Cu, 5.3 percent Sn, 7.8 percent Zn	As, Pb, Bi
Cleopatra's Barge 1816/1824	98.0 percent Cu, 2.0 percent Pb	
USS Alabama 1819/1922	100.0 percent Cu	
Spring of Whitby 1824	93.1 percent Cu	
Steamboat *Washington* 1825/1831	100.0 percent Cu	
Niantic 1835/1851	100.0 percent Cu	
General Harrison 1840/1851	100.0 percent Cu	

* For sources of the information presented here see Table 8:3. - 5.

** The first date reflects the construction or launch date, while the second date denotes the time of loss. If only one date is listed, it is the date of loss. If no dates are listed, than none are known.

*** As or Arsenic is a naturally occurring trace element commonly found in copper ore.

Table C3.

A Comparative Analysis of the Archaeological Copper Alloy Sheathing Samples from Nautical Contexts

Ship/Wreck, Dates*	Composition	Trace Elements
De Rosa Samples	62.7 percent Cu, 37.2 percent Zn	Pb
*Robert**1800	62.5 percent Cu	
King Philip 1856/1878	61.2 percent Cu, 37.9 percent Zn	Pb, Sn
Mary Celeste 1864/1886	Muntz**	
Thomas F. Bayard 1880/2002	Muntz	

* The date of loss for the Robert is suspect, because Muntz metal was not invented until 1832.
** Muntz metal was typically a mixture 60 % Cu and 40 % Zn.

Table C4.

A Comparative Analysis of the Archaeological Lead Sheathing and Lead Artifacts from Nautical Contexts

Ship/Wreck, Dates*	Composition	Trace Elements
Pilar 1619	99.0 percent Pb	
Mica Hawse Pipe	100.0 percent Pb	Cu, Bi
Modern lead	100.0 percent Pb	Sn

Table C5.

Sources for the Metallic Sample/Information Sheets Provided in Tables C1, C2, C3 and C4.

Metallic Sample	Source	Data Type
De Braak Sheathing	Charles Fithian	Sample
De Braak Fasteners	Charles Fithian	Sample
Mica Sheathing	Toby Jones	Sample
Mica Fasteners	Toby Jones	Sample
Cleopatra's Barge	Paul Johnston	Information
USS Alabama	Kevin Crisman	Sample
Spring of Whitby	James Sinclair	Sample
Steamboat *Washington*	Peter Johnson	Information
Niantic	James Delgado	Information
General Harrison	James Delgado	Information
De Rosa Samples	Horatio De Rosa	Information/ Sample
Robert	James Sinclair	Sample
King Philip	James Delgado	Information
Mary Celeste	James Delgado	Information
Thomas F. Bayard	James Delgado	Information
Pilar	Carol Tedesco	Sample
Mica Hawse Pipe	Toby Jones	Sample
Modern lead	Toby Jones	Sample

9:0 APPENDIX 4: HYPOTHETICAL RECONSTRUCTION OF THE RIGGING by Toby Jones

The Mica shipwreck field investigation provided relatively little direct evidence concerning the design, construction, and rig of the vessel. However, as a research exercise the scant archaeological evidence could be combined with historical data to construct a hypothetical sailing rig. The fact that the small vessel was sheathed with expensive copper suggests that it was worth sheathing, meaning that it was well built. The fine lines and fast hull created by the metallic sheathing would best be complemented by a schooner rig. The following hypothetical rigging reconstruction offers a possible example of what the Mica vessel might have looked like and how it might have been rigged. The example should not be taken as fact, but should hopefully serve as a foundation for future research on the Mica shipwreck.

The following section outlines the methods undertaken during the Mica shipwreck rigging reconstruction. Contemporary sources were researched and analyzed to determine a plausible design and rig for a fast sailing coastal merchant schooner in the early nineteenth century. The vessel was reconstructed using the hull profile of the contemporary merchant schooner *Glasgow* (Figure D1). The accompanying drawing shows the masts, spars, running rigging and standing rigging. The chapter also provides justifications for the rigging choices depicted in the drawing.

Armed with information about vessel dimensions, probable vessel origin and rig type, it was possible to reconstruct the ship's rig by utilizing contemporary sources on early nineteenth-century merchant schooner rigging and ship construction. The sources included photographs of aging schooners taken in the mid-nineteenth century, drawings and paintings of schooners, and contemporary tables of salient ship rigging dimensions and marine architecture treatises.

Secondary sources were useful because they reprinted photographs and plates from rare works, as was the case with the Peter Hedderwick treatise on marine architecture. The Hedderwick treatise, reprinted in part in a recent work by David R. MacGregor, provided useful information concerning the merchant schooner *Glasgow* of 151 tons that was built in 1826 (MacGregor 1997: 37-40). The vessel, a two-masted topsail schooner, had a length on deck of 21.9 meters (72 feet) and a length on the keel of 20.5 meters (67 feet), exactly matching the length dimensions of the Mica shipwreck. The *Glasgow* hull form, with its full entrance and extremely narrow run, provided an excellent fit with the extant Mica hull. For those reasons, the merchant schooner depicted on plate XXVI of Hedderwick's treatise was chosen to be the hull form of the Mica vessel rigging reconstruction (MacGregor 1997: 39).

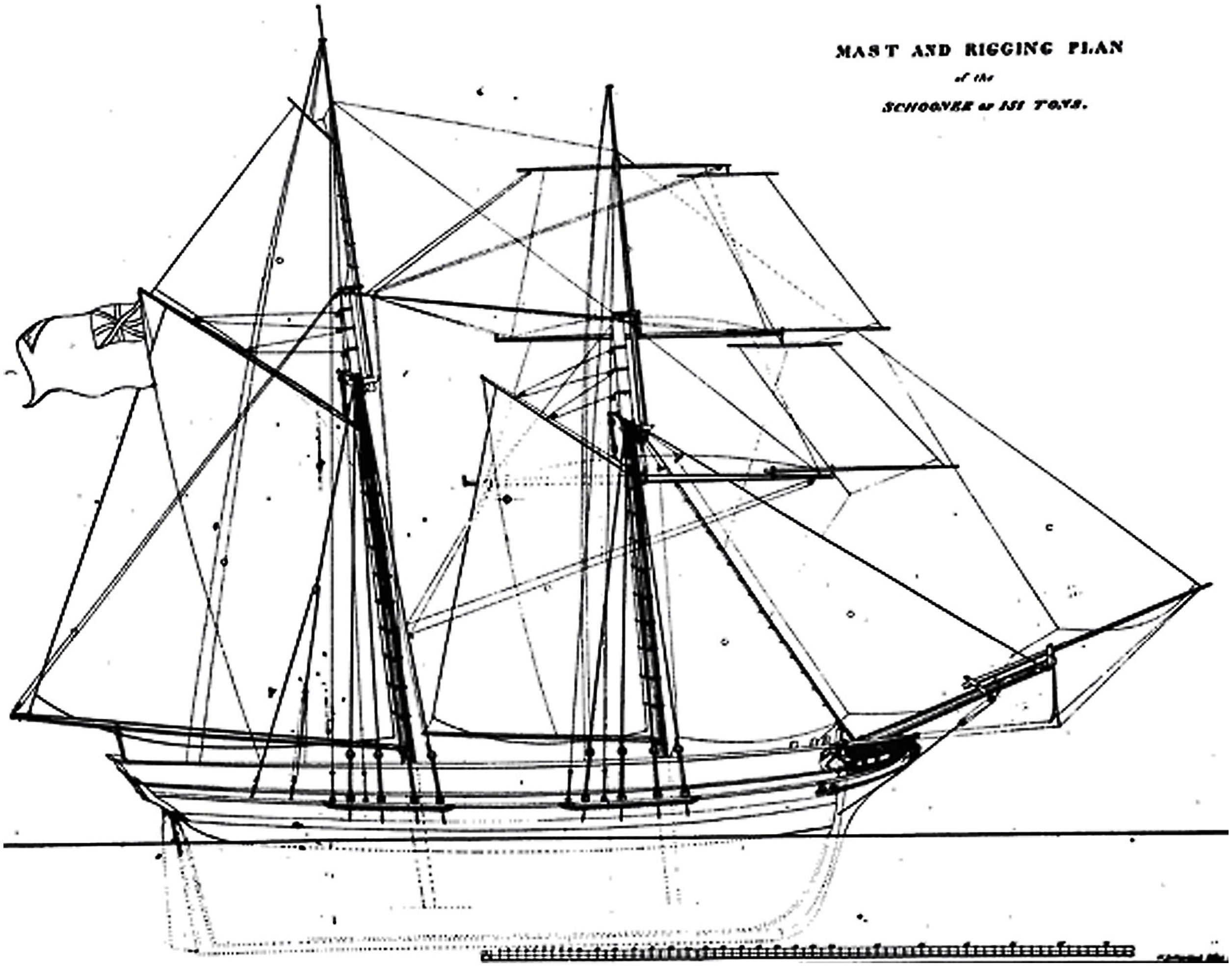

Figure D1. Peter Hedderwick’s 1826 rigging plan for *Glasgow*, a schooner of 151 tons (From MacGregor 1997: 39).

Because no rigging elements, with the exception of two sets of chainplates, were identified during the investigation of the Mica wreck, the placement of these elements, as well as their dimensions, was a matter of informed conjecture. The location of the chainplates was documented by an archaeologist during a visit to the site in the submarine *NR-1*. Photographic images were the primary source of rigging element dimensions and their placement. Three photographs of representative examples of contemporary fore-and-aft rigged schooners were used during the rigging reconstruction process. They included *Polly*, a two-masted schooner built in Amesbury, Pennsylvania in 1805, *Hope*, a two-masted schooner built in Bideford, England, in 1849, and an aging unidentified schooner photographed in Havana in 1860 (Figures D2, D3 and D4). Dimensions were scaled off of the photographs by basing the scale on the height of a person at six feet.

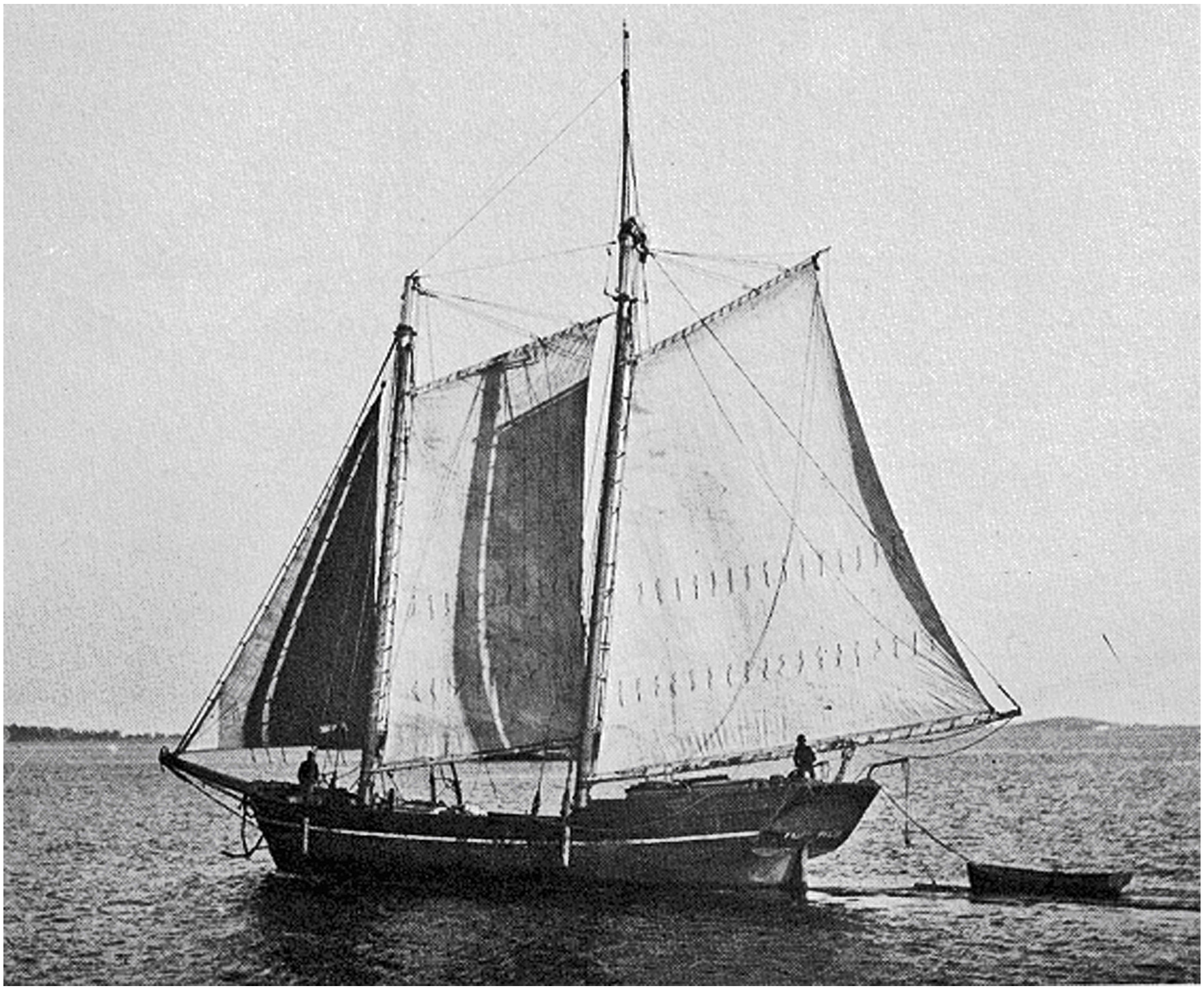

Figure D2. The gaff rigged schooner *Polly*. Built in 1805 in Amesbury, Pennsylvania, and later rebuilt in 1861 (From MacGregor 1982: 55).

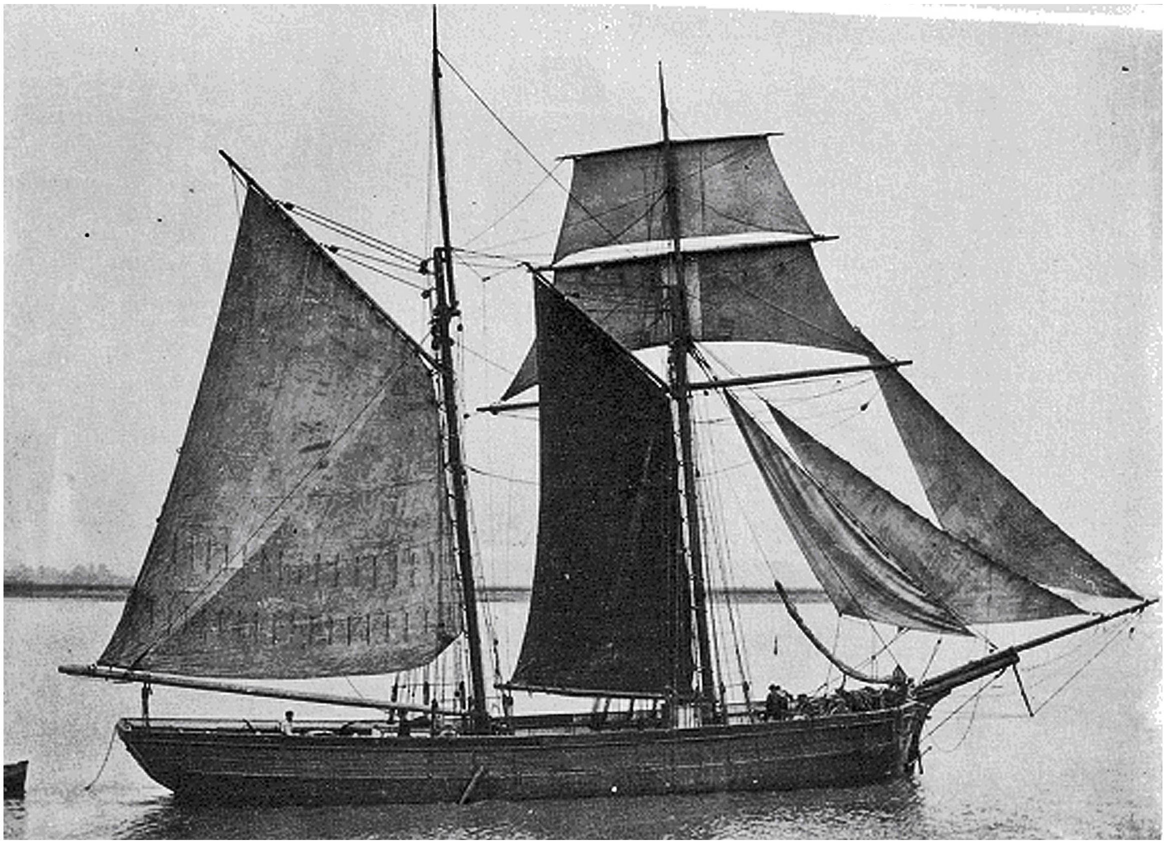

Figure D3. The two-masted fore-and-aft rigged merchant schooner *Hope*. The vessel is shown with double topsails and no studding sail (From MacGregor 1997: 67).

