THE LOUISIANA STATE MUSEUM VESSEL: A HISTORICAL AND ARCHAEOLOGICAL ANALYSIS OF AN AMERICAN CIVIL WAR-ERA SUBMERSIBLE BOAT

A Thesis
by
RICHARD KEITH WILLS

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

August 2000

Major Subject: Anthropology
THE LOUISIANA STATE MUSEUM VESSEL: A HISTORICAL AND ARCHAEOLOGICAL ANALYSIS OF AN AMERICAN CIVIL WAR-ERA SUBMERSIBLE BOAT

A Thesis

by

RICHARD KEITH WILLS

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

MASTER OF ARTS

Approved as to style and content by:

Frederick M. Hocker
(Co-Chair of Committee)

Kevin M. Crisman
(Co-Chair of Committee)

John L. Canup
(Member)

David L. Carlson
(Head of Department)

August 2000

Major Subject: Anthropology
ABSTRACT

The Louisiana State Museum Vessel: A Historical and Archaeological Analysis of an
American Civil War-Era Submersible Boat. (August 2000)

Richard Keith Wills, B.A., Evangel College
Co-Chairs of Advisory Committee: Dr. Frederick M. Hocker
Dr. Kevin J. Crisman

During the spring of 1992, and again in the winter of 1993, seven graduate students from Texas A&M University's Nautical Archaeology Program participated in a project to document the Louisiana State Museum Vessel, an American Civil War-era submersible boat presently residing in the collections of the Louisiana State Museum in New Orleans.

The project initially focused on providing archaeological documentation of the boat's design and construction characteristics, and on compiling some basic historical documentation regarding its known past. Since the turn of the century, this vessel has been presumed by many to be the New Orleans-built Confederate privateer Pioneer, which was scuttled at the time of the evacuation of New Orleans by Federal forces, and last reported in very close proximity to where the Louisiana State Museum Vessel was found in 1878. This was the assumption made at the time the documentation project was conducted, and based upon the information available at that time, an argument in support of this identification was published in a subsequent article summarizing the project's findings. Additional research has clearly determined that this vessel is not the Pioneer. Recent research also indicates that efforts to design, fabricate, and employ submersible vessels within the Confederate States were more widespread than conventionally believed. Furthermore, it now appears that the level of Confederate government support enjoyed by these efforts was more substantial than has traditionally been presumed.

The Louisiana State Museum Vessel constitutes the oldest extant example of an important American watercraft tradition. The goals of this thesis are to historically and archaeologically document the Louisiana State Museum Vessel, and, as it cannot presently be identified, to establish likely historical candidates for potential association with it. In this process, the boat is used as a lens through which to view the larger picture of submersible watercraft development efforts undertaken within the Confederacy, and to discuss the collective body of antebellum American experiences and technical knowledge available to the Confederate submersible boat builders. It is also used as a vantage point from which to explore the relationship between Confederate and contemporaneous Federal submersible development efforts, and to acknowledge the common postwar legacy that emerged as a result of these parallel programs.
This research is dedicated to the memory of the five U.S. Navy sailors who perished with their ship, the U.S. Steam Sloop *Housatonic*, during its engagement with the Confederate submersible *H.L. Hunley*:

Ensign Edward C. Hazeltine
Captain's Clerk Charles O. Muzzey
John Williams, Quartermaster
Theodore Parker, Landsman
John Walsh, Second Class Fireman

_He reached down from on high and took hold of me; He drew me out of deep waters._ Psalm 18:16
ACKNOWLEDGEMENTS

First and foremost, I would like to thank the six Texas A&M Nautical Archaeology Program students who dedicated their time and effort toward making the Louisiana State Museum Vessel documentation project a reality: Alan Flanigan, David Robinson, Juan Vera, Elizabeth Baldwin, Greg Cook, and Colin O'Bannon. Additional logistical and technical assistance was provided by Texas A&M Nautical Archaeology Program students John Bratten, Tina Erwin, Pete Hitchcock, Brett Phaneuf, and Mike Scafuri, and Tulane University graduate student Karen Galambos. Program students Joseph "Coz" Cozzi, Brendan McDermott, and James Coggeshall apprised me of relevant historical information on early American submersible experimentation they ran across in their research. Program students Kyra Bowling, Mike Fitzgerald, and Taras Pevny provided timely help in inking maps and drawings. Taras Pevny additionally lent valuable time and efforts in applying his particular genius to calculating the vessel's buoyancy and seaworthiness characteristics; I am indebted more to him than anyone else for helping this research project reach its logical conclusion. Four archaeologists at the U.S. Army Corps of Engineers, Dr. Charles Slawmaker, Dr. Michel K. “Sonny” Trimble, Christopher Pulliam, and Teresa Militello, not only offered technical assistance, but more importantly they also provided me with time and understanding which enabled me to complete this thesis. Dr. Jerome Lynn Hall kindly allowed me to stay in his College Station, Texas home while finalizing this document. And Dr. Helen Dockall of the U.S. Army Central Identification Laboratory-Hawaii provided words of encouragement and ran some timely interference for me at a particularly difficult moment. Thanks for the support, everybody.

The project was made possible by the helpful curatorial staff of the Louisiana State Museum, particularly Tom Czekanski, Deanna Bedigian, Bert Harter, Jim Sefcik, and the late Larry Tanner, who permitted us to study the vessel and provided historical data from their files. Later assistance was thoughtfully provided by the museum's Associate Curator, Greg Lambousy, who apprised me of a most significant resource, the previously unknown David McNeely Stauffer sketchbooks, which were at that time about to go up for estate auction. And to the proprietor of an unnamed hardware store in New Orleans' French Quarter, who gave me a great deal on an industrial extension cord in a moment of need because he assumed I was from the nearby shooting set of Interview with the Vampire, I offer my gratitude, and can only say I was taught never to look a gift horse in the mouth. While residing in the District of Columbia, fate provided me with a housemate and friend in the form of sixth-generation New Orleans native David Laballe III, Esq., to whom I owe thanks for information regarding the history and landmarks of the French Quarter, which he imparted to me during his almost daily backyard barbecues.