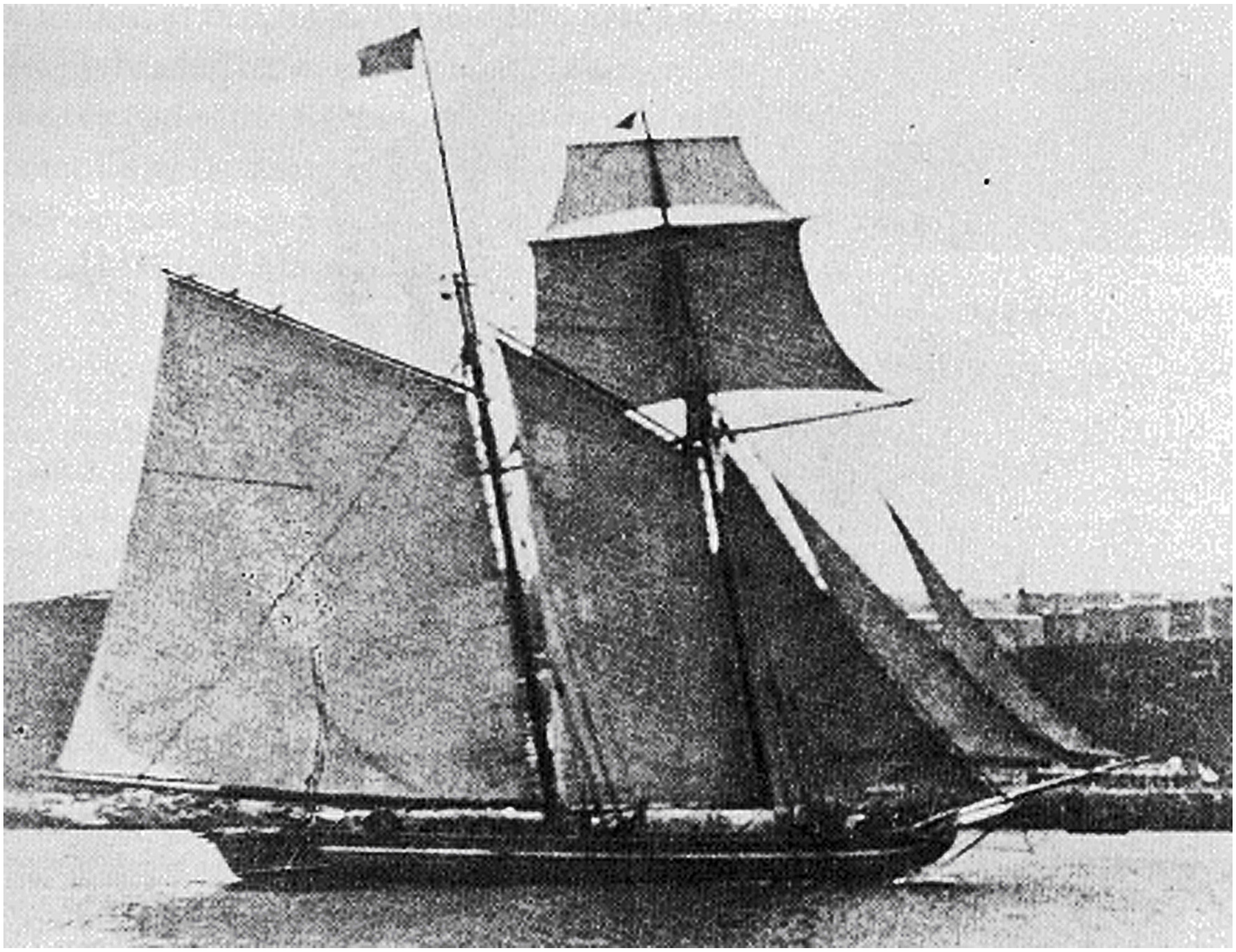

Figure D4. An aging unidentified two-masted topsail schooner. The vessel, showing a top gallant sail, was photographed in the Havana harbor in 1860 (From MacGregor 1997: 33).

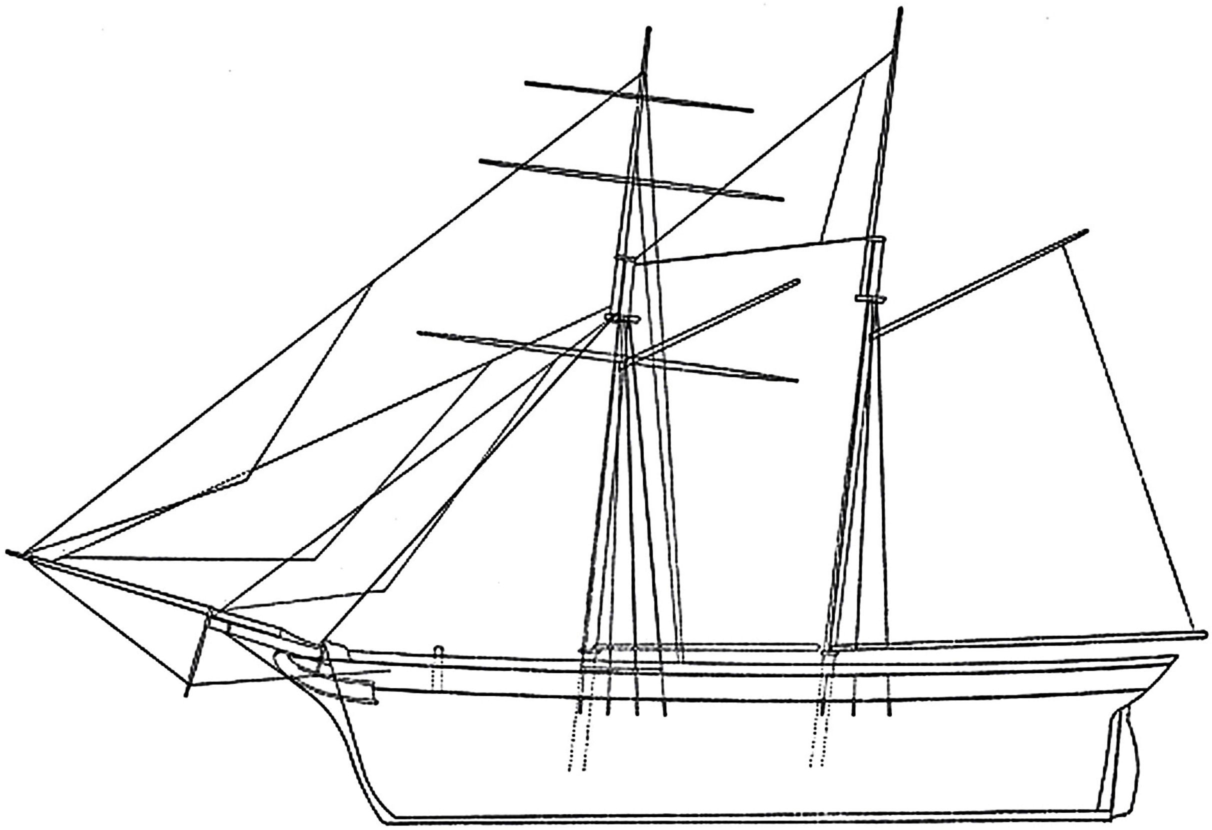

Figure D5. Original builder's plans for the topsail schooner *Elizabeth Austen* (After Underhill 1952 Plate 18).

The photographs were compared to several building plans of merchant schooners, including Hedderwick's *Glasgow*, an original builder's plan of the schooner *Elizabeth Austen*, and a lines drawing of the HMS *Subtle*, an American-built, Danish-owned schooner captured by the British in 1808 and pressed into naval service as an armed schooner (Figures D5 and D6). *Subtle* was lost in a violent squall while pursuing an American privateer in the West Indies in 1812. Chapelle, who drew the lines and recorded a table of *Subtle's* mast and spar dimensions, failed to cite his original sources (Chapelle 1935: 234).

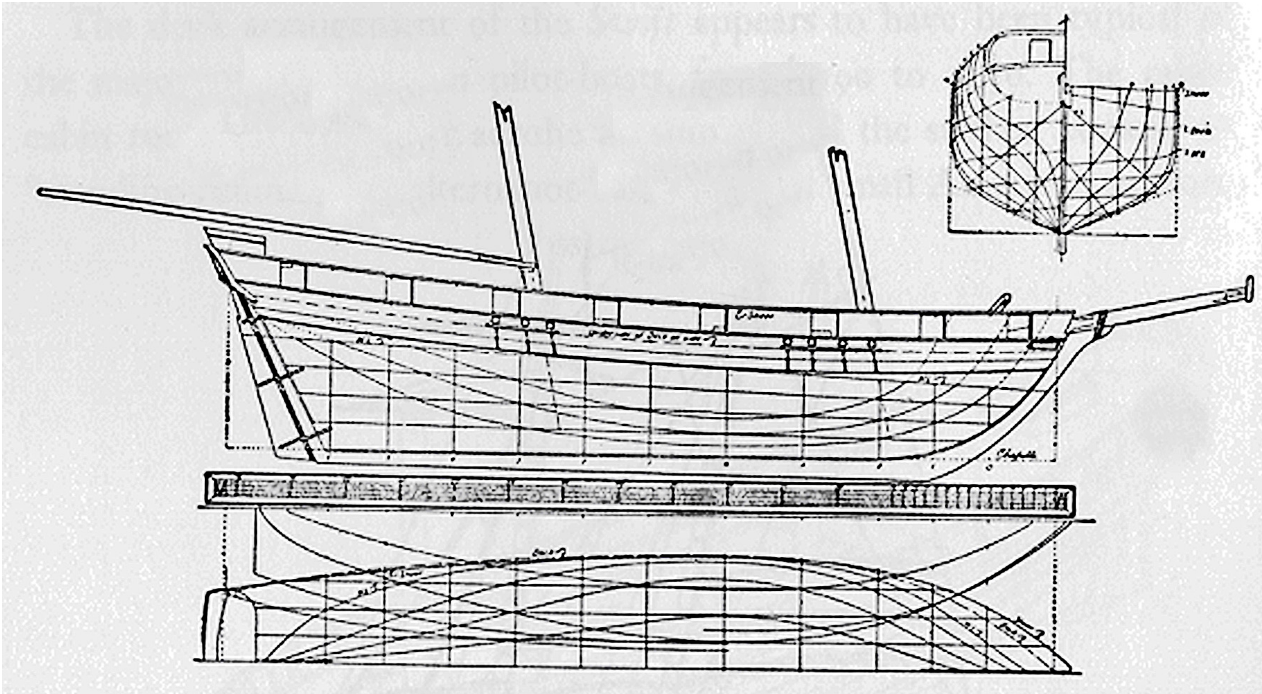

Figure D6. Lines of HMS *Subtle*, lost in a violent squall while pursuing an American privateer in the West Indies in 1812 (From Chapelle 1935, 232).

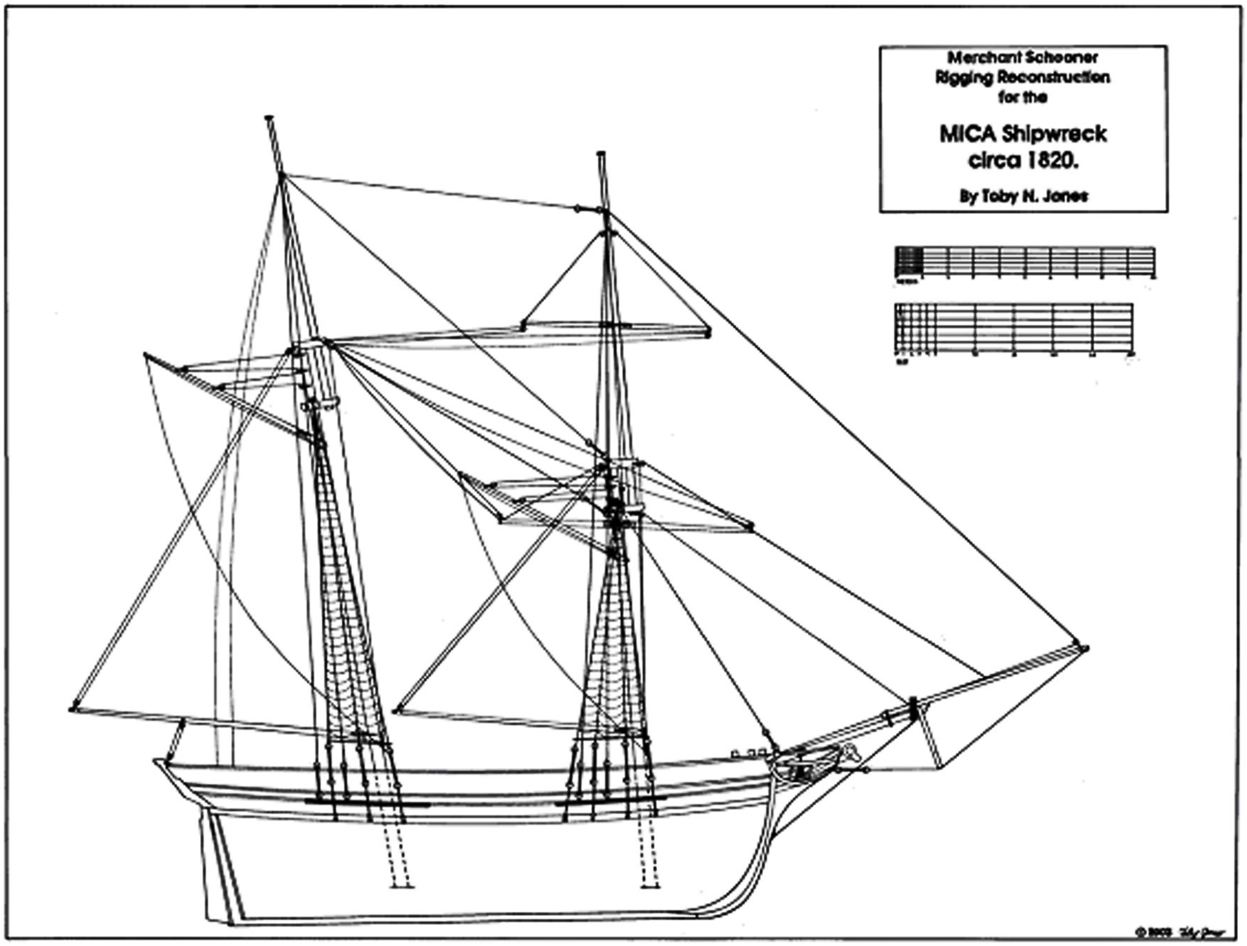

Figure D7. Hypothetical Mica shipwreck rigging reconstruction (Drawing by Toby Jones).

All six representations of nineteenth-century merchant schooners were analyzed and averaged to create a plausible rigging reconstruction to place on Hedderwick's *Glasgow* hull (Figure D7). Therefore, the Mica shipwreck rigging reconstruction did not exactly resemble any single source, but rather, was a sum of its parts, a hypothetical hybrid two-masted fore-and-aft rigged schooner of the type that would have been common along the coast and in the ports of the early American republic.

The following section includes specific details relating to the reconstruction of the vessel. The hull selection has already been discussed above, so the next logical areas to explore were the dimensions of the vessel's masts and spars, followed by the standing and running rigging, and concluding with the sail plan and sailing performance considerations.

MASTS

The Mica shipwreck rigging reconstruction was a two-masted fore-and-aft rigged merchant schooner, and by definition, it had a foremast and a mainmast. Both masts had topmasts, but only the foremast carried a topsail. The diameter, dimensions and placement of the masts was determined by averaging the dimensions visible in the photographs and builder's plans. The foremast was an average of 19.7 meters (54 feet) in height, when measured from the keelson, while the mainmast measured 25.9 meters (71 feet) in height, also measured from the keelson. The fore topmast averaged 16.8 meters (46 feet) in length, while the main topmast was 13.0 meters (38 feet) in length. The diameter of both the fore topmast and main topmast was calculated to be 0.4 meters (1 foot), with both tapering upward to a minimum of 0.17 meters (0.58 feet) in diameter.

The doubling was averaged, with the foremast having 2.1 meters (7 feet) of it, while the mainmast had 2.7 meters (9 feet). The foremast diameter was an average of 0.5 meters (1.6 feet) at the deck, while the mainmast has a diameter at the deck of 0.51 meters (1.7 feet). Chapelle listed the *Subtle* as having a mainmast diameter of 0.44 meters (1.45 feet) at the deck, while the foremast had a diameter of 0.45 meters (1.48 feet) at the deck (Chapelle 1935: 234). The similarity of the mast diameters is reflected in the nearly identical diameter of both lower masts on the Mica reconstruction. The foremast entered the deck 4.9 meters (16 feet) abaft of the stem, while the main mast entering 13.1 meters (43 feet) abaft of the stem. The forward set of chainplates seen on the Mica shipwreck were located 5 meters (16.4 feet) abaft of the stem. The forward most chainplate would have been even with or slightly forward of the front face of the foremast.

The rake of the masts was established by averaging the rake of *Glasgow*, *Polly*, *Hope*, *Elizabeth Austen* and *Subtle*. The foremast averaged five degrees of aft rake, while the mainmast had 10 degrees. The average rakes were incorporated in the drawing. The mast taper for the main, fore, and topmasts were determined by measuring the widths of the masts at the deck, below the cap, above the cap and below the signal pole or mast head on all the representations where the diameter was visible. The mast caps, trestle trees, and cross trees were scaled off Hedderwick's *Glasgow* building plan (MacGregor 1997: 39).

The bowsprit and jib boom measurements were arrived at in a similar fashion. The bowsprit had a diameter of 0.56 meters (1.83 feet), while the jib boom had a diameter of 0.25 meters (0.83 feet). The angle or steeve of the bowsprit projection was averaged from several photographs and drawings, and determined to be 18 degrees above the horizontal plane. The bowsprit protruded an average of 6.1 meters (20 feet) from the stem, while the jib boom had an overall length of 8.53 meters (28 feet). The doubling was estimated to be 1.21 meters (4.0 feet). The dolphin striker, which extended at a right angle from the jib boom on five out of the six representations (the *Glasgow's* bowsprit being the exception, pointed straight down) was calculated to be 2.6 meters (8.5 feet) long, with a hanging knee or carrier brace placed on the forward face.

SPARS

The fore-and-aft rigged Mica shipwreck reconstruction carried a large square sail on the foremast, which provided additional sail area to propel the sleek hypothetical vessel even faster. The lower yard was slung from the foremast, while the fore topsail yard was slung from the fore topmast. The fore topsail was thus anchored to the lower foremast, a practical solution that directed the majority of the strain from the large sail into the thicker lower mast. The dimensions and placement of the yards was determined in the same way as that of the masts discussed above. The dimensions were scaled off of the photographs and builder's plans, calculated and then averaged. The lower yard was an average of 9.8 meters (32 feet) in length, while the topsail yard was 7.3 meters (24 feet) in length. The top edge of the foremast yard was slung just below the doubling, 11.0 meters (36 feet) above the deck. The top edge of the fore topsail yard was slung 18.6 meters (61 feet) above the deck. The lower yard had a maximum diameter of 0.25 meters (0.83 feet), while the upper yard had a maximum diameter of 0.20 meters (0.7 feet). Both yards had an even taper towards the yardarms, and were attached to the mast with rope lashings and cleats. Both of the yards were controlled by braces, which are discussed below.

The primary sail on the foremast was the large fore-and-aft gaff sail. The boom was 9.8 meters (32 feet) in length, from the tip of the boom to the tip of the jaws. The diameter of the boom was 0.25 meters (0.83 feet), just abaft of the throat. The fore boom has an angle of 80 degrees, if the mast was set horizontal at zero degrees. The fore gaff was an average of 7.3 meters (24 feet) in length from tip to jaw, and had a diameter of 0.25 meters (0.83 feet) abaft the throat. The foresail gaff came off the foremast at an angle of 57 degrees. The center of the boom was located 2.4 meters (8 feet) above the deck, while the foresail gaff was located 9.1 meters (30 feet) above the deck.

The main mast carried a single large fore-and-aft sail. The boom measured 12.2 meters (40 feet) in length, with a diameter of 0.30 meters (1 foot) abaft the throat. The boom left the mast at an angle of 75 degrees, if the mast was set horizontal at zero degrees. The top of the main boom was set 2.7 meters (9.0 feet) above the deck. The top of the main gaff was set 13.7 meters (45 feet) above the deck, at an angle of 53 degrees. It had a length of 7.9 meters (26 feet) and a maximum diameter of 0.25 meters (0.83 feet).

STANDING RIGGING

The standing rigging of the Mica ship reconstruction was relatively simple. It consisted of forestays, shrouds, backstays, a bobstay and a martingale stay. Analyzing and comparing the photographs of contemporary vessels helped determine the correct placement of the rigging. The builder's plans of similar vessels and a little common sense regarding ship rigging were also employed.

The dolphin striker provided a fulcrum point that allowed the martingale to pull down on the jib boom with enough force to counteract the strong upward pull of the foremast forestays. The bobstay, as well as the gammoning of the bowsprit to the knee of the head provided additional support to the bowsprit and jib boom. The jib boom was attached to the bowsprit where it ran through the bowsprit cap, and was supported by the jib boom saddle that was abaft the cap, as well as a clamp abaft the chock (Figure D8).

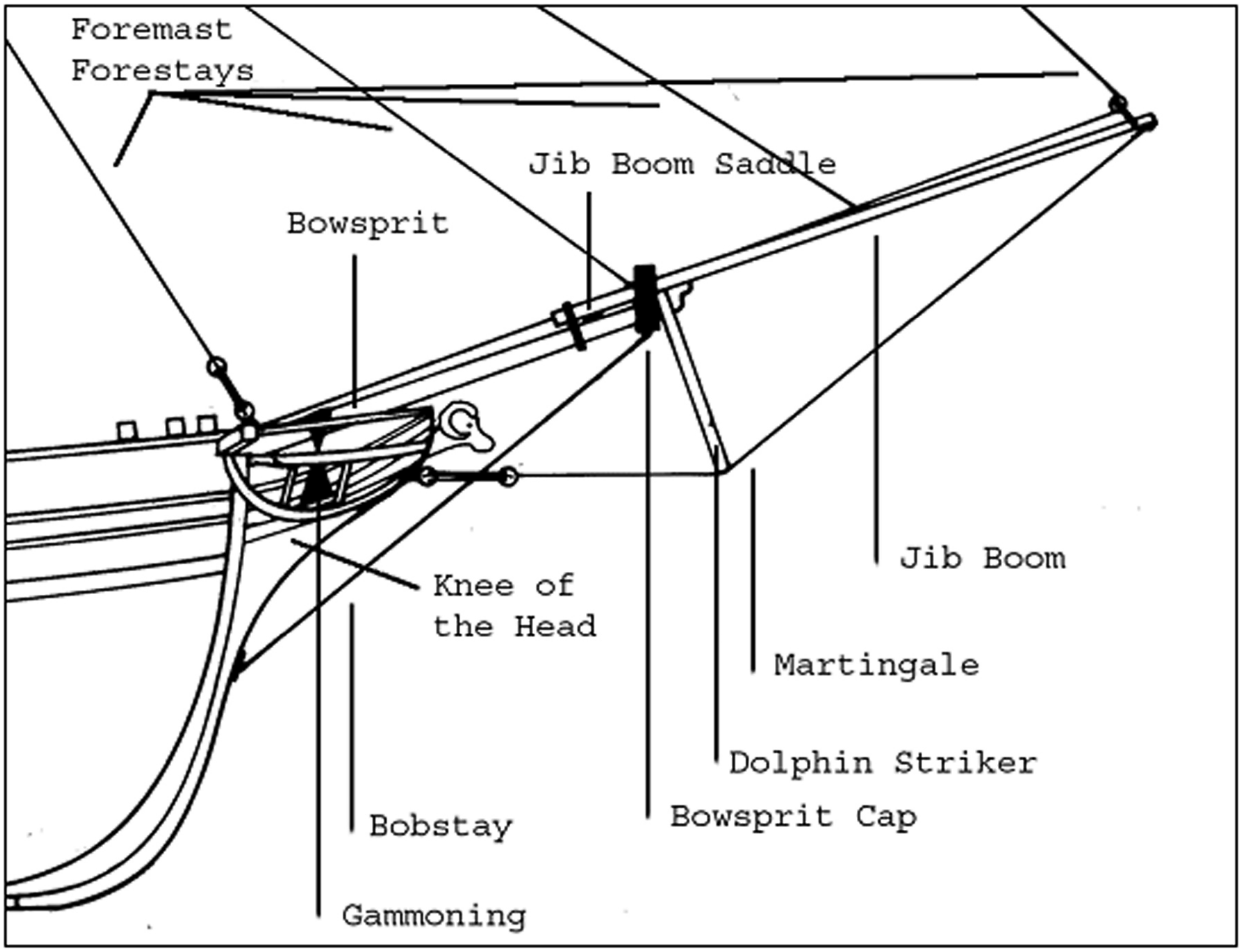

Figure D8. Selected bow area nomenclature (Drawing by Toby Jones).

There were four forestays on the foremast. The fore topmast forestay was anchored to the fore topmast and ran through a block attached near the end of the jib boom. That line ran aft along the bowsprit before entering the hull, where it was secured to a set of deadeyes. The next lower stay, the outer jib stay, was anchored to the jib boom and ran up and aft, where it ran through a block fastened to the forward edge of the foremast cap. That line ran down to a cleat on the forward edge of the foremast, where it was tied off. The next lower stay, the inner jib stay, ran in the same direction, through a block on the forward crosstree on the foremast. That stay was anchored abaft the bowsprit cap.

The foremast forestay was attached to the foremast immediately above the crosstrees and trestletrees. That stay ran forward and down, and was anchored to a set of deadeyes attached to the top of the stem. The forestays for the mainmast and main topmast ran forward to the foremast. The forestay on the main topmast ran forward and down to a set of deadeyes attached to the after edge of the foremast cap. The mainmast forestay ran forward and down to a set of deadeyes attached to the after crosstree on the foremast.

In the reconstruction, four shrouds were placed on each side of the foremast, and two shrouds on each side of the fore topmast (Figure D9). The remains of two sets of deadeyes and chainplates were seen in both the starboard bow quarter and port stern quarter of the Mica wreck. This was taken as a minimum number, with the likelihood that additional elements were missing or buried under the sediment inside the wreck. A comparison of the contemporary photographs and Hedderwick's treatise show the vessels rigged with 3-4 chainplates and deadeyes per side on the fore and main masts. The reconstructed mainmast had three shrouds on either side of the mast. Both sets of lower shrouds looped around the lower masts and were spliced to themselves, just above the crosstrees and trestletrees. According to Biddlecombe, the shrouds were 0.13 meters (0.44 feet) in circumference (Biddlecombe 1990: 150). All the shrouds ran from the mast down to deadeyes attached to chainwales. The deadeyes were 0.25 meters (0.83 feet) in diameter, which was half of the diameter of the mast which they were serving, a rule cited by R.C. Anderson (Anderson 1982: 93).

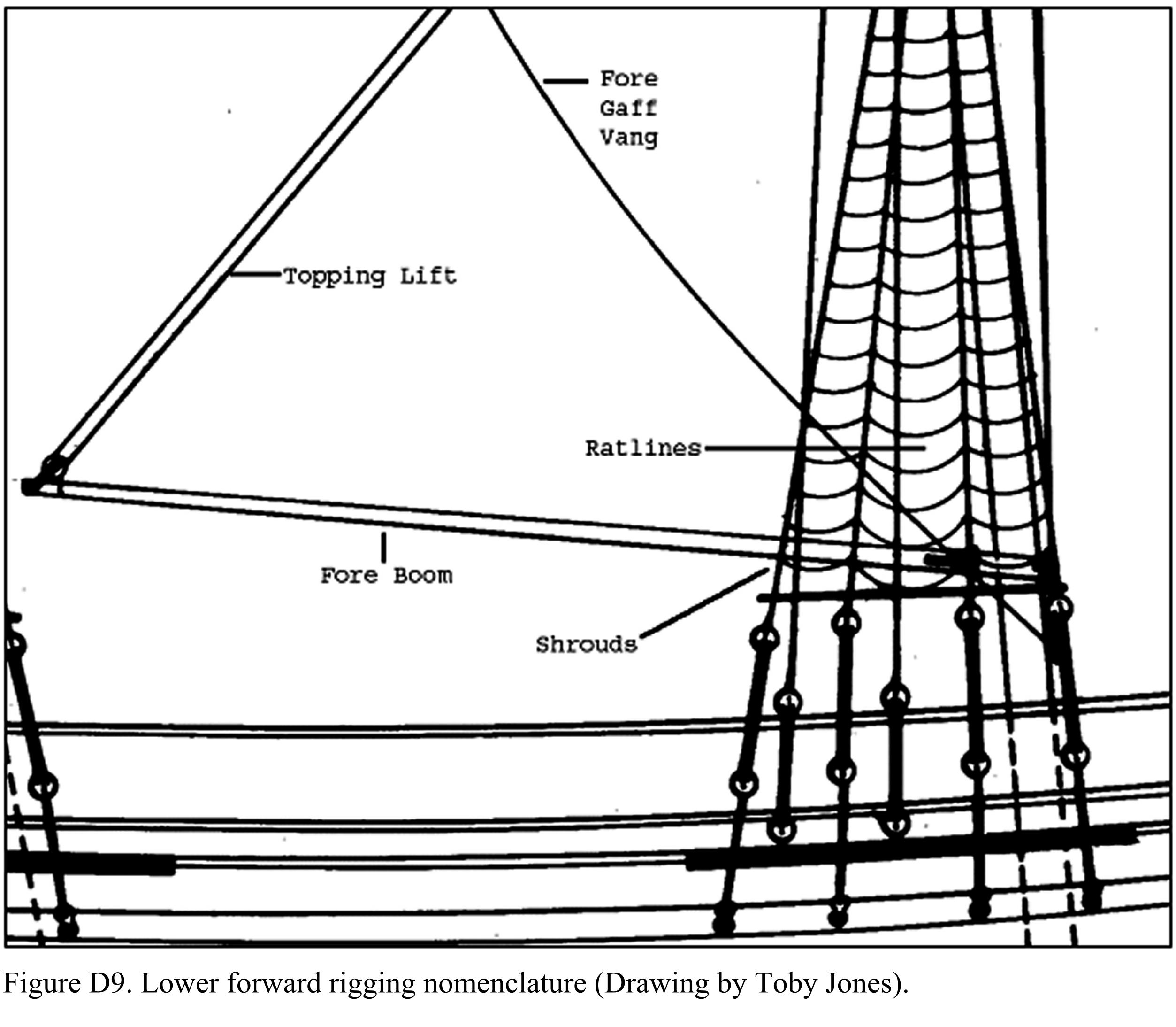

Figure D9. Lower forward rigging nomenclature (Drawing by Toby Jones).

The fore topmast was supported by two shrouds on either side, which were attached to deadeyes that were anchored through the outer ends of the crosstrees. According to Biddlecombe, a merchant schooner of between 100 and 200 tons would have topmast shrouds that were 0.07 meters (0.23 feet) in circumference (Biddlecombe 1990: 150).

The deadeyes for each shroud were spaced 1.75 meters (5.75 feet) apart. The dimensions were taken from Hedderwick's *Glasgow* building plan, because the deadeyes were clearly depicted. This amount of spacing would vary depending upon the lengths of the shrouds, which were probably only consistent to a general degree. Ratlines were placed on the foremast and mainmast shrouds, with a vertical spacing of 0.36 meters (1.2 feet). The ratlines began just above the pine sheer batten, which prevented the deadeyes from twisting. It should be noted that the ratlines would probably have been tauter in reality than were depicted in the Mica shipwreck rigging reconstruction drawing.

The main boom was secured downward with a main sheet and tackle to an iron staple or 'sheet horse' in the deck. Two backstays were placed on each side of the fore topmast and main topmast and ran down and aft to the aft part of the chainwales, where they were attached to deadeyes. The deadeyes were identical to those employed by the lower masts (Figure D10).