I would also like to thank Dr. Robert Neyland of the Naval Historical Center's Underwater Archaeology Branch, and Director of Naval History Dr. William S. Dudley, for giving me advanced opportunities to carry out relevant research, including the chance to participate in the H.L. Hunley identification, documentation, and assessment project. Many of the NHC's staff also have my thanks, especially my fellow Underwater Archaeology Branch colleagues who provided much support: Barbara
Voulgaris, Wilson West, Alexandra Elliott, Lisa Goldberg, Gareth Lewis, and Captain James K. "Otto" Orzech, USNR. Others of the NHIC staff who kindly helped me in my research include Glenn Helm of the Library Branch, Charles Brodine of the Early History Branch, Bernard Cavalcante of the Operational Archives Branch, Sandra J. Doyle of the Office of the Senior Historian, Tim Francis and Kevin Hurst of the Ship History Branch, Dr. Charles Haberlein of the Curatorial Branch's Photographic History Section, and Dr. Edward Furgol, Curator of the Navy Museum. I must especially thank my coffee messmates from the Contemporary History Branch, who imparted much to me regarding the scholarly pursuit and appreciation of naval history, if only through repeated exposure and absorption: Dr. Gary Weir, Dr. Bob Schneller, Bob Cressman, Rick Russell, and Dr. Jeff Barlow. Dr. Kevin Foster of the National Maritime Initiative also provided advice and enthusiasm during our interesting but too infrequent talks. I owe further thanks to the U.S. Naval Academy Museum's Robert F. Sumrall, Curator of Ship Models, and James W. Cheevers, Associate Director and Senior Curator, for their assistance in allowing me to view the submarine model in the museum's collections, and making available to me the extant documentation regarding its provenance. Maxine Turner of the Confederate Naval Historical Society, and Benjamin Trask of The Mariners Museum also provided time and helpful information which contributed to this research.

The people who participated in the H.L. Hunley project were an exceptional source of information and encouragement with whom it was a pleasure to work. I would like to thank: Dr. Dan Lenihan, Larry Murphy, Larry Nordby, Matt Russell, Tim Smith, Dave Conlon, Diane Richardson, and John Brooks, all of the National Park Service's Submerged Cultural Resources Unit; Dr. Bruce Rippeteau, Chris Amer, Dr. Jon Leader, Jim Spirek, Lynn Harris, Joe Beatty, Carl Naylor, and Steve Smith, all of the South Carolina Institute of Archaeology and Anthropology; Dr. Dan Polley of the Naval Facilities Engineering Service Center; John Spruance and Darren Moss of EdgeTech Corporation; Marty and Larry Wilcox of Marine Sonic Technology Limited; Leonard Whitlock of Ocean Engineering Technologies; Peter Hitchcock and Brett Phaneuf of the Institute of Nautical Archaeology; and Paul Tucker of the Department of Natural Resources, who by day expertly piloted the R/V Anita to and from the wreck of the Hunley, and who by night entertained us at the Sand Dollar, where he played bass with the house band Wolfpack. I also offer appreciation to Dr. John R. Brumgardt, Director of the Charleston Museum, for his hospitality during our time there, and Commander Jeffrey J. Tall, RN (Ret.), OBE, Director of the Royal Navy Submarine Museum, for journeying to Charleston to share his experiences in submarine archaeology, and for impressing upon me the significance of the connection between early British and American submersible development, especially as it relates to the recently recovered HM Submarine No. 1 (Holland I). Finally, I am grateful for the hospitality of Harry Pecorelli III, an old friend and the very first archaeologist to "see" the H.L. Hunley, who with his wife, Daralyan, made me feel welcome in their lovely home on Folly Island.

The great American dilettante and scam artist Wilson Mizner once said something to the effect of "if you copy the work of one it's called plagiarism, whereas if you copy the work of many, it's called research." If this is true, then I certainly have a lot of people to thank. I believe that much of the originality in the following work comes not from the uniqueness of the scholarship itself, but rather from
the act of pulling together the many disparate threads of research woven by several generations of historians and researchers, and in synthesizing and building upon this diverse body of knowledge. The scholarly foundation for the study of Confederate submersible vessel development was laid in the early and middle part of this century by scholars such as Simon Lake, William M. Robinson, Jr., and Milton F. Perry. Lake's professional interest in the developmental history of the submersible became a personal one in which he came to seek out and preserve information from surviving Confederate submariners, and to studying the "New Orleans Submarine" in particular. Robinson's wide-ranging scholarship examined the legal issues of the Confederate Patent Office and the rise of privateering (as well as the vessel which is the study of this thesis), while Perry provided a much-needed overview of the Southern submersible experimentation efforts known up to that time as part of his study of Confederate underwater warfare. Their work has been added to with the more recent studies in Confederate naval and technological history by Dr. Alex Roland, Dr. William Still, Jr., Dr. John Coski, Professor Raimondo Luraghi, and astronomer James Kloepell.

Whereas the aforementioned research constitutes the scholarly foundation, several quantum leaps have been made by a dedicated network of historians, researchers, enthusiasts, and advocates that extends back over several generations. In mid-century, important sources of consultable information regarding Confederate submersible construction efforts were compiled by early H.L. Hunley advocates Louis J. Genella of New Orleans; Eustace Williams of Van Nuys, California; and Ruth H. Duncan of Memphis, Tennessee. During this same period, the historian, archivist, and naturalist Stanley Clisby Arthur, Executive Director of the Louisiana State Museum, was documenting the heritage of Louisiana, and New Orleans in particular, and within this context was studying the unusual boat under his care.