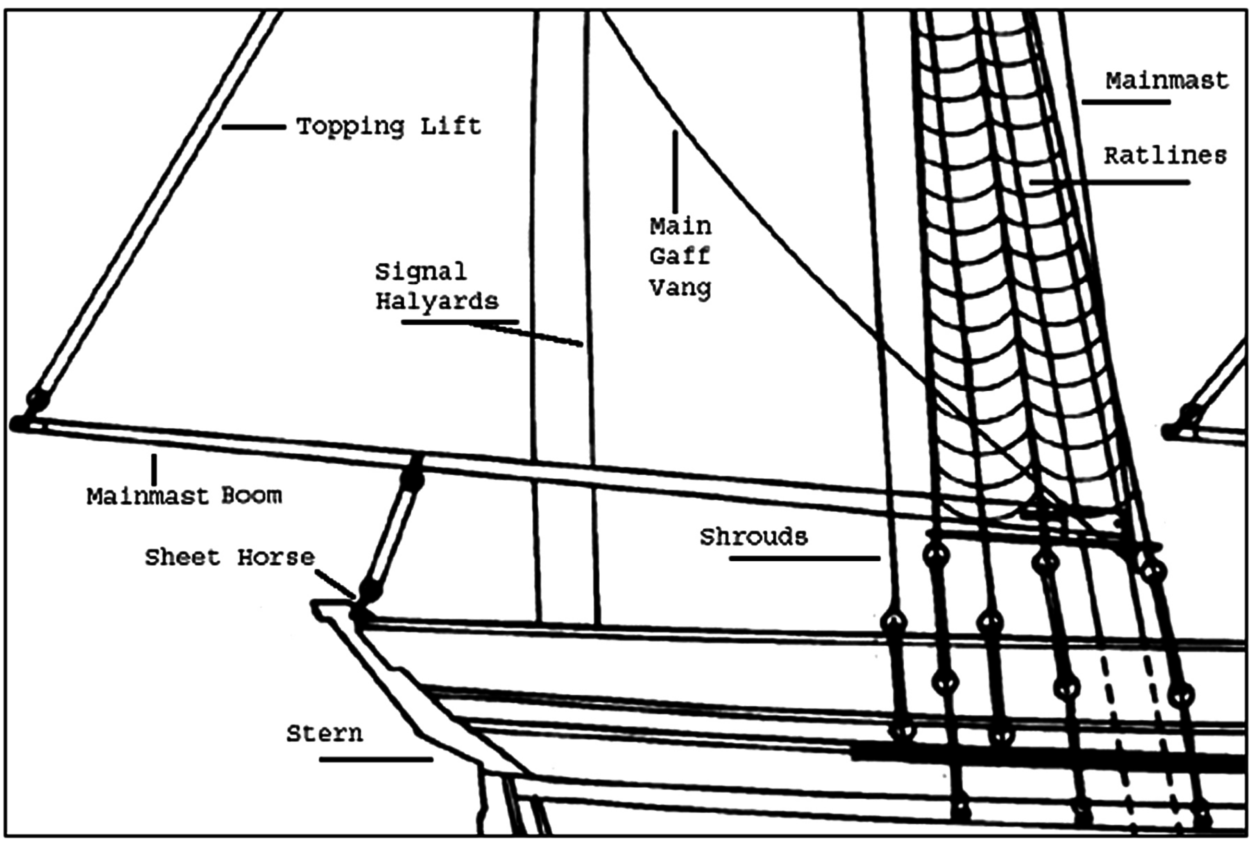

Figure D10. Lower aft rigging nomenclature (Drawing by Toby Jones).

The mainmast had three forestays running forward to the foremast. Two of the mainmast forestays ran from near the top of the main topmast forward, and attached near the top and bottom of the fore topmast. The third forestay ran from the forward edge of the mainmast cap forward to a deadeye anchored immediately beneath the aft crosstree on the foremast.

A note on the shroud placement is in order. The forward most shroud on both the foremast and mainmast was placed slightly forward of the plane of the mast itself. This feature only appeared clearly on Hedderwick's *Glasgow*. The other schooner representations showed the forward-most shroud on each mast being even with the forward edge of the mast. To be consistent with the averaging of features that form the foundation of this reconstruction, the shrouds should have been drawn as represented in the photographs, not the builder's plan.

RUNNING RIGGING

The running rigging controlled the sail and spar adjustment, and, on the Mica shipwreck rigging reconstruction, consisted of topping lifts, peak and throat halyards, vangs and braces. Much of the rigging information was derived from Hedderwick's building plan, although all the images were utilized in some fashion. The topping lifts were clearly represented in several of the photographs, and their attachment points and dimensions were scaled, averaged and applied to the reconstruction. The circumference of the topping lifts, according to Biddlecombe's rigging table for schooners between 120 and 130 tons, was 0.08 meters (0.25 feet) (Biddlecombe 1990: 151). Both the fore boom and main boom were depicted as having topping lifts. However, evidence of this was not visible in the photographs. It was assumed that this extra support on the fore boom would be necessary given the length of the boom and the total sail area. If it were not deemed necessary by the ship operator, it could have been removed. However, while installed, it would not detract from the sailing ability of the vessel, and would add an extra measure of support to the fore boom element.

The peak and throat halyards for the fore and main gaffs were visible on *Glasgow*, *Polly*, and *Hope*. All of the halyards had similar placement and size. The *Glasgow* and the *Hope* had three blocks on the mast, while the *Polly* only showed two. Given the large size of the gaffs on the Mica reconstruction, three halyard blocks were chosen to support the gaff on both the fore and main masts. The lines running through these blocks were 0.08 meters (0.25 feet) in circumference on both gaff sails (Figure D11) (Biddlecombe 1990: 149).

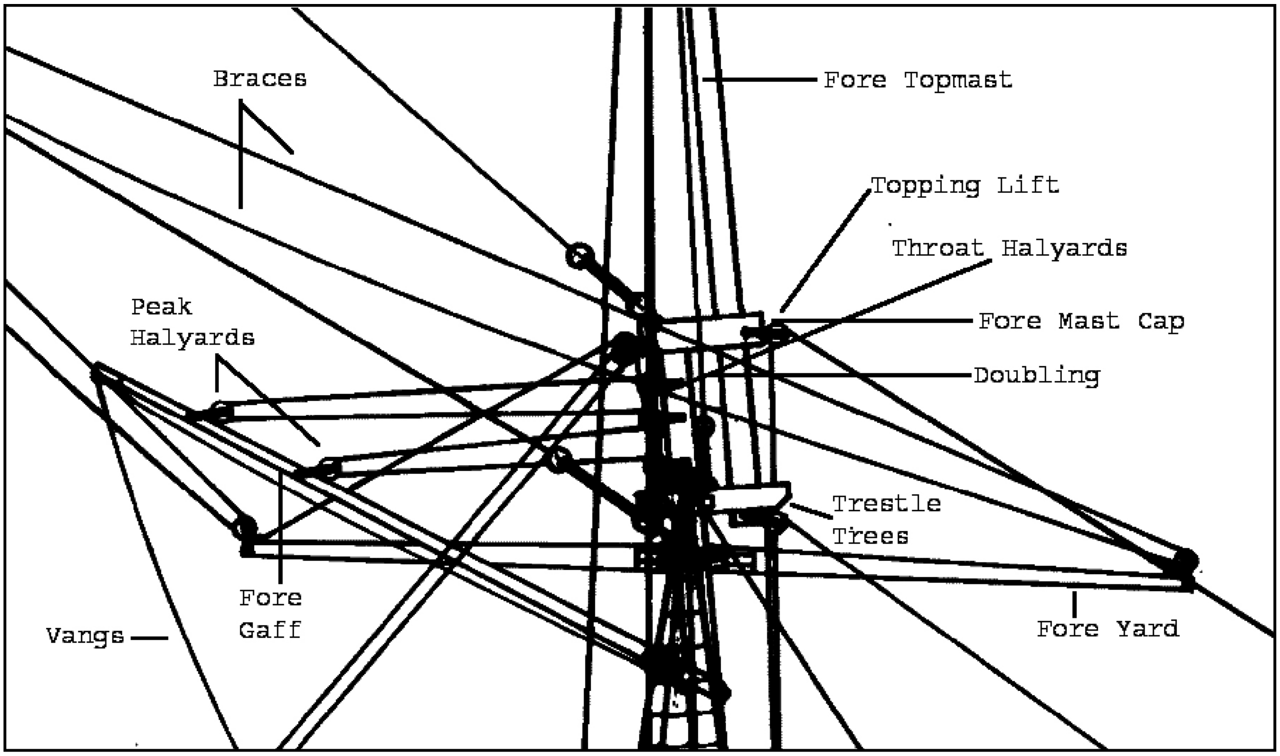

Figure D11. Upper forward rigging nomenclature (Drawing by Toby Jones).

Vangs were visible on the *Glasgow*, *Hope*, *Polly*, and on an unidentified schooner moored in Havana. The vangs were used for manipulating the gaff towards the port or starboard. All of the images showed the vangs attached near the after end of the gaff on both the main gaff and fore gaff. The vangs hung slack and trail forward and down, where they are tied off to a cleat on the forward face of their respective masts. Two signal halyards were placed aft of the mainmast, and ran from the gunwale to the head of the main topmast (Figure D12).

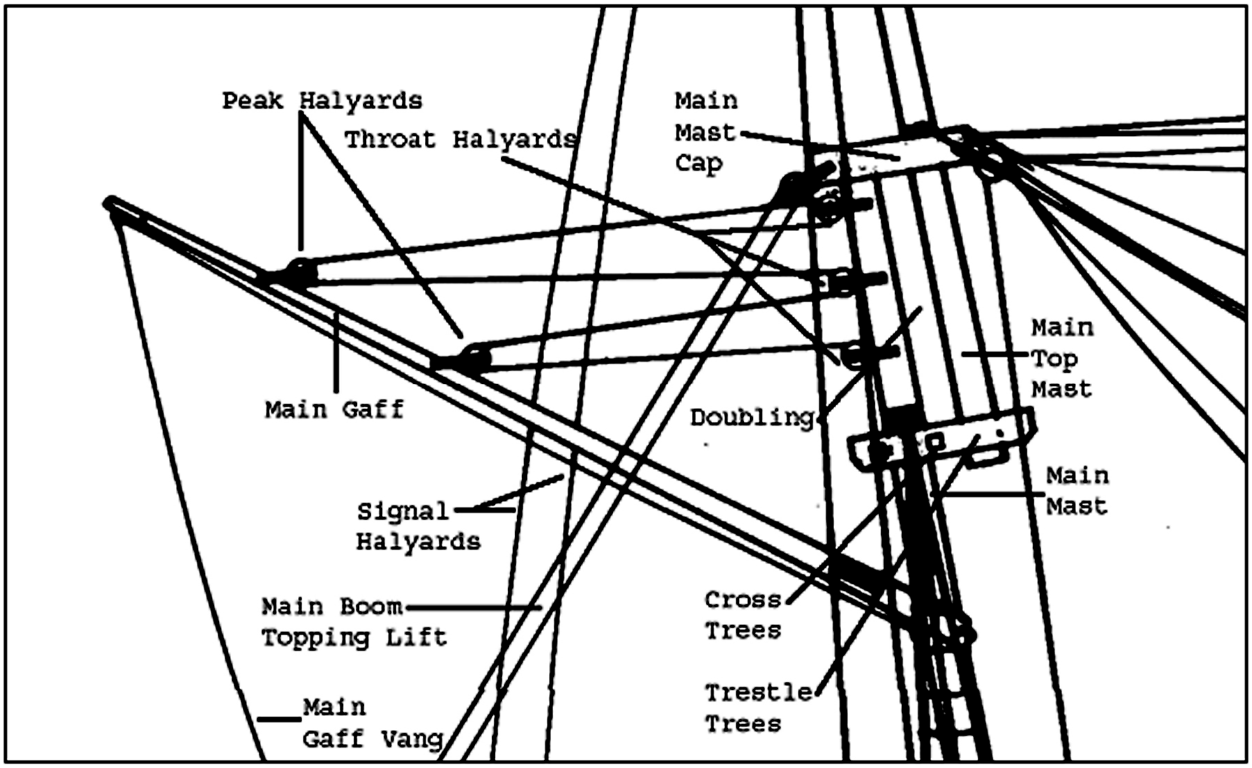

Figure D12. Upper aft rigging nomenclature (Drawing by Toby Jones).

There were four braces shown on the Mica shipwreck rigging reconstruction. They all trailed aft from the fore topsail yard and the foresail yard. The braces for each yard ran through a double block attached to the forward edge of the mainmast cap. From there, the lines ran down to cleats on the forward edge of the mainmast. Biddlecombe stated that all of the braces on a merchant schooner of this size were 0.04 meters (0.15 feet) in circumference (Biddlecombe 1990: 149).

SAILS

There were seven sails that the reconstructed Mica wreck vessel could have set. The flying jib stretched along the fore topmast stay, between the fore topmast and the jib boom. Another jib sail was set along the outer jib stay, running from the forward edge of the foremast cap toward the center of the jib boom. The third jib sail was set on the inner jib stay, and ran from the forward edge of the forward crosstree toward the aft edge of the bowsprit mast cap. A staysail was set on the foremast forestay, running from the foremast, immediately above the crosstrees and trestletrees, to the top of the stem.

The foremast carried a fore-and-aft sail, and a large square sail hung from a fore topmast yard and a larger yard placed just below the doubling on the foremast. The mainmast carried a large fore-and-aft sail. Other sails could have plausibly been added to the Mica shipwreck vessel reconstruction plan. These included a triangular gaff topsail on the main topmast, and possibly a double topsail or a topsail and topgallant sail on the fore topmast. Both were commonly seen on merchant schooners during the first half of the nineteenth century.

CONCLUSION

The reconstruction of the Mica shipwreck's rig produced a generalized mast, rigging, and sail plan for an early nineteenth-century two-masted merchant schooner. Such schooners were ubiquitous along the coasts of North America, and were probably rigged with a multitude of variations. It is important to remember that there were no hard and fast laws concerning the way to rig a ship. Functional considerations, practicality and common sense were the guiding principles when building a sailing rig. Economy and safety were continually at odds, with ship operators trying to sail with a minimum crew and maximum amount of cargo. The operators of the fast-sailing metallic-sheathed Mica vessel likely analyzed that balance, and were continually looking for ways to improve economic efficiency.

10:0. APPENDIX 5: AN ANALYSIS OF THE SHIP ENROLLMENT RECORDS FOR NEW ORLEANS by Toby Jones

Information provided in the table below is the result of a research carried out by Toby Jones. Ship Registers and Enrollments of New Orleans, Louisiana (prepared by the Survey of Federal Archives in Louisiana Division of Community Service Programs Work Projects Administration) is the source of the information (see bibliography for detailed reference data). Volumes I (1804-1820) and II (1831-1840) - to a lesser extent, due to the time frame being researched for the Mica Shipwreck - were reviewed. The goal of the research was to identify the ships of similar tonnage and size to the Mica Shipwreck, and investigate the fate of these vessels. Such research avenues could ultimately determine the identification of the Mica Shipwreck, its name, date of loss and possibly cargo. The number of ships that were in the approximate size range of the Mica vessel clearly illustrates that this size of vessels was popular in the period, and the sail arrangement chosen for Mica was also in widespread use.

However, we choose to include the results of this research in this report, with the hope that the organization of the data presented here might help other researchers in the future.

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1805	*Actress*	brig	New Orleans	Chatham CN	176 29-95	76'	23' 3.5"	11' 7"	1 deck, 2 masts, sq. stern	Shearman, Willet, Ball	Parker	vol. 1-3
na	*Adventure*	brig	New Orleans	na	86 3-95	61' 8"	19' 2"	6' 6"	1 deck, 2 masts, sq. stern, round tuck	Carraby, Faurie, Lugeol, St. Marc, Mayrone, Baligent	Songy, Lagan, Mayrone, Quere	vol. 1-7
1808	*Agent*	brig	Alexandria VA	Warren RI	152	71' 3"	22' 4"	11' 2"	1 deck, 2 masts, sq. stern, male figurehead	Davidson, Alford, McLean, Camp,	Davidson, Vanhorn, McLean, Camp	vol. 1-13
1817	*Alabama*	brig	Baltimore MD	Talbot Co. MD	229 45-95	84'	24' 6"	12' 10"	1 deck, 2 masts, sq. stern, billethead, round tuck	Thompson	Hamilton	vol. 1-16
1815	*Alert*	sloop	Boston MA	Kennebunk MA	55 52-95	59' 6"	18' 7"	5' 10.5"	1 deck, 1 mast, sq. stern	Smith, Mazin	Smith, Mahe	vol. 1-20
1810	*Alexandrew*	brig	New Orleans	Absecomb NJ	163 61-95	70' 8"	24' 9"	11' 3.5"	1 deck, 2 masts, sq. stern, billethead	Cox, Bartlett	Jones, George	vol. 1-22
na	*Alexandrine*	brig	New Orleans	na	100 89-95	70' 2"	20' 8"	8'	1 deck, 2 masts, round stern, billethead	DuBourg	Petit	vol. 1-23
1805	*Alfred*	brig	New Orleans	Brooklyn NY	260 32-95	82'	24' 6"	15'	1 deck, 2 masts, sq. stern, billethead, round tuck	Dyson	Riddell	vol. 1-24

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
na	*Aligator*	brig	New Orleans	na	212 18-95	81' 10"	24' 6"	12' 3"	2 decks, 2 masts, sq. stern, round tuck	Girod	Larson	vol. 1-26
1804	*Alleghany*	schooner	Pittsburg PA	Pittsburg PA	104 55-95	72' 9"	20'	9'	1 deck, 2 masts, sq. stern, round tuck	Barber, Lord Sr., Lord Jr.	Canfield	vol. 1-27
1818	*Almy*	brig	Tiverton RI	Berkely, Bristol Co. MA	91 17-95	63' 10"	20' 4"	8' 3"	1 deck, 2 masts, sq. stern	P. Corey	G. Corey	vol. 1-31
1805	*Amazon*	brig	New Orleans	Rochester MA	214 9-95	82' 6"	24' 6"	12' 3"	2 decks, 2 masts, sq. stern, billethead	Winter, Coe	Hatch	vol. 1-32
1817	*Amelia*	sloop	New Orleans	Lyme CN	70 70-95	60'	20'	7'	1 deck, 1 mast, sq. stern, woman head	Forstall	Bunker	vol. 1-35
1812	*American Hero*	schooner	Wareham MA	Hallowell MA	128 28-95	73'	23'	8' 11.5"	1 deck, 2 masts, sq. stern	Gibbs, W. Perry, S. Perry, C. Perry, R. Clay, D. Clay, S. Clay, Glidden	Gibbs	vol. 1-36
na	*Amiable Lucy*	brig	New Orleans	na	176 69-95	80' 8"	24' 2"	10' 2"	1 deck, 2 masts, sq. stern, round tuck, woman figurehead	Reynes	Morant, Thomas	vol. 1-39

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1807	*Ann*	brig	New Orleans	Connecticut	82 23-95	66'	20' 4"	7' 3-4"	1 deck, 2 masts, sq. stern	Willet	Smith	vol. 1-40
1809	*Ann*	schooner	New Orleans	Dorchester Co. MD	142 82-95	78' 6"	23' 1"	9' 1"	1 deck, 2 masts, sq. stern	Michel, Sagory	Lauve, Songy	vol. 1-41
1814	*Ann*	schooner	Cohasset MA	Cohasset MA	91 18-95	67' 3"	19' 9"	7' 11"	1 deck, 2 masts, sq. stern	N. Tower, L. Tower, Whittington	Collins	vol. 1-42
1815	*Ann*	schooner	Portsmouth NH	Portsmouth NH	86 38-95	66.8'	17.6'	8.4'	1 deck, 2 masts, sq. stern, woman figurehead	Clark, Odiorne	Clark	vol. 1-43
1804	*Ann Jane*	brig	Philadelphia PA	Elizabethtown PA	186 2-95	78' 1"	23' 6"	11' 9"	2 decks, 2 masts, sq. stern, round tuck	R. McFarland, J. McFarland	Shaddock	vol. 1-47
1819	*Ann Jane*	sloop	Petit Coquilles	New York NY	50 87-95	59'	20' 4"	12' 1"	1 deck, 1 mast, sq. stern, billethead, round tuck	Bennet, Morte, Brent	Welden, Tucker,	vol. 1-48
1811	*Ardent*	brig	Marblehead MA	Duxbury MA	125 21-95	71' 5"	21' 7"	9' 5.5"	1 deck, 2 masts, sq. stern, woman figurehead	Hooper	Hooper	vol. 1-53
1812	*Argo*	brig	New Orleans	Great Egg Harbor NJ	179 50-95	76'	24.1'	11.5'	1 deck, 2 masts, sq. stern	McNair, Gardiner, Torrey, Center, Linton, Wilkins	Dill, Ireland, Meader	vol. 1-54

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
na	*Arkansas*	brig	New Orleans	na	136 75-95	66' 7"	19' 9"	12'	1 deck, 2 masts, sq. stern, round tuck, man figurehead	Reynes, Esteva, LeGrave, Elmes	Mahe, Jones, Williams	vol. 1-59
1818	*Arringdon*	schooner	Gardiner MA	Hallowell MA	110	70'	21' 6"	8' 6"	1 deck, 2 masts, sq. stern	Perry Jr., Lowell, Clay, Hogdon	Perry Jr.	vol. 1-61
1806	*Astrea*	brig	New Orleans	Haverhill MA	115	65' 6"	19' 6"	10' 5"	1 deck, 2 masts, sq. stern	Chew	Franklin	vol. 1-63
1816	*Atalanta*	brig	Freetown MA	Freetown MA	184	69' 8"	23' 1"	11' 6.5"	1 deck, 2 masts, sq. stern	Hathaway	Pratt	vol. 1-64
1803	*Atlas*	schooner	New Orleans	Groton CN	70 58-95	58'	18' 7"	7' 8.5"	1 deck, 2 masts, sq. stern, round tuck, figurehead	Miller, Holand, Lay	Holland, Sasportas	vol. 1-68
1806	*Aurora*	brig	New Orleans	King and Queen Co. VA	204 54-95	78'	24'	12' 6"	1 deck, 2 masts, sq. stern, round tuck, billethead	Amelung, Harrod, G. Ogden, P. Ogden	Schoolfield, Lake	vol. 1-71
1815	*Aurora*	brig	New York NY	Saybrook CN	197 94-95	82'	24' 3"	11' 6"	1 deck, 2 masts, sq. stern, round tuck, woman head	McKinne	Smith	vol. 1-72
na	*Barilla*	brig	New Orleans	na	151 10-95	68'	21' 9"	12'	1 deck, 2 masts, sq. stern	Dent, Gardiner, Center, Torrey, Linton, Wilkins	Tubbs, Jones	vol. 1-75

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1799	*Beaver*	schooner	Philadelphia PA	North Yarmouth MA	88 86-95	78' 7"	26' 9"	7' 3"	1 deck, 2 masts, sq. stern	Simonton, Scott	Connaly	vol. 1-76
1796	*Bee*	schooner	Norfolk VA	Newburyport MA	75 51-95	66' 9"	20' 1"	6' 6.5"	1 deck, 2 masts, sq. stern	Hipkins	Hipkins	vol. 1-78
1804	*Bellisarius*	brig	New Orleans	Kennebunk MA	199 50-95	79' 10"	24' 1"	12' .5"	2 decks, 2 masts, sq. stern	Junior	Lauve	vol. 1-81
na	*Bellona*	brig	New Orleans	na	113 4-95	68'	19' 2"	9' 11"	1 deck, 2 masts, sq. stern, square tuck, woman head	Brooks	Laffon	vol. 1-82
1811	*Belvidere*	brig	Beverly MA	Barnstable MA	143 94-95	74' 9"	21' 7"	6' 3"	1 deck, 2 masts, sq. stern	Lamson, Gage	Lamson	vol. 1-87
1799	*Betsey*	brig	Portsmouth NH	Dover NH	133 22-95	68.5'	21.3'	10.65'	2 decks, 2 masts, sq. stern	Smith, Havens	Rowe	vol. 1-88
1805	*Betsey*	schooner	Pittsburg PA	Pittsburg PA	115 35-95	61'	20' 1"	9' 3"	1 deck, 2 masts, sq. stern, square tuck	Bebee, O'Hara	Bebee	vol. 1-89
1807	*Betsey*	schooner	Fairhaven PA	Saco MA	83 14-95	65' 6.5"	21' 1"	7' 1"	1 deck, 2 masts, sq. stern, short quarter deck	L. Wood, Tripp, W. Wood, Fish	L. Wood, W. Wood, Southworth	vol. 1-90
1807	*Betsey*	schooner	Barnstable MA	Barnstable MA	94 40-95	67' 10"	19' 11"	8' 10.25"	1 deck, 2 masts, sq. stern	Crowell, Baker, J. Chipman, B. Chipman (both heirs of U. Baker, Chase	Crowell	vol. 1-91

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1803	*Betsy*	schooner	Wareham MA	Scituate MA	74 45-95	65' 3.5"	29' 5"	6' 6.5"	1 deck, 2 masts, sq. stern	A. Gibbs, S. Burgess, P. Burgess, Swift, C. Gibbs, Fearing	W. Gibbs	vol. 1-93
1805	*Black Walnut*	brig	East Haddam CN	Pittsburg PA	160 25-95	78' 4"	23'	10' 3"	1 deck, 2 masts, sq. stern	Lord Jr., Barber	Reynolds	vol. 1-96
1817	*Bright Phoebus*	schooner	Hempstead NY	Hempstead NY	46 2-95	59' 6"	18' 9"	4' 10"	1 deck, 2 masts, sq. stern, round tuck	Anthony, Chandler	Smith, Chandler	vol. 1-98
1815	*Brisk*	schooner	New Orleans	Baltimore MD	110 34-95	77' 6"	19' 6"	8' 2"	1 deck, 2 masts, sq. stern, round tuck	Lanusse, Millaudon	Lanone, De Morant	vol. 1-100
1816	*Brunswick*	sloop	New Brunswick NJ	New Bedford MA	76 84-95	65' 2"	24' 3"	6' 7"	1 deck, 1 mast, sq. stern, billethead	Graw, Vandyke, Flagg, Boggs	Courtis	vol. 1-101
1810	*Brutus*	schooner	New Orleans	Accomack Co. VA	60 59-95	57'	17' 8"	7'	1 deck, 2 masts	DeBon, Nicholson	Tougard, Brown	vol. 1-102
1807	*Buckskin*	schooner	New Orleans	Annapolis MD	56	60'	18'	6'	1 deck, 2 masts, sq. stern	Landreu, Folger, Cornell, Morin	George	vol. 1-104

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1810	*Calypso*	brig	New Orleans	New London CN	144 11-95	73' 10.5"	22' 9"	10'	1 deck, 2 masts, sq. stern, billethead	Gilley, West, Pryor, Wray, Nicholls, Morse, Walden, Penn Jr., Burton	Stickney, Landberg, Daly	vol. 1-111
1796	*Camalus*	brig	New York NY	Bath MA	168 83-95	72' 7"	23.4'	11.7'	2 decks, 2 masts, sq. stern	Kennedy, Delaplaine	Kennedy	vol. 1-112
1814	*Caroline*	schooner	New Orleans	Talbot Co. MD	56 55-95	58' 6"	17' 6"	6' 3"	1 deck, 2 masts, sq. stern	Tio, Zacharie, Nelson	Tio, Nelson	vol. 1-124
1809	*Caroline*	brig	Providence RI	Somerset MA	106 58-95	68' 1"	21' 1"	8' 8"	1 deck, 2 masts, sq. stern	Ives, Brown	Cooke	vol. 1-118
1806	*Catherine*	schooner	Boston MA	White Oak River NC	76 49-95	59' 7"	18' 10"	8'	1 deck, 2 masts, sq. stern, round tuck, fiddlehead	Holbrook, Kingsbury	Rousset	vol. 1-132
1815	*Catherine*	schooner	New York NY	Stonington CN	161 24-95	77' 7"	22' 6"	10' 7.5"	1 deck, 2 masts, sq. stern, square tuck, figurehead	C. Davenport, R. Davenport, E. Davenport, A. Arcularius, P. Arcularius, Lathem	Welden	vol. 1-133
1805	*Caty Ann*	schooner	New Orleans	Lyme CN	133 73-95	70' 10"	21' 2"	10' 4"	1 deck, 2 masts, sq. stern, scroll head	Elmes	Pascal	vol. 1-135
na	*Celeste*	schooner	New Orleans	na	131 28-95	68' 6"	20' 6"	10' 10"	1 deck, 2 masts, sq. stern, carved scroll head	West	James	vol. 1-140

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1806	*Centurion*	schooner	New Orleans	Saybrook CN	133 77-95	80' 9"	20'	9' 7"	1 deck, 2 masts, sq. stern	J. Fortier, M. Fortier, Gracie, H. Amelung, F. Amelung, M. Fortier Sr., M. Fortier Jr., Soubercaze, Cornell	Walsh, Bru,	vol. 1-142
1814	*Ceylon*	schooner	New Orleans	Saybrook CN	210	76' 9"	23' 8"	13' 6"	1 deck, 2 masts, sq. stern, round tuck, fiddlehead	Center, Gardiner, Odie, Dent, McMaster, Bassett, Bogart, McLanahan, Walden	Ferrier, Gillman, Boyd, Brown	vol. 1-145
1818	*Champlin*	schooner	New Orleans	New York NY	67 52-95	58' 4"	18'	7' 7"	1 deck, 2 masts, sq. stern	West	Mitchell	vol. 1-148
1814	*Chance*	schooner	New Orleans	Manchester MA	104 6-95	70'	19' 10"	8' 7"	1 deck, 2 masts, sq. stern	Junca, Arnoux	Junca, Arnoux	vol. 1-149
na	*Charles*	brig	New York NY	na	163 87-95	69' 6"	22' 2"	12' 6"	1 deck, 2 masts, sq. stern	Wibray, McCrea, Slidell Jr.	Wibray	vol. 1-151
1815	*Charles*	schooner	Salem MA	Westbrook MA	109 82-95	68' 4"	21' 5.5"	8' 9.25"	1 deck, 2 masts	Carrico, Dix	Carrico	vol. 1-152
1813	*Charles Stewart*	schooner	New Orleans	Charlestown MA	65 82-95	61' 7"	17' 6"	7"	1 deck, 2 masts, sq. stern	Stanley	Watts	vol. 1-154

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1806	*Charlotte*	schooner	New Orleans	Norfolk Co. VA	100 14-95	70' 6"	20' 4"	8'	1 deck, 2 masts, sq. stern, round tuck	Callender, Amory, J. Fortier, M. Fortier	Richards, Reynolds	vol. 1-155
1811	*Clarissa Ann*	brig	Portsmouth NH	Bowdoinham MA	197 34-95	80' 10"	23' 9.5"	11' 10.7"	2 decks, 2 masts, sq. stern	Holmes, Forstall, Garland	Greenough, Smith	vol. 1-165
1807	*Commerce*	brig	Providence RI	Dighton MA	121	72' 2"	20' 7"	9' 4"	1 deck, 2 masts, sq. stern	Franklin, Bowen Jr., Waterman	Daggett	vol. 1-178
1816	*Commodore Barney*	schooner	Mobile AL	Lewistown DE	71 24-95	63.10'	20.50'	6.50'	1 deck, 2 masts, sq. stern	Wheeler, Heartt	Tripp	vol. 1-180
1812	*Commodore Hull*	brig	Boston MA	Charlestown MA	139 55-95	75'	21' 9"	9' 10"	1 deck, 2 masts, sq. stern	W. Wyer, N. WyerW. Sweet, S. Sweet	Hiter	vol. 1-181
1816	*Commodore Patterson*	sloop	New Orleans	Baltimore MD	83 15-95	64' 6"	19'	7' 10"	1 deck, 1 mast, sq. stern, round tuck	Bennet, Shields,	Bennet, Moreton, Myrick, Stevens, Hubbell	vol. 1-182
1796	*Concord*	brig	New Orleans	Newport RI	87 55-95	64'	20'	8'	1 deck, 2 masts, sq. stern, woman figurehead	Paraire, Hugnet	Paraire, Beauvais	vol. 1-185
1804	*Conquest*	schooner	Pittsburg PA	Pittsburg PA	112 50-95	68'	20' 4"	9' 5"	1 deck, 2 masts, sq. stern	O'Hara, Bebee	Kenney	vol. 1-189

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1802	*Constitution*	schooner	New York NY	Kinderhook NY	123 35-95	71' 4"	22' 3"	9' 1"	1 deck, 2 masts, sq. stern, billethead	Walden, White	Peckham, Smith	vol. 1-193
1814	*Criterion*	schooner	New Orleans	Dorchester Co. MD	76 69-95	67' 9"	20' 6"	6'	1 deck, 2 masts, sq. stern	Lamotte, J. Prados, Segura	Mesoulet, F. Prados	vol. 1-200
1819	*Cygnet*	schooner	Hallowell MA	Pittston MA	135 48-95	72' 10"	22' 6"	9' 9"	1 deck, 2 masts, sq. stern, billethead	Kimball, Agray, Emerson	Kimball	vol. 1-205
1806	*Dart*	brig	New Orleans	Salisbury MA	172 49-95	76' 2"	22' 11"	11' 5.5"	2 decks, 2 masts, sq. stern, figurehead	Duncan, Jackson, Gray, Taylor	Latimer	vol. 1-207
1819	*Dart*	schooner	New Orleans	Plymouth MA	64 93-95	61'	17'	7'	1 deck, 2 masts, sq. stern	Fiske, Richardson	Hard	vol. 1-210
1818	*David*	sloop	New York NY	Saybrook CN	97 56-95	68' 10"	21' 8"	7' 9"	1 deck, 1 mast, sq. stern	Storer, Grim	Storer	vol. 1-211
na	*Diana*	schooner	New Orleans	na	61 73-95	55' 4"	17' 2"	7' 7"	1 deck, 2 masts, sq. stern	Peebles, Rivarde	Campbell, Rivarde	vol. 1-216
1807	*Dolly*	brig	New Orleans	New Bedford MA	211 25-95	82'	24' 5"	12' 2.5"	2 decks, 2 masts, sq. stern	W. Thorn, C. Thorn, Henderson, Kenner	Holden	vol. 1-221
na	*Dolores*	schooner	New Orleans	na	123 72-95	75' 8"	21'	8' 10.5"	1 deck, 2 masts, sq. stern	Patterson, Cox	Smith, Liberal	vol. 1-222
1790	*Dolphin*	schooner	Philadelphia PA	Great Egg Harbor NJ	62 81-95	57' 8"	18' 3"	7'	1 deck, 2 masts, sq. stern	Blake	Dove	vol. 1-225

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1804	*Dove*	schooner	Portsmouth NH	Kittery MA	62 76-95	57.2'	17.2'	7.4'	1 deck, 2 masts, sq. stern	J. Goodrich, W. Goodrich	Bowles Jr.	vol. 1-227
1811	*Dread*	sloop	Hudson NY	Newburgh NY	95 92-95	68' 8"	23' 3"	7' 2"	1 deck, 1 mast, sq. stern, round tuck	Goodwin, Inslee, Grosvenor, Barker	Jenkins	vol. 1-228
1817	*Earl*	sloop	Rochester MA	Rochester MA	95 36-95	65' 8.25"	19' 6.5"	8' 5.25"	1 deck, 1 mast, sq. stern	Cushing, Meigs, Church, Ellis, Cannon, Goodspeed	Cushing	vol. 1-234
1815	*Edward*	brig	New Orleans	Concord DE	140 88-95	81'	23'	8' 8"	1 deck, 2 masts, sq. stern, round tuck	Carleton, Mayhew	Hudson	vol. 1-236
1802	*Eliza*	schooner	Portsmouth NH	New Bedford MA	74 3-95	60' 6"	19' 9"	7' 5"	1 deck, 2 masts, sq. stern	Merrill	Stocker	vol. 1-247
1814	*Eliza*	schooner	New Orleans	Pittsburg PA	48 1-95	60??	16' 6"	3' 11"	1 deck, 2 masts, sq. stern	Bathrick, Gridley, Gifford, Armitage	Smith, Gridley, Gifford, Fletcher	vol. 1-249
1801	*Eliza and Sarah*	brig	New Orleans	Philadelphia PA	107 11-95	64' 6"	21'	9' 4"	1 deck, 2 masts, sq. stern, full built	Lester, Muxo	Lambert, Griffith	vol. 1-257
1803	*Eliza Tice*	schooner	Philadelphia PA	Mantua Cr. Glouchester Co. NJ	98 61-95	62' 2"	21' 6"	8' 10"	1 deck, 2 masts, sq. stern, woman figurehead	Tice	Tice	vol. 1-258

Table E1.