More recent research undertaken by a number of individuals has resulted in great increases in our understanding of the Confederate efforts. Sidney Schell of Mobile, Alabama has made a most important contribution in his establishing that Confederate submersible construction efforts were more extensive than generally believed. Frank C. Furman of Rolla, Missouri established a possible means, motive, and timeline for associating the Louisiana State Museum Vessel with the C.S. Navy program at the Tredgar Iron Works. Colonel Lester Hopper, AUS (Ret) of the SubCommittee introduced me to Schell's research, and was correct from the first in vehemently arguing that this boat was not Pioneer. Mark Ragan of Edgewater, Maryland subsequently uncovered, through his dogged, far-ranging research at the National Archives, the long-sought plans of Pioneer, information on the little-known Triton Company, and other data, which he generously shared with me. Texas A&M University Nautical Archaeology Program students Peter Hitchcock and Brett Phaneuf, during a companion study of the U.S. Navy submersible Intelligent Whale, apprised me of the existence of the postwar McClinton material secretly collected by the Royal Navy, which had been, incredibly, sent to the Navy Museum by accident following a request to the Public Records Office for documents relating to the Whale. Charlestonian Charlie V. Peery, M.D. has not only amassed an incredible personal collection of information on Confederate naval and maritime history, but has also provided encouragement through his unforgettable enthusiasm on the subject. Anyone who has
ever had the pleasure of visiting his private museum and library will know what I mean. John A. Friend of Mobile has been a source of similar expression in his love of Mobile Bay-area Civil War maritime history, especially as it relates to the as-yet unlocated *American Diver*. John Hunley of the “Raise the Hunley” Association is another who exhibits such a love of history.

I offer my thanks to Dr. William Piston of Southwest Missouri State University’s History Department, who first fired my interest in the subject of Civil War submersible vessel development, and who encouraged me to attend Texas A&M. In preparation for this, a basic appreciation of the scholarship desired in the study of technological history was forced upon me by the staff of the Smithsonian Institution’s National Museum of American History, Division of Transportation, namely, Dr. Paul Johnston, Dr. John H. White, Jr., William W. Withuhn, John Stine, and Roger B. White.

I would like to offer thanks to my committee, Drs. Fred Hooker, Kevin Crisman, and John Canup, for their good advice and patience over the last nine or so years. They have so tried to beat good sense into me. And I am most grateful to my conscience, confessor, therapist, and physically manifested Thesis Harpy, Liz Baldwin, whom even when our ways diverged for a time, left such a lasting impression that she still managed to incessantly haunt my psyche to attain closure.