An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
na	*Eliza Vickery*	schooner	New Orleans	na	89 45-95	62'	20'	8' 6"	1 deck, 2 masts, sq. stern, woman figurehead, round tuck	McCarty, Vickery	Vickery	vol. 1-259
na	*Emilie*	brig	Baltimore MD	na	116 48-95	67'	21' 6"	9' 6"	1 deck, 2 masts, billethead	Hathaway	Godfrey	vol. 1-262
1805	*Enterprize*	schooner	Hampden MA	Hampden MA	99 46-95	71' 8"	21' 3"	7' 6"	1 deck, 2 masts, sq. stern	R. Newcomb Sr., R. Newcomb Jr., Walter	R. Newcomb Jr.	vol. 1-272
1806	*Exchange*	brig	Baltimore MD	Pittsburg PA	114 7-95	66' 8"	19' 2"	10' 3"	1 deck, 2 masts, sq. stern, round tuck	Moore	Coane	vol. 1-281
na	*Fair American*	brig	New Orleans	na	100 36-95	64' 3"	19'	9' 6"	2 decks, 2 masts, sq. stern, figurehead, round tuck	Carrick, Morgan, Hinard, Dusser	Johnson, Hinard, Laporte	vol. 1-290
1806	*Fame*	brig	Sandwich MA	Sandwich MA	129 67-95	76'	21' 6"	9' 1"	1 deck, 2 masts, sq. stern	Bodfish, Hamblin, Handy, W. Perry, S. Perry, Morey, J. Phinney, C. Perry, E, Phinney	Bodfish	vol. 1-294
1815	*Farmers Fancy*	schooner	Richmond VA	Cabbin Pt. VA	147 48-95	75' 8"	24' 1"	9' 6"	1 deck, 2 masts, round tuck, billethead	Pleasants, Ralston	Otis	vol. 1-299

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1813	*Favorite*	schooner	Worchester Co. MD	Glastonbury CN	102 79-95	68'	21' 9"	8' 2"	1 deck, 2 masts	Prideaur, Green	Prideaur, Green	vol. 1-300
1810	*Flora*	schooner	New Orleans	Duxbury MA	141 88-95	72' 10"	21' 10"	10' 6"	1 deck, 2 masts, sq. stern, figurehead	Gerard, Cottin	Gerard, Bougon	vol. 1-314
1813	*Flying Fish*	schooner	New Orleans	Middletown CN	83 36-95	64'	20' 5"	7' 6"	1 deck, 2 masts, sq. stern	Baron, Sere, Vives	Baron, Fernandez	vol. 1-319
1811	*Formax*	brig	New Orleans	Falmouth MA	173 76-95	78' 6"	23' 7.75"	10' .25"	1 deck, 2 masts, sq. stern, billethead	David	Tougard	vol. 1-320
1813	*Fox*	sloop	New Orleans	Middletown CN	65 76-95	63'	19' 2"	6' 4"	1 deck, 1 mast, sq. stern	Driscol	Driscol	vol. 1-322
1814	*Frances*	brig	New York NY	Norfolk VA	169 76-95	77'	22' 2"	11' 5"	1 deck, 2 masts, sq. stern	Simond, Dixon	Neilson	vol. 1-323
1802	*Free Love*	brig	New Orleans	Great Egg Harbor NJ	134 92-95	72'	22' 9"	9' 8"	1 deck, 2 masts, woman figurehead	Junior, Shepherd, Thompson	Morant, Lake,	vol. 1-331
1816	*Free Town*	schooner	Boston MA	Bristol MA	116 20-95	72' 11"	22' 8"	8' 2.5"	1 deck, 2 masts, sq. stern	Guild, McClure, Hatch, Bryant	Pitts	vol. 1-332
1798	*Friendship*	brig	New Orleans	Berwick MA	132 1-95	69'	21.1'	10.55'	2 decks, 2 masts, sq. stern, woman figurehead	Ogden, Williamson, De Bloss	Hobkirk	vol. 1-334
1787	*Gayoso*	brig	New Orleans	Philadelphia PA	92 32-95	59' 8"	19' 2"	9' 6"	1 deck, 2 masts, sq. stern	De Bon	Millet	vol. 1-336

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1815	*General A. Jackson*	sloop	New York NY	New York NY	67	58' 4"	20' 10"	6' 8"	1 deck, 1 mast, sq. stern, man bust head, round tuck	Gantz, Jr.	Rhodes	vol. 1-337
1798	*George Clinton*	brig	New Orleans	New York NY	97	66' 2"	21' 8"	8'	1 deck, 2 masts	Durrousseau	Durrousseau	vol. 1-364
1810	*George Washington*	brig	New Orleans	Bath MA	200 79-95	77' 6"	23' 4"	12' 10.5"	1 deck, 2 masts, sq. stern, billethead	R. Shepherd, J. Shepherd, Townes, Marshall, Wilson, Smith, Speed, Pratt, Wolff Jr.	Powell, Wilson, Pratt	vol. 1-366
1818	*Globe*	schooner	Hingham MA	Hingham MA	73 13-95	63' 2"	16' 11"	7' 9"	1 deck, 2 masts, pink stern?	C. Sprague, S. Sprague, Souther	Hobart	vol. 1-368
1811	*Gold Huntress*	sloop	Providence RI	Providence RI	111 22-95	68' 5"	21' 10"	8' 9"	1 deck, 1 mast, sq. stern, woman figurehead	Currie, Stone, OlneyWard, Goodale	Drown	vol. 1-369
1811	*Good Hope*	schooner	Charleston SC	Dorchester Co. MD	116 50-95	72'	22' 9"	8' 5"	1 deck, 2 masts	Bruchet	Bruchet	vol. 1-370
1807	*Good Intent*	sloop	Baltimore MD	Rochester MA	77	58' 4"	19' 11"	8'	1 deck, 1 mast, sq. stern	Clowdsby, Spicer, Richards, Morton	Watson, Morton, Young	vol. 1-371

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1809	*Greyhound*	schooner	New Haven CN	Killingsworth CN	87 67-95	61' 7"	20'	8' 5"	1 deck, 2 masts, sq. stern, hound figurehead	Seward, Kidston, Bishop	Seward	vol. 1-378
1797	*Hannah*	brig	New Orleans	Newbury MA	143 25-95	68'	22' 4"	7' 2"	2 decks, 2 masts, sq. stern	Henderson, Kenner, Trimble, W. Thomas, A. Thomas, O. Thomas, Harrod, G. Ogden, P. Ogden.	Coffin, Kennedy	vol. 1-381
1798	*Hannah*	schooner	Manchester MA	Amesbury MA	86 69-95	64' 1"	18' 2.5"	8' 6"	1 deck, 2 masts, sq. stern	Burges Jr.	Burges Jr.	vol. 1-382
1801	*Hannah*	schooner	Newburyport MA	Frankfort MA	111 71-95	65' 4"	20'	10'	2 decks, 2 masts, sq. stern	Coffin	Sommerby	vol. 1-383
1810	*Hannibal*	brig	New London CN	Westerly RI	165 2-95	71' 7"	23' 9"	11' 7"	1 deck, 2 masts, sq. stern	Denison, T. Williams, W. Williams	Denison	vol. 1-384
1816	*Hector*	schooner	Balize	St. Mary's Co. MD	66 86-95	64' 8"	18' 2.5"	6' 6"	1 deck, 2 masts, pilot boat built	Pollock, Silva, Sere	Pollock, Baron	vol. 1-392
1812	*Hector*	schooner	New Orleans	Dorchester Co. MD	149 44-95	82' 6"	23' 6"	8' 10"	1 deck, 2 masts, sq. stern	Cucullu	Massicot	vol. 1-393
1797	*Helen*	schooner	Charleston SC	Middletown CN	73 47-95	59' 9"	18' 10"	7' 10.5"	1 deck, 2 masts, sq. stern	Stiles, Hobkirk	Stiles	vol. 1-395
1811	*Henrico*	brig	Boston MA	Barnstable MA	205 2-95	83' 10"	24' 6"	11' 6"	1 deck, 2 masts, sq. stern	Snow, Stovey, Stephens	Snow	vol. 1-399

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1804	*Hercules*	brig	New York NY	Haddam CN	178 28-95	80'	22' 6"	10' 8"	1 deck, 2 masts, sq. stern, man figurehead	Perpignan, Labouisse	Weeks	vol. 1-404
1807	*Hero*	brig	Boston MA	Wiscasset MA	141 28-95	75'	20' 8.5"	10' 4.5"	2 decks, 2 masts, sq. stern	Andrews, Gay	Southworth	vol. 1-405
1814	*Hero*	brig	New Orleans	Kennebunk MA	123 75-95	70' 10"	20' 11.75"	9' 7.5"	1 deck, 2 masts, sq. stern	Giraudel, Lepretre, St. Amant, Casanovas	Giraudel, Canes, Rivero	vol. 1-406
1805	*Hibernia*	brig	New Orleans	Alexandria DC	135 81-95	71'	22' 2.5"	10' 1"	1 deck, 2 masts, sq. stern, woman figurehead	Duplesses, West, Phillips	Latham	vol. 1-411
1800	*Hiram*	schooner	Charleston SC	Columbia MA	114 82-95	74' 1"	21' 11"	8' 2"	1 deck, 2 masts, sq. stern	Hunt	Oliver	vol. 1-415
1807	*Holkar*	brig	New York NY	CN	192 34-95	81'	23' 7"	11' 9.5"	1 deck, 2 masts, sq. stern, billethead	Morgan Jr. bach, Puffer, Wellman	Horn, Kemble	vol. 1-417
1802	*Hope*	schooner	New Orleans	Dorchester Co. MD	51 42-95	59'	17' 3"	5' 10"	1 deck, 2 masts	Belcour, Michel	Martin	vol. 1-422
1805	*Hornet*	schooner	New Orleans	Norfolk Co. VA	92 13-95	70'	18' 10"	7' 11"	1 deck, 2 masts, sq. stern, round tuck	Merieult	Nassivet	vol. 1-429
1815	*Hornet*	schooner	New Orleans	Hartford Co. MD	58 30-95	60' 6"	18' 9"	6'	1 deck, 2 masts, sq. stern, round tuck	Harang	Troude	vol. 1-430

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1799	*Hunter*	brig	Baltimore MD	Stansborough NC	109 65-95	67' 6"	19' 3"	9' 8"	1 deck, 2 masts, sq. stern	Newman, Hyde, Leeds, Crocker, Rogers,	Newman, Rogers,Canovas	vol. 1-431
na	*Huntress*	schooner	New York NY	na	128 51-95	70' 8"	22' 9"	9' 5"	1 deck, 2 masts, sq. stern, round tuck, billethead	Fowler	Fowler	vol. 1-432
na	*Imperial*	schooner	Bayou St. John	na	38 27-95	56' 10"	16' 3"	4' 9"	1 deck, 2 masts, sq. stern	Blanc	Robasso	vol. 1-434
na	*Indiana*	schooner	New Orleans	na	113	80' 4"	22' 4"	7' 2"	1 deck, 2 masts, round stern	Hambleton, Joly	Sasportas, Gassiotte	vol. 1-438
1813	*James Lawrence*	schooner	New Orleans	Tappan NY	56 79-95	61' 1"	20'	5' 6"	1 deck, 2 masts, sq. stern, round tuck, billethead	Quere, LaPorte, Williams	Quere, LaPorte, Williams	vol. 1-449
1818	*James Monroe*	schooner	Sandwich MA	Sandwich MA	116 31-95	70'	21' 6.5"	9'	1 deck, 2 masts, sq. stern, billethead	P. Gibbs, Swift, N. Gibbs	P. Gibbs	vol. 1-454
1802	*Jefferson*	brig	New Orleans	Freetown MA	111 53-95	66' 9"	21' 3"	9' 3"	1 deck, 2 masts, sq. stern	Wells, Richardson	na	vol. 1-465
1810	*Joanna*	sloop	New Orleans	Swansey MA	65 30-95	58' 3"	18' 5"	7' 2"	1 deck, 1 mast, sq. stern, woman figurehead	Francolin, Andrich	Quidiniac	vol. 1-471
1801	*John*	brig	Alexandria DC	Mathews Co. VA	121 2-95	75' 1"	22' 8"	8' 3"	1 deck, 2 masts, sq. stern	Taylor	Stevens	vol. 1-472
1808	*John*	brig	Philadelphia PA	Belfast MA	144 36-95	79' 3"	23' 1"	9' 1"	1 deck, 2 masts, sq. stern	Stiles Sr.	Stiles Sr.	vol. 1-473

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1808	*John*	schooner	New Orleans	Newbern NC	87 41-95	60'	20' 6"	8' 6"	1 deck, 2 masts, sq. stern	Michel	Loveless	vol. 1-476
1815	*John Hope*	schooner	New Orleans	Hampton VA	50 44-95	57'	17' 6"	6'	1 deck, 2 masts, sq. stern	Cox, Somers, Pollock, Silva, Miller	Licatt, Somers, Pollock	vol. 1-481
1810	*Joseph and Ruth*	brig	Philadelphia PA	Pittsburg PA	171	81' 7"	24' 9"	9' 10"	1 deck, 2 masts, sq. stern	James, Updegrafe	Frost	vol. 1-486
1815	*Laura*	schooner	New Orleans	Baltimore MD	171 3-95	84' 6"	22' 9"	10' 1"	1 deck, 2 masts, round tuck	Rivery	Rivery	vol. 1-499
1801	*Liberty*	schooner	New Orleans	Burlington NJ	80 10-95	60'	19' 9"	8'	1 deck, 2 masts, sq. stern	Miller	na	vol. 1-506
1800	*Little Dromo*	schooner	Glouchester MA	Wheeling VA	97 61-95	77' 7"	18' 4"	7' 8"	1 deck, 3 masts, sq. stern	J. Beach	W. Beach	vol. 1-508
1819	*Little William*	schooner	Boston MA	Bangor MA	121 24-95	72' 4"	22' 1"	8' 10"	1 deck, 2 masts, sq. stern	Ballard	Carnes	vol. 1-514
1782	*Lively*	schooner	Salem MA	Salem MA	84 38-95	59'	17' 11"	9' 4"	1 deck, 2 masts	Richard Smith, Issac McCoy, Alexander Clay Jr., James Cox Jr.	Richard Smith, William Avery	vol. 1-516
1810	*Louisiana*	brig	Boston MA	Dorchester MA	202 30-95	79' 6"	24' 4"	12' 2"	2 decks, 2 masts, sq. stern, figurehead	Pratt	Ryan, Pratt	vol. 1-526
1804	*Louisiana*	schooner	New Orleans	Baltimore MD	74 87-95	70' 6"	22' 4"	5' 7"	1 deck, 2 masts, sq. stern	Bouechereaun	Renohle	vol. 1-527

Table E1.