And lastly, I would like to thank Bou, for giving me a reason to finish, and my family, for everything.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABSTRACT</strong></td>
<td>iii</td>
</tr>
<tr>
<td><strong>DEDICATION</strong></td>
<td>iv</td>
</tr>
<tr>
<td><strong>ACKNOWLEDGEMENTS</strong></td>
<td>v</td>
</tr>
<tr>
<td><strong>TABLE OF CONTENTS</strong></td>
<td>ix</td>
</tr>
<tr>
<td><strong>LIST OF FIGURES</strong></td>
<td>xi</td>
</tr>
<tr>
<td><strong>SHORT TITLE KEY TO ABBREVIATIONS</strong></td>
<td>xvi</td>
</tr>
<tr>
<td><strong>CHAPTER</strong></td>
<td></td>
</tr>
<tr>
<td><strong>I</strong> INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td><strong>II</strong> PRELUDE: ANTEBELLUM AMERICAN SUBMERSIBLE VESSEL DEVELOPMENT EFFORTS</td>
<td>4</td>
</tr>
<tr>
<td>The War for Independence</td>
<td>4</td>
</tr>
<tr>
<td>The Napoleonic Wars</td>
<td>7</td>
</tr>
<tr>
<td>The War of 1812</td>
<td>10</td>
</tr>
<tr>
<td>Efforts Undertaken between 1815 and 1861</td>
<td>13</td>
</tr>
<tr>
<td>Summary: American Submersible Vessel Technology on the Eve of the Southern Secession</td>
<td>26</td>
</tr>
<tr>
<td><strong>III</strong> AN OVERVIEW OF SUBMERSIBLE VESSEL DEVELOPMENT EFFORTS WITHIN THE CONFEDERACY</td>
<td>30</td>
</tr>
<tr>
<td>The Place of the Submersible within Confederate Military and Naval Strategy</td>
<td>30</td>
</tr>
<tr>
<td>Submersible Vessel Patents</td>
<td>32</td>
</tr>
<tr>
<td>Smith’s Design</td>
<td>34</td>
</tr>
<tr>
<td>Winans’ Experimental Hull</td>
<td>37</td>
</tr>
<tr>
<td>Leavitt’s Design</td>
<td>39</td>
</tr>
<tr>
<td>The C.S. Navy Program at the Tredegar Iron Works</td>
<td>40</td>
</tr>
<tr>
<td>McClintock’s Coalition and Boats in New Orleans, Mobile, and Charleston</td>
<td>48</td>
</tr>
<tr>
<td>Halligan’s Boat at the Selma Naval Gun Foundry and in Mobile</td>
<td>79</td>
</tr>
<tr>
<td>Other Efforts in Mobile, Real and Imagined</td>
<td>81</td>
</tr>
<tr>
<td>The Triton Company in Richmond and the Trans-Mississippi</td>
<td>83</td>
</tr>
<tr>
<td>Summary</td>
<td>88</td>
</tr>
<tr>
<td><strong>IV</strong> A HISTORY OF THE LOUISIANA STATE MUSEUM VESSEL FROM 1878 TO PRESENT</td>
<td>91</td>
</tr>
<tr>
<td><strong>V</strong> AN ARCHEOLOGICAL ANALYSIS OF THE LOUISIANA STATE MUSEUM VESSEL</td>
<td></td>
</tr>
<tr>
<td>The Documentation Project</td>
<td>108</td>
</tr>
<tr>
<td>Design and Performance Characteristics</td>
<td>109</td>
</tr>
<tr>
<td>Hull Construction</td>
<td>118</td>
</tr>
<tr>
<td>Systems Configuration</td>
<td>138</td>
</tr>
<tr>
<td>CHAPTER</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Analysis</td>
<td>167</td>
</tr>
<tr>
<td>VI A COMPARISON OF THE LOUISIANA STATE MUSEUM VESSEL WITH KNOWN</td>
<td></td>
</tr>
<tr>
<td>CONFEDERATE EFFORTS</td>
<td>170</td>
</tr>
<tr>
<td>VII CONCLUSIONS</td>
<td>185</td>
</tr>
<tr>
<td>Physical Characteristics of the Louisiana State Museum Vessel</td>
<td>185</td>
</tr>
<tr>
<td>Potential Sources of Design Influence</td>
<td>185</td>
</tr>
<tr>
<td>Identity and Significance of the Louisiana State Museum Vessel</td>
<td>186</td>
</tr>
<tr>
<td>The Larger Context of Confederate Submersible Vessel Development</td>
<td>189</td>
</tr>
<tr>
<td>The Confederate and Federal Development Efforts in Perspective</td>
<td>193</td>
</tr>
<tr>
<td>The Postwar Legacy of the Civil War Submersibles</td>
<td>198</td>
</tr>
<tr>
<td>REFERENCES CITED</td>
<td>203</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>218</td>
</tr>
<tr>
<td>VITA</td>
<td>219</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>David Bushnell’s <em>Turtle</em></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Robert Fulton’s <em>Nautilus</em></td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>One of two extant watercolor sketches of the New London submarine that ran aground on Long Island in 1814. These sketches were made by Lieutenant John Bowen of the Royal Marines, the man who led the landing party that destroyed the boat.</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Samuel Colt’s undated (circa 1842) sketch of a boat attributed to Silas Halsey and “lost in New London Harbor in an effort to blow up a British 74 in 1814.”</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Alexandre Lambert’s submersible working vessel, constructed in New York circa 1851</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>Drawing of the Submarine Exploring Company’s circa 1851 vessel. The vessel reportedly had no propeller, contrary to what is depicted in this print</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>Lodner Phillips’ second vessel, the so-called <em>Fool Killer</em>, built circa 1845-1850, lost in Lake Erie, and recovered in 1916</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>Phillips’ third vessel, the <em>Marine Cigar</em>, built in 1851 and lost in Lake Erie in 1853 during depth tests</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>Phillips’ 1852 patent for a rudderless submersible vessel steered by a movable propeller shaft mounted through a universal joint</td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td>Phillips’ last submersible design, not known to have been constructed</td>
<td>24</td>
</tr>
<tr>
<td>11</td>
<td>Brutus de Villeroi’s vessel for salvaging treasure from HMS <em>De Braak</em>, as it appeared in <em>Frank Leslie’s Illustrated News</em> on 25 May 1861</td>
<td>27</td>
</tr>
<tr>
<td>12</td>
<td>Map of the Confederate States of America showing known areas of submersible development or operation</td>
<td>31</td>
</tr>
<tr>
<td>13</td>
<td>The unidentified iron model (side view) of a double-ended submersible vessel in the collections of the U.S. Naval Academy Museum</td>
<td>35</td>
</tr>
<tr>
<td>14</td>
<td>A top view of the same model. The uphauling and downhauling screws are visible through the tubular housings located on either side of the hatch</td>
<td>35</td>
</tr>
<tr>
<td>15</td>
<td>A bottom view of the same model. The uphauling and downhauling screws are visible through the tubular housings visible in the boat’s bottom</td>
<td>36</td>
</tr>
<tr>
<td>16</td>
<td>A view of the model with the two portions separated. Note the hand-operated crankshafts, and the deck-mounted gun on the right (the left is missing from the model).</td>
<td>36</td>
</tr>
<tr>
<td>17</td>
<td>A photograph of the Winans’ steam vessel, taken shortly before its launching</td>
<td>38</td>
</tr>
<tr>
<td>FIGURE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Sketch by Acting Master W.G. Cheeney, CSN, dated September 1861, of a proposed propeller design probably intended for use with one of the Tredegar submersibles.</td>
<td>41</td>
</tr>
<tr>
<td>19</td>
<td>The <em>Harper's Illustrated Weekly</em> sketch of the submersible reportedly operating at the mouth of the James River, and which may have attempted to destroy the USS <em>Minnesota</em> on 9 October 1861.</td>
<td>46</td>
</tr>
<tr>
<td>20</td>
<td>Drawing of the “Rebel Submarine Ram” <em>Pioneer</em>, made by Assistant Engineers G.W. Baird, USN and Alfred Colina, USN during the Federal occupation of New Orleans.</td>
<td>51</td>
</tr>
<tr>
<td>21</td>
<td>A page from the sketchbook of Ensign David McNeely Stauffer, USN, displaying a drawing of the “Rebel Torpedo Boat Taken from the bottom of the New Basin, N.O.” dated “March 5, 1865.”</td>
<td>52</td>
</tr>
<tr>
<td>22</td>
<td>Sheer view of James McClintock’s described submersible design as recorded in 1872 by Royal Navy interviewers aboard HMS <em>Royal Alfred</em>.</td>
<td>55</td>
</tr>
<tr>
<td>23</td>
<td>Top view of McClintock’s described submersible design as recorded in 1872 by Royal Navy interviewers.</td>
<td>56</td>
</tr>
<tr>
<td>24</td>
<td>Interior profile of McClintock’s described submersible design as recorded in 1872 by Royal Navy interviewers.</td>
<td>57</td>
</tr>
<tr>
<td>25</td>
<td>Commander G.W. Baird’s sketch of a submersible vessel, most likely <em>American Diver</em>, which he made following the war in the presence of McClintock, and based upon McClintock’s verbal description.</td>
<td>58</td>
</tr>
<tr>
<td>26</td>
<td>William Alexander’s postwar sketches of the <em>H.L. Hunley</em>.</td>
<td>61</td>
</tr>
<tr>
<td>27</td>
<td>Conrad Wise Chapman’s oil portrait of <em>H.L. Hunley</em>, painted at Charleston in December 1863, shortly after its second salvage.</td>
<td>65</td>
</tr>
<tr>
<td>28</td>
<td>Diagram of the wreck of the <em>H.L. Hunley</em> based upon documentation collected during the 1996 assessment survey by NPS-SCRU, NHC-UA, and SCIAA archaeologists.</td>
<td>75</td>
</tr>
<tr>
<td>29</td>
<td>An illustration that appeared in <em>Harper's Illustrated Weekly</em> depicting the St. Patrick’s 26 January 1865 attack on the USS <em>Octorara</em>, and the astute reaction of one of the <em>Octorara</em>’s crew.</td>
<td>80</td>
</tr>
<tr>
<td>30</td>
<td>A U.S. Navy sailor’s sketch of a Confederate vessel run aground in Mobile Bay and captured in August 1864.</td>
<td>82</td>
</tr>
<tr>
<td>31</td>
<td>The unconfirmed <em>American Ram</em> attributed to “Alstitt” or “Anstilt.”</td>
<td>84</td>
</tr>
<tr>
<td>32</td>
<td>Pesce’s later redrawing of the so-called <em>American Ram</em>’s longitudinal cross-section.</td>
<td>85</td>
</tr>
<tr>
<td>33</td>
<td>Document found by Federal forces in a captured Confederate mail shipment. It contains the design of a Triton Company submarine boat designed by C. Williams and intended to operate in Trans-Mississippi Department waters.</td>
<td>87</td>
</tr>
<tr>
<td>34</td>
<td>Late-19th century view of the Louisiana State Museum Vessel, probably made by Georges Francois Mugnier.</td>
<td>92</td>
</tr>
<tr>
<td>FIGURE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>35</td>
<td>Late-19th century view of the Louisiana State Museum Vessel, probably made by Mugnier.</td>
<td>92</td>
</tr>
<tr>
<td>36</td>
<td>Another late-19th century view of the Louisiana State Museum Vessel, possibly also made by Mugnier.</td>
<td>93</td>
</tr>
<tr>
<td>37</td>
<td>Turn-of-the-century view of the Louisiana State Museum Vessel.</td>
<td>93</td>
</tr>
<tr>
<td>38</td>
<td>Poor quality 1909 image of the vessel at the time of its being dedicated at the Soldiers’ Home on Bayou St. John.</td>
<td>95</td>
</tr>
<tr>
<td>39</td>
<td>Poor quality image of the vessel, circa 1914.</td>
<td>96</td>
</tr>
<tr>
<td>40</td>
<td>Photographs of the Louisiana State Museum Vessel taken in 1926 by William M. Robinson, Jr.</td>
<td>98</td>
</tr>
<tr>
<td>41</td>
<td>Photograph of the Louisiana State Museum Vessel, probably taken in the 1930s.</td>
<td>99</td>
</tr>
<tr>
<td>42</td>
<td>Photograph of the Louisiana State Museum Vessel, circa the Second World War (from Burgess 1975:50).</td>
<td>100</td>
</tr>
<tr>
<td>43</td>
<td>Photograph of the Louisiana State Museum Vessel, circa the Second World War (from Barnes 1946:12).</td>
<td>101</td>
</tr>
<tr>
<td>44</td>
<td>Photograph of the Louisiana State Museum Vessel, circa the Second World War (from Arthur 1942:4).</td>
<td>102</td>
</tr>
<tr>
<td>45</td>
<td>Photograph of the Louisiana State Museum Vessel being moved from Jackson Square to the Louisiana State Museum’s Pontalba Building on St. Ann Street.</td>
<td>103</td>
</tr>
<tr>
<td>46</td>
<td>The Louisiana State Museum Vessel on display at the Pontalba Building on St. Ann Street.</td>
<td>104</td>
</tr>
<tr>
<td>47</td>
<td>The Louisiana State Museum Vessel being moved to the Arcade of the Presbytere.</td>
<td>104</td>
</tr>
<tr>
<td>48</td>
<td>The Louisiana State Museum Vessel today.</td>
<td>105</td>
</tr>
<tr>
<td>49</td>
<td>Map of New Orleans showing the past locations of both Pioneer and the Louisiana State Museum Vessel.</td>
<td>106</td>
</tr>
<tr>
<td>50</td>
<td>Lines plan of the Louisiana State Museum Vessel, drawn based upon documentation gathered during the 1992 recording project. The boat’s port side is represented in sheer, mid-body breadth, and section views, as well as upper and lower hull diagonals. The dashed lines indicate the locations of external plate seams, while the dotted lines represent the keel’s projected original form before it suffered deformation.</td>
<td>111</td>
</tr>
<tr>
<td>51</td>
<td>External construction plan of the Louisiana State Museum Vessel, showing port and starboard side profiles, topside and bottom plan views, and bow and stern end views. Components that are now missing but which may be reconstructed from early photographs of the boat are represented by dashed lines.</td>
<td>119</td>
</tr>
<tr>
<td>FIGURE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Internal construction plan of the Louisiana State Museum Vessel, showing views in longitudinal interior profile (revealing the starboard side), longitudinal top and bottom interior plan views, and transverse section views at the locations of key features. Components that are now missing but which may be reconstructed from early photographs of the boat are represented by dashed lines.</td>
<td>120</td>
</tr>
<tr>
<td>53</td>
<td>Simplified diagram of the Louisiana State Museum Vessel's port and starboard sides, showing the reference designations assigned to each hull plate during recording.</td>
<td>121</td>
</tr>
<tr>
<td>54</td>
<td>Detail of the keel form and construction.</td>
<td>124</td>
</tr>
<tr>
<td>55</td>
<td>Detail of the external lower starboard hull showing the keel, hull plating, and fastener arrangement, as well as the deteriorated condition and attempted consolidation of the garboard strake.</td>
<td>125</td>
</tr>
<tr>
<td>56</td>
<td>Detail of internal plating lap seams and fastener arrangement.</td>
<td>125</td>
</tr>
<tr>
<td>57</td>
<td>Detail of the external hatchway construction.</td>
<td>128</td>
</tr>
<tr>
<td>58</td>
<td>Detail of the internal hatchway construction.</td>
<td>129</td>
</tr>
<tr>
<td>59</td>
<td>Detail of the hatch hinges.</td>
<td>129</td>
</tr>
<tr>
<td>60</td>
<td>Detail of the external construction of the bow end piece and socket.</td>
<td>131</td>
</tr>
<tr>
<td>61</td>
<td>Detail of the internal construction of the bow end piece and socket.</td>
<td>132</td>
</tr>
<tr>
<td>62</td>
<td>Detail of the stern end piece.</td>
<td>132</td>
</tr>
<tr>
<td>63</td>
<td>Detail of the forward external eye.</td>
<td>135</td>
</tr>
<tr>
<td>64</td>
<td>Detail of the aft external eye.</td>
<td>136</td>
</tr>
<tr>
<td>65</td>
<td>Internal detail of the through-bolts securing the forward external eye.</td>
<td>137</td>
</tr>
<tr>
<td>66</td>
<td>Internal detail of the gear wheel and drive shaft forward bearing.</td>
<td>139</td>
</tr>
<tr>
<td>67</td>
<td>External detail of the drive shaft stuffing box, drive shaft, propeller hub, and boss nut.</td>
<td>139</td>
</tr>
<tr>
<td>68</td>
<td>External side view of the drive shaft stuffing box, drive shaft, propeller hub, and boss nut.</td>
<td>141</td>
</tr>
<tr>
<td>69</td>
<td>Detail of the disassociated component found within the vessel.</td>
<td>141</td>
</tr>
<tr>
<td>70</td>
<td>Detail of the forward rudder steering mechanism.</td>
<td>144</td>
</tr>
<tr>
<td>71</td>
<td>Detail of the forward rudder shaft's stuffing box external cover.</td>
<td>144</td>
</tr>
<tr>
<td>72</td>
<td>Detail of the aft rudder steering mechanism.</td>
<td>145</td>
</tr>
<tr>
<td>73</td>
<td>Detail of the aft rudder shaft's stuffing box external cover.</td>
<td>145</td>
</tr>
<tr>
<td>FIGURE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>74</td>
<td>Detail of the pilot’s dive plane control mechanism</td>
<td>150</td>
</tr>
<tr>
<td>75</td>
<td>Detail of the damaged starboard dive plane</td>
<td>150</td>
</tr>
<tr>
<td>76</td>
<td>External detail of the port dive plane’s stuffing box through-bolts and surviving shaft component</td>
<td>151</td>
</tr>
<tr>
<td>77</td>
<td>Internal detail of the brass pipe fitting in the starboard side</td>
<td>154</td>
</tr>
<tr>
<td>78</td>
<td>External detail of the brass pipe fitting in the starboard side (at center of picture).</td>
<td>154</td>
</tr>
<tr>
<td>79</td>
<td>Detail of the unidentified item visible through the deteriorated bottom hull plating.</td>
<td>155</td>
</tr>
<tr>
<td>80</td>
<td>Detail of the external stack structure.</td>
<td>157</td>
</tr>
<tr>
<td>81</td>
<td>Internal view of the threaded collar beneath the stack structure, also showing the partially covered evidence of the unidentified features located forward and aft of the stack.</td>
<td>158</td>
</tr>
<tr>
<td>82</td>
<td>Detail of the upper deck showing the unidentified features located forward and aft of the stack structure.</td>
<td>158</td>
</tr>
<tr>
<td>83</td>
<td>Detail of the two overhead brackets possibly relating to an air replenishment system.</td>
<td>159</td>
</tr>
<tr>
<td>84</td>
<td>Detail of the pilot’s starboard thwart bracket, looking forward.</td>
<td>163</td>
</tr>
<tr>
<td>85</td>
<td>Detail of the pilot’s port thwart bracket, looking aft.</td>
<td>163</td>
</tr>
<tr>
<td>86</td>
<td>Detail of the support member for the cranksman’s bench, in foreground.</td>
<td>164</td>
</tr>
<tr>
<td>87</td>
<td>Edward Willis’ sketch of “Hunley’s Fish Fin Torpedo Boat” giving the dimensions of the Louisiana State Museum Vessel.</td>
<td>173</td>
</tr>
<tr>
<td>88</td>
<td>Drawing of the ironclad steam ram CSS Manassas (ex-Enoch Train), which appears similar to the Louisiana State Museum Vessel in its construction above the waterline.</td>
<td>176</td>
</tr>
<tr>
<td>89</td>
<td>W.E. Newton’s design (in internal profile view) for a submersible salvage vessel, which he developed between the years 1838 and 1858.</td>
<td>181</td>
</tr>
<tr>
<td>90</td>
<td>A representation of Newton’s proposed vessel being used in a working environment.</td>
<td>182</td>
</tr>
<tr>
<td>91</td>
<td>Simon Lake’s Argoaut under construction at the Columbia Iron Works and Dry Dock Company in Baltimore, Maryland, shortly before its launching in August 1897.</td>
<td>200</td>
</tr>
<tr>
<td>92</td>
<td>USS Holland (SS-1) in drydock, circa 1900.</td>
<td>201</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Adm.</td>
<td>PRO Admiralty Office Series</td>
<td></td>
</tr>
<tr>
<td>BuC&amp;R</td>
<td>U.S. Navy Bureau of Construction and Repair</td>
<td></td>
</tr>
<tr>
<td>BuOrd</td>
<td>U.S. Navy Bureau of Ordnance</td>
<td></td>
</tr>
<tr>
<td>CHS</td>
<td>Connecticut Historical Society</td>
<td></td>
</tr>
<tr>
<td>CV</td>
<td>Confederate Veteran Magazine</td>
<td></td>
</tr>
<tr>
<td>CWNC</td>
<td>Civil War Naval Chronology, 1861-1865</td>
<td></td>
</tr>
<tr>
<td>DANFS</td>
<td>Dictionary of American Naval Fighting Ships</td>
<td></td>
</tr>
<tr>
<td>DON</td>
<td>Department of the Navy</td>
<td></td>
</tr>
<tr>
<td>JC</td>
<td>Journal of the Congress of the Confederate States of America</td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>Library of Congress</td>
<td></td>
</tr>
<tr>
<td>LSM</td>
<td>Louisiana State Museum</td>
<td></td>
</tr>
<tr>
<td>MHS</td>
<td>Maryland Historical Society</td>
<td></td>
</tr>
<tr>
<td>NARA</td>
<td>National Archives and Records Administration</td>
<td></td>
</tr>
<tr>
<td>NAVDOCS</td>
<td>Naval Documents of the American Revolution</td>
<td></td>
</tr>
<tr>
<td>NHC</td>
<td>Naval Historical Center</td>
<td></td>
</tr>
<tr>
<td>NPS-SCRU</td>
<td>National Park Service, Submerged Cultural Resources Unit</td>
<td></td>
</tr>
<tr>
<td>NUMA</td>
<td>National Underwater and Marine Agency Foundation</td>
<td></td>
</tr>
<tr>
<td>ORA</td>
<td>War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies</td>
<td></td>
</tr>
<tr>
<td>ORN</td>
<td>Official Records of the Union and Confederate Navies in the War of the Rebellion</td>
<td></td>
</tr>
<tr>
<td>RG</td>
<td>NARA Record Group</td>
<td></td>
</tr>
<tr>
<td>SCIAA</td>
<td>South Carolina Institute of Archaeology and Anthropology</td>
<td></td>
</tr>
<tr>
<td>SHSP</td>
<td>Southern Historical Society Papers</td>
<td></td>
</tr>
<tr>
<td>SFLM</td>
<td>Submarine Force Library and Museum</td>
<td></td>
</tr>
<tr>
<td>UCV</td>
<td>United Confederate Veterans</td>
<td></td>
</tr>
<tr>
<td>USNA</td>
<td>U.S. Naval Academy</td>
<td></td>
</tr>
<tr>
<td>USNIP</td>
<td>U.S. Naval Institute Proceedings</td>
<td></td>
</tr>
<tr>
<td>VHS</td>
<td>Virginia Historical Society</td>
<td></td>
</tr>
<tr>
<td>VSL</td>
<td>Virginia State Library</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