An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1792	*Lucy*	schooner	Charleston SC	Connecticut	82 64-95	61'	19' 8"	7' 11.5"	1 deck, 2 masts, sq. stern	Torrey	Torrey	vol. 1-535
na	*MacDonough*	schooner	Philadelphia PA	na	74	59' 9"	19' 9"	7' 6"	1 deck, 2 masts, sq. stern	Adams, Hobart, Knight	Knight	vol. 1-536
na	*Margaret*	brig	New Orleans	na	149 4-95	79' 6"	22' 7"	9' 6"	1 deck, 2 masts, sq. stern	Granpera, Portas, Campanel, David	Thomas, Barjan	vol. 1-541
na	*Margaret*	brig	New Orleans	na	104 70-95	62' 8"	20' 5"	9' 8"	1 deck, 2 masts, sq. stern, woman figurehead, round tuck	Tio, St. Marc, Brunie,	Lagua, Paillet, Meserve	vol. 1-542
1789	*Mary*	brig	New Orleans	Mount Holly NJ	165 11-95	77' 6"	20' 7"	11' 8"	1 deck, 2 masts, sq. stern	Duncan, Jackson, Muir	Barnhard	vol. 1-567
1800	*Mary*	brig	New Orleans	Providence RI	107 59-95	64' 8"	19' 8"	9' 10"	1 deck, 2 masts	Ward	Carrico	vol. 1-568
na	*Mary*	brig	New Orleans	na	151 92-95	66'	23' 7"	11' 9.5"	2 decks, 2 masts, sq. stern, figurehead, round tuck	Morgan	Teaball	vol. 1-569
na	*Mary*	brig	New Orleans	na	145 32-95	69' 6"	22' 2"	11' 1"	2 decks, 2 masts, sq. stern, billethead, round tuck	Dent, Spicer, Richards, Odie	Wilder, Watson	vol. 1-570

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1804	*Mary*	schooner	New Orleans	Pittsburg PA	36 31-95	61' 9"	13' 6.5"	4' 10"	1 deck, 2 masts, sq. stern	Vrignaud, Montoro, De Momenes, Bosque	Vrignaud, Petit, De Momenes, Saragosa	vol. 1-572
1812	*Mary*	schooner	New Orleans	Alleghany Co. PA	205 59-95	78' 1"	22' 11"	13' 3"	1 deck, 2 masts, sq. stern, square tuck	Robins	Griffing	vol. 1-576
1815	*Mary and Eliza*	schooner	Boston MA	Bangor MA	82 53-95	65' 2"	19' 6.5"	7' 6.5"	1 deck, 2 masts, sq. stern	Fisher, Bradford Jr., Eaton, C. Stone	N. Stone	vol. 1-581
1811	*Mary Ann*	brig	New London CN	New London CN	186 25-95	79'	22' 11"	11' 10"	1 deck, 2 masts, sq. stern, woman figurehead	J. Deshon, D. Deshon	J. Deshon	vol. 1-586
1816	*Mary Ann*	brig	New Orleans	Addison MA	175 52-95	80' 3"	23' 5"	10' 9"	1 deck, 2 masts, sq. stern	P. Ogden, V. Ogden, Harrod	Schlor	vol. 1-587
1817	*Mary Ann*	brig	New Orleans	Philadelphia PA	88 31-95	59.6'	21.35'	8.4'	1 deck, 2 masts, sq. stern, fiddlehead	Bogart, McLanahan, Callaghan	Selby	vol. 1-588
1804	*Mary Ann*	schooner	New Orleans	Charlestown VA	99 5-95	63'	19' 11"	9' 3"	1 deck, 2 masts, sq. stern, round tuck	Offley	West	vol. 1-590
1808	*Maryland*	brig	New Orleans	Dartmouth MA126 40-95	67'	21' 9"	10' 2.5"		1 deck, 2 masts, sq. stern, billethead	La Porte, Bissell	Williams, Bates	vol. 1-593

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1806	*Mary Mason*	schooner	New Orleans	Mathews Co. VA	62 78-95	59' 9"	16' 9"	6' 10"	1 deck, 2 masts	Berra	Peters	vol. 1-594
1815	*Mediterranean*	schooner	New Orleans	Dorchester Co. MD	75 90-95	70' 6"	20'	6' 2"	1 deck, 2 masts, sq. stern, round tuck	Assenso, Mantiga	Johnston	vol. 1-599
1800	*Mentor*	brig	New Orleans	Freetown RI	112 61-95	66'	20' 8"	9' 6"	1 deck, 2 masts, sq. stern, round tuck	Portas, Angelini, Smith	Barjan, Arno, Smith	vol. 1-601
1811	*Merino*	schooner	New Orleans	Alma MA	78 62-95	54' 9"	20' 3"	8' 8"	1 deck, 2 masts, sq. stern	Woodbury, Morse, Hyde	Wolfe, Morse	vol. 1-602
1818	*Milo*	sloop	Fairhaven MA	Fairhaven MA	77 66-95	59' 7"	19' 5.5"	7' 11"	1 deck, 1 mast, sq. stern	Delano, A. Pease, T. Pease, Eldredge	Delano	vol. 1-606
na	*Mississippi*	schooner	New Orleans	na	72 86-95	68' 3"	17' 8"	6' 9"	1 deck, 2 masts, round stern	Landreu	Russell	vol. 1-610
1817	*Monroe*	brig	Yarmouth MA	Portsmouth NH	114 65-95	70.1'	20.2'	9.3'	1 deck, 2 masts, sq. stern	Hallet, Baker	Hallet	vol. 1-621
1816	*Morgiana*	schooner	Duxbury MA	Duxbury MA	120 5-95	73' 10"	21' 9"	8' 7.5"	1 deck, 2 masts, sq. stern	B. Sampson, W. Sampson, J. Sampson, L. Sampson, Allen	B. Sampson	vol. 1-623

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1815	*Mount Vernon*	schooner	New Orleans	St. Mary Co. MD	65 47-95	65'	18' 2"	6' 4"	Flush Deck, 2 Masts	Hepburn, Pleasants, Sample, Dupuis, Baron, Turner, Zacharie, Ogden	Wade, Rivarde, Buret, Baron, Nelson, Weston	vol. 1-625
1818	*Mulberry*	schooner	Annapolis MD	West River MD	75 62-95	71'	19' 6"	6' 2"	1 deck, 2 masts, sq. stern	Tongue	Masson	vol. 1-626
1816	*Nancy*	sloop	New York NY	Glastonbury CN	80 50-95	64' 1"	20' 9.5"	7' 1.5"	1 deck, 1 mast, sq. stern	Grim, Stacy	Staple	vol. 1-632
1815	*New Packet*	brig	Boston MA	Barnstable MA	139 22-95	72' 2"	21' 7.5"	10' 4"	1 deck, 2 masts, sq. stern	Thatcher, Walter, Miller, Cobb	Thatcher	vol. 1-649
1815	*Nonsuch*	schooner	New Orleans	Dorchester Co. MD	84 89-95	64' 6"	19' 6"	7' 4"	1 deck, 2 masts, sq. stern	Miller, Harang	Bennett, Mann	vol. 1-652
1810	*Ohio*	schooner	Beverly MA	Ohio Co. VA	109 81-95	71' 3"	21' 2"	8' 5"	1 deck, 2 masts, round stern, square tuck	Willett, Rea	Willett	vol. 1-658
1812	*Orion*	schooner	New Orleans	Glastonbury CN	147 27-95	85'	22' 4"	8' 9"	1 deck, 2 masts, sq. stern	Mitchell	Mitchell	vol. 1-664
1795	*Orlando*	brig	New Orleans	Newbury MA	128 26-95	71'	20' 10"	10'	1 deck, 2 masts, sq. stern	Thorn	Harris	vol. 1-665

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1813	*Orleans*	brig	New York NY	Killingsworth CN	237 57-95	83' 6"	24' 3"	13' 6"	1 deck, 2 masts, sq. stern, billethead	Vail, Van De Water, M. Wheeler, H. Wheeler, Stewart, R. Russell, I. Russell	Stewart, Thornton	vol. 1-666
1804	*Orleans Packet*	schooner	New Orleans	Pittsburg PA	(1?)43 37-95	76' 7"	13' 6"	4' 5.5"	1 deck, 3 masts, sq. stern	C. Evans, Harvey, W. Evans, Dufau, Bufrenil, David, Bujac, Carr, Fowler, Daniel	W. Harvey, Cadit, Buffrenil, Bryant, Drury	vol. 1-668
1818	*Pearl*	brig	Boston MA	Bath MA	176	78' 10"	23' 8"	10' 11"	1 deck, 2 masts, sq. stern	Hall, Shepard, Baker, Sargent	Hall	vol. 1-685
1813	*Phebe Ann*	sloop	New Orleans	Goshen Creek NJ	55 18-95	57.9'	28.8'	5.55'	1 deck, 1 mast, sq. stern	Clark, Cornwall	Dillion	vol. 1-695
na	*Polar Star*	schooner	New Orleans	na	38 41-95	56'	16' 4"	4' 10"	1 deck, 2 masts, sq. stern	Casteres	Casteres, Aristade Pinquet	vol. 1-707
1795	*Polly*	brig	New Orleans	Connecticut	77 9-95	58'	18' 4"	8' 6"	1 deck, 2 masts, sq. stern, figurehead	Ogden, LePrince	Perudino	vol. 1-708
1791	*President*	schooner	Baltimore MD	Gloucester Co. VA	67	56'	17' 6"	8'	1 deck, 2 masts, sq. stern	Taylor, Hart, White Jr., Thomas	Jones, Ulrich, Drury	vol. 1-714

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1801	*President*	schooner	New York NY	Surrey MA	98	69' 2"	22'	7' 6"	1 deck, 2 masts, sq. stern	Allen	Allen	vol. 1-715
1804	*President*	schooner	New Orleans	Dorchester Co. MD	70 78-95	64' 9"	19' 6"	6' 6"	1 deck, 2 masts, sq. stern	Miller, Fowler	Fowler	vol. 1-716
1810	*Prompt*	brig	New York NY	Middletown CN	164 15-95	78' 6"	24' 2"	10' 1"	1 deck, 2 masts, sq. stern, serpent head	Riley, Carter, Cowman, Murray, Ogden,	Riley	vol. 1-720
1805	*Ranger*	schooner	New Orleans	Baltimore MD	150 26-95	84'	22' 6"	9'	1 deck, 2 masts, sq. stern	United States	Reed	vol. 1-727
1818	*Ranger*	schooner	Hallowell MA	Pittston MA	123	73'	21' 6.5"	9'	1 deck, 2 masts, sq. stern	Agry	Kean	vol. 1-729
1800	*Rebecca*	schooner	New Orleans	Mathews Co. VA	120 44-95	68' 7"	20' 9.5"	9' 11"	1 deck, 2 masts, sq. stern	Barrie, Lweis, Lee	Lippiatt, Sasportas	vol. 1-734
na	*Rebecca*	schooner	New Orleans	na	64 69-95	62' 5"	18' 5"	6' 6"	1 deck, 2 masts, sq. stern	West, Duplessis Jr.	Baxter	vol. 1-735
1816	*Rebecca*	schooner	Norfolk VA	Talbot Co. MD	92 6-95	71'	21'	7'	1 deck, 2 masts, round tuck	Hall, Reed	Hall	vol. 1-736
1805	*Recovery*	brig	New Orleans	Charleston VA	177 39-95	80' 8"	23' 10"	10' 8"	1 deck, 2 masts, sq. stern, badges	Tillinghast, Marshall, Connell, McCluney, Rodgers, Harford	Fry	vol. 1-738
1802	*Regulator*	schooner	New Orleans	Hampton VA	49 30-95	55' 8"	16' 4"	6' 3"	1 deck, 2 masts, sq. stern	Callender, Amory	Churnside	vol. 1-740

Table E1.

An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1810	*Resolution*	schooner	Mobile AL	Saybrook CN	75 65-95	59' 11"	19' 2"	7' 9"	1 deck, 2 masts, sq. stern, scroll head	Wilder, Sibley	Wilder	vol. 1-744
1817	*Retrieve*	schooner	Hallowell MA	Hallowell MA	102	66' 7"	21' 4"	8' 4"	1 deck, 2 masts, sq. stern	Cox, Hinkley II, Lovell, Gardner	Dorr	vol. 1-746
1812	*Rising Sun*	schooner	New Orleans	Rochester MA	74 5-95	62' 4"	20'	7'	1 deck, 2 masts, sq. stern	Densmore, Fernandez	Densmore	vol. 1-750
1801	*Rover*	schooner	New Orleans	Massachusetts	80	61'	19'	7' 8"	1 deck, 2 masts, sq. stern	Cornell. Coit, Foster	Green, Hopkin	vol. 1-760
1806	*Rover*	schooner	Charleston SC	Connecticut	91 75-95	61' 4"	19' 5"	8' 9"	1 deck, 2 masts, billethead	Burrows, Halsey, Hyde, Leeds, Chapman	Pike, Halsey, Smith, Douglass	vol. 1-761
1819	*St. Tamany*	schooner	Covington	Covington	44 35-95	55' 2"	16' 9"	5' 7"	1 deck, 2 masts, round stern	Gillmore, Jones	Sullivan	vol. 1-771
1811	*Sally*	schooner	Philadelphia PA	Steuben MA	77 45-95	65' 3"	20' 5.5"	6' 9.5"	1 deck, 2 masts, sq. stern	Brethoff, Clifford	Brethoff	vol. 1-774
1802	*Sally and Priscilla*	schooner	Providence RI	Great Egg Harbor NJ	83 20-95	59' 7"	20' 10"	8' 2"	1 deck, 2 masts, sq. stern	Brown, Ives	Bowers	vol. 1-775
1815	*Sampson*	brig	New York NY	Westerly RI	196 10-95	78' 4"	24' 7"	11' 10"	1 deck, 2 masts, sq. stern, billethead	Britton Jr., Hartshorne, Denison	Britton Jr.	vol. 1-778
1804	*Samuel*	schooner	New Orleans	Bertie Co. NC	52 2-95	57' 7"	17' 10"	5' 11"	1 deck, 2 masts	Allen	Mallisson	vol. 1-779

Table E1.

An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1815	*Sarah Ann*	brig	New Orleans	Amesbury MA	137 11-95	67' 8"	21' 6.5"	11' 1.5"	1 deck, 2 masts, sq. stern, billethead	Cutter, Lumbard	Lumbard	vol. 1-781
1809	*Satellite*	schooner	Charleston SC	Chatham CN	93 43-95	56' 4"	20' 11"	7' 11"	1 deck, 2 masts	Field	Field	vol. 1-783
1805	*Saturn*	schooner	New Orleans	Marshfield MA	107 1-95	66' 11"	20' 2.5"	9' 2.5"	1 deck, 2 masts, sq. stern	Vidal	Vidal	vol. 1-784
1819	*Sea Flower*	schooner	Hallowell MA	Hallowell MA	77	62' 7"	19' 3.25"	7' 5"	1 deck, 2 masts, sq. stern, billethead	Smith	Soule	vol. 1-790
1814	*Solon*	schooner	Boston MA	North Yarmouth MA	93 29-95	69' 11"	20' 7"	7' 5"	1 deck, 2 masts, sq. stern	Goddard	Sawyer	vol. 1-794
1791	*Sophia*	brig	New Orleans	Falmouth MA	188 63-95	64'	23' 8"	11' 10"	2 decks, 2 masts, sq. stern	T. Brooks. De Wees, A. Brooks, Watts, Larionda, Holbet	McCann, Watts, La French, Silva, Holbet	vol. 1-796
1814	*Speedy Peace*	brig	New York NY	New York NY	186 29-95	82' 6"	22' 8"	11' 4"	2 decks, 2 masts, sq. stern, woman bust head	Halleck	Swain	vol. 1-802
na	*Sperry Baker*	schooner	New Orleans	na	90 34-95	65' 3"	18' 8"	8' 9"	1 deck, 2 masts, sq. stern, man head, round tuck	Clavie, Barclay, Baker	Barclay	vol. 1-804

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1806	*Stephen*	brig	New York NY	Catskill NY	183 62-95	76' 4"	23' 9"	na	1 deck, 2 masts, sq. stern, round tuck	Jumel, Desobry	Berry	vol. 1-805
1795	*Suckey and Polly*	schooner	New Orleans	Jerusalem VA	67 52-95	57'	18'	7' 9"	1 deck, 2 masts, sq. stern	Genois	Petit	vol. 1-806
1810	*Sumatra*	brig	New York NY	Saybrook CN	261 84-95	85'	24' 6"	14' 4"	1 deck, 2 masts, sq. stern, woman figurehead	Sturges	Hudson	vol. 1-809
1818	*Surprize*	schooner	New Orleans	Dorchester Co. MD	52 73-95	62' 6"	18' 6"	5' 3"	1 deck, 2 masts, sq. stern	Hart	Hart	vol. 1-812
1816	*Susan*	sloop	Petit Coquilles	Washington NC	70 19-95	65' 8"	19' 8"	6' 7"	1 deck, 1 mast, sq. stern	Bennet, Morte	Harris	vol. 1-814
1798	*Susanna*	brig	Philadelphia PA	Gloucester Co. NJ	92 54-95	61'	20' 8"	8' 9"	1 deck, 2 masts, sq. stern	Reilly, Allen	Reilly	vol. 1-815
1790	*Swanwick*	brig	Philadelphia PA	Philadelphia PA	230 62-95	82'	25' 8"	12' 10"	2 decks, 2 masts, sq. stern, man figurehead	Adams	Hays	vol. 1-819
na	*Thomas and Betsey*	schooner	New Orleans	na	38 91-95	62' 10"	14' 8"	4' 8"	2 masts, sq. stern	Hosking, Ogden	Kelley, Chambers	vol. 1-832
1809	*Thorn*	sloop	New Orleans	Fort Lee NJ	58 14-95	57' 4"	19' 6"	6' 2.5"	1 deck, 1 mast, sq. stern	Azarett	Massicot	vol. 1-838
1817	*Three Brothers*	schooner	Monhegan MA	Monhegan MA	79 75-95	65'	19' 6"	7' 2.25"	1 deck, 2 masts, sq. stern	H. Trefethen, H. Trefethen Jr.	J. Thompson Jr.	vol. 1-839
1812	*Three Sisters*	schooner	Snow Hill MD	Worcester Co. MD	73 55-95	65'	19' 5.75"	6' 8.75"	1 deck, 2 masts, sq. stern	Davis, Scott, Smith	Davis, Scott	vol. 1-842