In July 1878, a dredging vessel encountered the wreck of a small iron submersible boat on the bottom of Lake Ponchartrain, north of New Orleans, Louisiana. The wreck was rigged for lifting and moved onto the nearby southern shoreline of the lake. After lying derelict in the mud of the shore for nearly two decades, it began a nomadic journey around the city that saw it variously serving as an amusement park display, a patriotic monument to the Confederate cause, and both an out-of-doors and sheltered public museum exhibit. It is presently on display at the Louisiana State Museum in New Orleans’ historic French Quarter.

The Louisiana State Museum Vessel’s identity, origins, and early history are a mystery. It has traditionally been presumed, beginning at the turn of the century, that this craft is the Confederate privateer submersible Pioneer, which was historically known to have been built in New Orleans and scuttled during the invasion of that city by Federal forces in 1862. This association is due to the very close proximity of the vessel’s recovery site (the southern edge of Lake Ponchartrain in the area between the mouths of the New Canal and Bayou St. John) with the area in which Pioneer is historically recorded as being lost (in the New Basin). In recent years several alternative theories of identity have been put forth, all of which argue that the Louisiana State Museum Vessel represents a boat other than Pioneer. The issue of identity has been clouded by a combination of poor scholarship, inaccurate folklore, the vessel’s nomadic nature, and a basic lack of documentation regarding not only the vessel but also the broader topic of Confederate submersible vessel development efforts. The only conclusion that can be drawn with some level of probability is that the Louisiana State Museum Vessel likely constitutes one of the many innovational warfare efforts undertaken within the Confederate States in the early years of the Civil War. In temporal terms, because its construction was probably motivated by the war, it was likely built no earlier than 1861. As it was found in Lake Ponchartrain, it was probably lost there either before or during the evacuation and fall of New Orleans in late April 1862. More than likely it was scuttled to prevent its capture, or any acquisition of knowledge by the enemy concerning such efforts. This is known to have been the case with the nearby Pioneer, as well as with other military hardware.