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
na	*Traveller*	brig	New Orleans	na	170 73-95	77' 9"	22' 5"	11' 3"	2 decks, 2 masts, sq. stern, round tuck	Faure, Rives, Faurie	Macy	vol. 1-848
1795	*Trio*	brig	New York NY	New Jersey	165 85-95	76'	22' 8"	11' 1.5"	1 deck, 2 masts, sq. stern, man figurehead	Hill, Berra	Fram, Berra	vol. 1-849
na	*Trio*	brig	New Orleans	na	152 15-95	73'	23' 4"	10' 6"	1 deck, 2 masts, sq. stern, fiddlehead	Martinez, Tricou, D. Urquhart, T. Urquhart, Lagan	Robin, Shaddock, Lagan	vol. 1-850
1809	*Two Brothers*	schooner	New Orleans	na	55 94-95	60'	18'	6'	1 deck, 2 masts, sq. stern	Barrie, Allen, Ferlat	Cathelin, Dunn, deMahy	vol. 1-861
1800	*Triumph*	schooner	New Orleans	Talbot Co. MD	56 72-95	61'	17'	6' 3"	1 deck, 2 masts, sq. stern	Cornell	Fernandez	vol. 1-853
na	*Two Sisters*	schooner	New Orleans	na	119 44-95	67' 6"	20' 9"	9' 11"	1 deck, 2 masts, sq. stern, round tuck	Bosque	Beluche	vol. 1-866
1816	*Two Sisters*	schooner	Boston MA	Westbrook MA	130 34-95	66'	21'	8' 6"	1 deck, 2 masts, sq. stern	Lewis	Brigham	vol. 1-867
1802	*Union*	schooner	Dartmouth MA	Barnstable MA	94 31-95	68'	20' 10"	7' 10.5"	1 deck, 2 masts, sq. stern	Blackner, Thacher	Hawes	vol. 1-870
1805	*Venus*	brig	New Orleans	Kent Island MD	173 71-95	76' 6"	21' 8"	12'	1 deck, 2 masts, sq. stern, woman head	Shepherd, Russel, Jones, McNair	J. Armstrong Jr, Parker, Green	vol. 1-873

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1811	*Venus*	schooner	New York NY	Woodbridge NJ	111 32-95	66' 4"	18' 11"	10' 2"	1 deck, 2 masts, sq. stern	Bailey	Church	vol. 1-874
1808	*Victory*	schooner	New Orleans	Dorchester MD	53 21-95	58' 5"	18' 3"	5' 10"	1 deck, 2 masts, sq. stern	Lanusse	Coulon	vol. 1-881
na	*Virginia*	schooner	New Orleans	na	43 58-95	60' 10"	16' 5"	5' 11"	1 deck, 2 masts, sq. stern	Lapauze	Casteres	vol. 1-883
1809	*Warren*	brig	New Orleans	Duxbury MA	184 32-95	78' 4"	23' 4"	11' 8"	2 decks, 2 masts, sq. stern, figurehead	Mayhew, Odie, Gardiner, Center, Durand	Fowler, Tew, Lagan	vol. 1-889
1812	*Washington*	schooner	Charleston SC	Pittstown MA	149 85-95	75' 6"	23' 10.5"	9' 9"	1 deck, 2 masts	McKinne, Pott, Ludlow	Stinson	vol. 1-894
1801	*Welcome Home*	schooner	New Orleans	Dorchester Co. MD	71-74-95	63'	19' 6"	6' 8"	1 deck, 2 masts, sq. stern	Esteva	Basabe	vol. 1-899
1801	*William*	brig	Cambridge MA	Hallowell MA	131 4-95	71' 6"	20' 6"	10' 3"	2 decks, 2 masts, sq. stern	Winthrop	Waters	vol. 1-904
na	*William*	brig	New Orleans	na	127 23-95	63' 5"	21' 10"	10' 11"	2 decks, 2 masts, sq. stern, man figurehead	Garland, Harman, Winter, Murray	Paillet, Hastie	vol. 1-905
1800	*William*	schooner	New Haven CN	Connecticut	85 51-95	61' 3"	20'	8' 2"	square stern	Cooper	Cooper	vol. 1-906
1807	*William*	schooner	Newport RI	Frankfort MA	127 56-95	75' 6"	22' 9"	8' 7"	1 deck, 2 masts, sq. stern	Sayer, Rhodes, Cahoone	Sayer	vol. 1-907

Table E1.
An Analysis of the Ship Enrollment Records for New Orleans (continued)

Built	Name	Ship Type	Home Port	Construction place	Tonnage	Length	Breadth	Depth	Description	Owner(s)	Master(s)	Log No.
1816	*William and Emeline*	schooner	Hallowell MA	Hallowell MA	118	69' 10"	21' 11"	9'	1 deck, 2 masts, sq. stern	Dorr, Aldrich, Bourne	Dorr	vol. 1-912
1816	*William Gray*	schooner	Bangor MA	Bangor MA	157 10-95	77' 2"	23' 8.5"	10'	1 deck, 2 masts, sq. stern	Snow, Fisher, Bradford Jr., Priest, Fairbanks, Eaton, Stubbs, Lombard, Collins	Dyer, Lombard	vol. 1-915
1815	*William Penn*	brig	Boston MA	Barnstable MA	152 19-95	74' 7"	22' 0.5"	10' 8.5"	1 deck, 2 masts, sq. stern	Haven, Hill	Beck	vol. 1-916
1802	*William Wright*	schooner	New Orleans	Mathews Co. VA	79 79-95	67' 5"	18' 4"	7' 4"	1 deck, 2 masts, sq. stern	Docqueminal, DeMorant, D'Ariza, Lafonta, J. Tricou, P. Tricou jr. Miller	DeMorant, Lagan, Ganon	vol. 1-918
1816	*Wiscasset and Boston Packet*	schooner	Wiscasset MA	New Castle MA	115 21-95	77' 6"	22' 1"	7' 8"	1 deck, 2 masts, sq. stern	Erskine	Nutter	vol. 1-919
1811	*Zephyr*	schooner	Warren RI	Warren RI	133	75' 6"	21' 11"	9' 3"	1 deck, 2 masts, sq. stern, woman head	J. Child, J. Child jr., Gardner,	J. Child jr	vol. 1-924

REFERENCES CITED

Anuskiewicz, R.J., D.A. Ball, and J.A. Irion. 2002. Discovery and Management of a Deepwater Historic Shipwreck in the Gulf of Mexico. In: Proceedings of the Twenty-first Annual Gulf of Mexico Information Transfer Meeting. Kenner, Louisiana. Pp. 77-83.

Anderson, R.C. 1982. The Rigging of Ships in the Days of the Spritsail Topmast: 1600-1720. Centreville: Cornell Maritime Press. (Original edition: 1927. Publisher not listed).

Andrews, K.R. 1978. The Spanish Caribbean. Trade and Plunder 1530-1630. New Haven: Yale University Press.

Biddlecombe, G. 1990. Reprint. The Art of Rigging. New York: Edward W. Sweetman Company. Original edition, Salem, Massachusetts. Marine Research Society, publication no. 8. 1925. (Developed from *The Elements and Practice of Rigging and Seamanship,* by David Steel, London, 1794).

Bingeman, J., J. Bethell, P. Goodwin, and A. Mack. 2000. Copper and Other Sheathing in the Royal Navy. International Journal of Nautical Archaeology 29(2):219-220.

Bryant, W.R., J. Lugo, C. Cordova, and A. Salvador. 1991. Physiography and Bathymetry. In: A. Salvador ed. The Gulf of Mexico Basin. Boulder, Colorado: Geological Society of America Inc. Pp. 13-31.

Bulteel, J. 1672. A Letter written to the Publisher concerning a New Way, by an English manufacture to preserve the Hulls of Ships from the Worm, etc. better for sailing and more cheap and durable than any sheathing or graving hitherto used. Philosophical Transactions 7:6192-6194.

Butts. I.R. 1980. The Merchant's and Mechanic's Assistant. In: Ronnberg, E.A.R.. The Coppering of 19th Century American Merchant Sailing Ships. Nautical Research Journal 26(3):145. (Originally published by I.R. Butts and Company, Boston, 1856).

Chapelle, H.I. 1935. The History of American Sailing Ships. New York: W.W. Norton Company.

Church, A.C. 1938. Whale Ships and Whaling. New York: W.W. Norton.

Cochrane, J.D., and F.J. Kelly. 1986. Low-frequency circulation on the Texas–Louisiana continental shelf. Journal of Geophysical Research 91:645-659.

Collins, W. 1818. Patent Specification for an Improvement in Composition and Preservation for the Manufacturing Thereof into Sheets or Plates. The Repertory of Arts, Manufactures, and Agriculture 32. London: J. Wyatt.

Crothers, W. 1997. The American Built Clipper Ship: 1850-1856. Characteristics, Construction, Details. Camden: International Marine.

Davis, D.D. 1984. Perspectives on Gulf Coast Prehistory. Gainesville: University Press of Florida.

Díaz del Castillo, B. 1955. Historia verdadera de la conquista de la Nueva España. (Original print: 1632). Mexico City: Porrua.

Flick, C. 1973. Muntz Metal and Ship's Bottoms. The Transactions of the Birmingham and Warwickshire Archaeological Society 87:70-88.

Garrison, E.G., C.P. Giammona, F.J . Kelly, A.R. Tripp, and G.A. Wolff. 1989. Historic shipwrecks and magnetic anomalies of the northern Gulf of Mexico: reevaluation of archaeological resource management zone 1. U.S. Dept. of the Interior, Minerals Management. Service, Gulf of Mexico OCS Regional Office, New Orleans, LA. OCS Study MMS 89-0024.

Gore, R.H. 1992. The Gulf of Mexico: A treasury of resources in the American Mediterranean. Sarasota: Pineapple Press.

Gray, J. 1830. Patent Specification for a New and Improved Method of Preparing and Putting on Copper Sheathing for Shipping. Franklin Journal and American Mechanics' Magazine 10:172-173.

Hale, T. 1695. Reprint. Mill'd Lead. London: University of London. London: Advertisement (No Publisher), November 20, 1695.

Hall, H. 1884. Report on the Ship-Building Industry of the United States. Washington, D.C.: Department of the Interior, Census Office. Tenth Census, Volume 8.

Hamilton, D.L. 2004. Online Conservation Research Lab Manual. Internet website: http://nautarch.tamu.edu/napcrl.htm. February 22.

Harris, J.R. 1966. Copper and Shipping in the Eighteenth Century. Economic History Review 19:550-568.

Hawkins, R. 1933. The Observations of Sir Richard Hawkins. In: J. A. Williamson ed. The Observations of Sir Richard Hawkins. London: The Argonaut Press. (Original edition 1622. London: no publisher listed).

Hocker, F. 1989. Lead Hull Sheathing in Antiquity. In: Proceedings of TROPIS 3: Third International Symposium on Ship Construction in Antiquity. Athens: Hellenic Institute for the Preservation of Nautical Tradition. Pp. 197-206.

Hoffman, P.E. 1980. The Spanish crown and the defense of the Caribbean 1535-1585. Baton Rouge: Louisiana State University Press.

Hofmann, E.E., and S.J. Worley. 1986. An investigation of the circulation of the Gulf of Mexico. Journal of Geophysical Research 91:14221-14236.

Honson, C., C. Sylvester, and J. Moorehouse. 1806. Patent Specification for a Method of Sheathing Ships …Not Heretofore Used for Those Purposes. The Repertory of Arts, Manufactures, and Agriculture 9. London: J. Wyatt.

Jones, T.N. 2004. The Mica Shipwreck: Deepwater Nautical Archaeology in the Gulf of Mexico. M.A. Thesis, Texas A&M University, TX. 203 pp.

Knight, R.J.B. 1976. Early Attempts at Lead and Copper Sheathing. Mariner's Mirror 66:292-294.

Laidlaw, F.B. 1952. The History of the Prevention of Fouling. in Marine Fouling and Its Prevention. Annapolis: Naval Institute Press.

MacGregor, D.R. 1982. Schooners in Four Centuries. Annapolis: Naval Institute Press.

MacGregor, D.R. 1997. The Schooner. Annapolis: Naval Institute Press.

Marquardt, K.H. 2003. The Global Schooner. Annapolis: Naval Institute Press.

McGrail, D.W. and M.R. Carnes. 1983. Shelf edge dynamics and the Nepheloid layer. In: Stanley D.J. and G.T. Moore, eds. Shelf Break: critical interface on continental margins. Special Publication 33. Tulsa: Society of Economic Paleontologists and Mineralogists. Pp. 251-264 .

Muntz, G. 1833. Patent Specification for Invention of an Improved Manufacture of Metal Plates, for Sheathing the Bottoms of Ships. Franklin Journal and American Mechanics' Magazine 16:195-6.

Muntz, G.1834 Patent Specification for Improved Manufacture of Bolts, and other, the Like, Ship's Fastenings. Franklin Journal and American Mechanics' Magazine 17:44-5.

No author. 1835. Patent Bronze Sheathing. Franklin Journal and American Mechanics Magazine 18:206-8.

The New Orleans *Bee*/ L'Abeille de la Nouvelle-Orléans. Newspaper. New Orleans, Louisiana.

Pattison, G.S. 1829. Notice of a Patent for Iron Sheathing for Ships. Franklin Journal and American Mechanics' Magazine 8:94-96.

Pearson, C.E. and P.E. Hoffman. 1995. The Last Voyage of El Nuevo Constante. Baton Rouge: Louisiana State University Press.

Petty, W. 1691. The New Invention of Mill'd Lead for Ship Sheathing. London: Published report for the Admiralty.

Piston, W.G. 1988. Maritime Shipbuilding and Related Activities in Louisiana, 1542-1986. Louisiana History 29(2):163-175.

Redard, T.E. 1985. The Port of New Orleans: An Economic History 1821-1860. Dissertation, Louisiana State University.

Rehder, J.B. 1999. Delta Sugar: Louisiana's Vanishing Plantation Landscape. Baltimore: Johns Hopkins University Press.

Revere, J. 1831. Revere's New Alloy for the Sheathing of Ships. Franklin Journal and American Mechanics' Magazine 12:29.

Royal Society of London. 1665/6. An Extract of a Letter, Written from Holland, about Preserving of Ships from Being Worm-eaten. Philosophical Transactions I:190-191.

Salvador, A. 1991. Introduction. In: A. Salvador ed. The Gulf of Mexico Basin. Boulder, Colorado: Geological Society of America Inc. Pp. 1-13.

Ship Registers and Enrollments of New Orleans, Louisiana. Vols. I-IV. Louisiana State University.

Slowey, N.C. and T. J. Crowley. 1995. Interdecadal variability of Northern Hemisphere circulation recorded by Gulf of Mexico corals. Geophysical Research Letters 22(17): 2345-2348.

Staniforth, M. 1985. The Introduction and Use of Copper Sheathing - A History. The Bulletin of the Australian Institute for Maritime Archaeology 9:21-48.

Underhill, H.A. 1952. Deep-Water Sail. Glasgow: Brown, Son and Ferguson.

Uzielli, M. 1831. Patent Specification for the Preparation of Certain Metallic Substances, and the Application Thereof to the Sheathing of Ships. Franklin Journal and American Mechanics' Magazine 12: 137-139.

Weddle, R.S. 1985. Spanish Sea: The Gulf of Mexico in North American discovery, 1500-1685. College Station: Texas A&M University Press.

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

Wetterstadt, C. 1832. Patent Specification for a Composition or Combination of Materials for Sheathing. Franklin Journal and American Mechanics' Magazine 13:411-412.

Whiteman, M. 1971. Copper for America. New Jersey: Rutgers University Press.

Wilkinson, J.J. 1842. On Wood, Lead, and Copper Sheathing. Nautical Magazine and Naval Chronicle 11:400-404.

Winfield, R. 1997. The 50-Gun Ship. London: Caxton Publishing Group.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.