This vessel requires a critical historical and archaeological analysis. Such an analysis is the subject of this thesis. The significance of this small craft has often been overlooked and it has instead been regarded as merely a Civil War curiosity. The truth is that it is one of the earliest known examples,

This thesis follows the style and format of American Antiquity.
and probably the oldest extant American example, of an important watercraft tradition. Furthermore, it may constitute the second-oldest known example in the world (second only to Wilhelm Bauer’s Brandtaucher). It possesses technological significance not only in general terms as a vessel type, but also as representative of a particular mode of warfare. It also possesses historical significance for its probable association with the Civil War, and particularly in the area of Confederate naval weapons development for underwater warfare applications. Finally, it possesses archaeological significance in its value as a comparative tool for evaluating parallel archaeological vessel examples. An analysis of this vessel is especially timely in light of archaeological research presently being conducted on the other two known extant Civil War era submersible boats, H.L. Hunley and the Intelligent Whale, as well as recent efforts to relocate American Diver and Alligator. Other comparable vessels include surviving postwar American submarines presently housed in museums, and recently relocated wreck sites. In the United States, such resources include two vessels presently residing at the Paterson Museum in New Jersey: the Holland No. 1, built and scuttled in 1878 and recovered half a century later, and the Fenian Ram, built in 1881. They also include the recently discovered wrecks of the tragic operational losses USS F-1 (SS-20), built in 1912 and lost in 1914, and USS O-9 (SS-70), built in 1918 and lost in 1941. Internationally, there exist vessels of similar importance. In Great Britain, these include the wreck site of the Resurgam, built 1879, lost in 1880, and relocated in 1995, and the recovered wreck of HM Submarine No. 1 (also known as Holland I), built in 1901, lost in 1913, and recovered in 1982. In Germany, they include the curated vessels Brandtaucher, lost in 1851 and recovered in 1887, and the U-1, built in 1906.

For the most part, the scope of this thesis will be limited to discussing this boat in terms of submersible vessel development, only touching upon the parallel concepts of weapon systems development, tactical and strategic employment of such vessels, and the larger picture of underwater warfare into which such vessels were integrated. While all of these topics deserve extensive treatment, such treatment is not within the parameters of the archaeological and historical analysis of this vessel, except only to place it in the larger context of such efforts in order to enable a broader understanding.

This thesis has five objectives. Each is the focus of a chapter, and will be presented in the following order:

The first objective is to establish an accurate historical picture of antebellum submersible vessel development efforts possessing American connections. This is necessary in order to provide a basic understanding regarding the collective body of knowledge that was available be drawn upon at the beginning of the Civil War.

The second objective is to establish, through the identification, analysis, and synthesis of pertinent historical sources, the true extent of submersible vessel development efforts undertaken within
the Southern Confederacy. Each known effort will be examined in order to identify candidates for potential association with the Louisiana State Museum Vessel, or to eliminate such candidates.

The third objective is to reconstruct the history of the Louisiana State Museum Vessel to as great an extent as possible by identifying, surveying, and synthesizing the scatter of historical documentation (both written and visual) that has been generated since the vessel’s discovery in 1878. In the process of doing this, the thesis seeks to identify and dispose of any perpetuated inaccuracies that have clouded the issue of the boat’s identity over the years.

The fourth objective is to archaeologically document, reconstruct (on paper), and offer reasonable interpretation regarding the design, construction, and configuration of the Louisiana State Museum Vessel.

The fifth objective is to compare the Louisiana State Museum Vessel with all known Confederate submersible vessels of historical record. The goal of this is to link the boat with a known effort or efforts if enough information justifies such an association. Consideration will be given to similarities and differences in basic design and structural characteristics, common sources of design influence, and geographical factors.

Following the summation of the analytical findings regarding the boat, it will be placed within its appropriate historic context relative to the larger picture of the submersible vessel development programs initiated within the Southern Confederacy, the efforts of both the Confederate and Federal military establishments in relation to one another, and the postwar legacy that grew out of them.

The first objective is addressed in Chapter II, entitled “Prelude: Antebellum American Submersible Vessel Development.” The second objective is addressed in Chapter III, entitled “An Overview of Submersible Vessel Development Efforts within the Confederacy.” The third objective is accomplished in Chapter IV, entitled “The History of the Louisiana State Museum Vessel from 1878 to Present.” The fourth objective is accomplished in Chapter V, entitled “An Archaeological Analysis of the Louisiana State Museum Vessel.” The fifth objective is accomplished in Chapter VI, entitled “A Comparison of the Louisiana State Museum Vessel with Known Confederate Efforts.” The findings are summarized in Chapter VII, simply entitled “Conclusions.”
CHAPTER II

PRELUDE:
ANTEBELLUM AMERICAN SUBMERSIBLE VESSEL DEVELOPMENT EFFORTS

THE WAR FOR INDEPENDENCE

The first documented American submersible vessel was a product of the War for Independence. Named the Turtle (Figure 1), it was built in 1775 at Saybrook, Connecticut under the direction of David Bushnell, who had envisioned its design as early as 1771. He was assisted in this endeavor by his brother, Ezra Bushnell. The war spurred the proposal of other efforts as well, such as one by Joseph Belton of Groton, Connecticut who in 1774 designed a submersible vessel for defensive purposes and presented the plan to the Pennsylvania Committee of Safety, but this boat was never constructed. The Turtle is the only one known to have proceeded past the design stage.

The project benefited from the sponsorship of the Connecticut Council of Safety, and enjoyed the official support of no less a military authority than General George Washington of the Continental Army. Washington later described Bushnell as “a man of great Mechanical powers – fertile of invention – and a master in execution,” and acknowledged the military resources he provided to the project in his recollection that Bushnell “wanted nothing that I could furnish to secure the success of it” (NAVDOCS 6:1500). With such excellent support, Bushnell was able to contract out production of some of the more intricate mechanisms, such as the water pumps and the clockwork mine fuzes, to local mechanics from the Saybrook area.

The Turtle measured seven feet in length, and five and a half feet in depth. Its hull was made of strong oak timbers six inches in thickness, and was firmly braced by a cross frame comprising the operator’s seat. The hull timbers were caulked and tarred to prevent leakage. On the hull’s top center was mounted a metal manhead (or “crown”), which could be securely dogged down from inside by three thumbscrews. One of its pilots, Sergeant Ezra Lee of the Continental Army, later described the boat’s shape as being “like a round clam, but longer, and set up on its square side” (NAVDOCS 6:1508). The craft’s controls were configured so that the pilot was required to row with one hand and oar with the other. Interior compass illumination was provided by foxfire, a phosphorescent wood occurring in nature. A glass pressure gauge indicated the depth of the vessel beneath the surface. The boat’s buoyancy was controlled using a foot-activated spring valve to regulate the amount of water allowed to enter through the bottom of the hull. The boat did not possess an enclosed ballast tank, as is usually assumed, but rather the water flowed directly into the cabin. To expel this ballast, the small craft possessed two brass force
pumps, one within reach of each hand. All valves open to the sea were equipped with strainers to protect them against clogging, and all of the brass plumbing was carefully machined and fitted. All movable components were kept well oiled. The boat could retain a thirty minute supply of air before surface ventilation was required, and also employed a snorkel system in the form of two air pipes. These were equipped with one-way valves designed to prevent water from entering when submerged, but to automatically open for air intake and exhaust upon the vessel’s reaching the surface. A ventilator mechanism drew air in through one of the air pipes and directed it to the bottom of the vessel, operating on the theory that the impure air would be lighter and therefore expelled through the other air pipe. The craft’s weapon was an externally carried charge possessing a clockwork fuse that could be set for a delayed detonation of up to 12 hours. It was intended to be fastened to the enemy bottom using a jettisonable woodscrew that was externally secured to the hull (Bushnell 1799, NAVDOCS 6:1499-1511, Roland 1977:171, Roland 1978:62-88).

Often overlooked is the fact that the Turtle was probably the first vessel to employ screw propulsion as a means of motive power, using what Sergeant Lee described as “an oar...formed upon the principle of the screw” (Abbot 1881-1882:44, NAVDOCS 6:1503). Lee later elaborated on this method of propulsion, recording that “it had two oars, of about 12 inches in length, &4 or 5 in width, shaped like the arms of a windmill...with hard labour, the machine might be impelled at the rate of 3 nts an hour for a short time” (NAVDOCS 6:1508). The propulsors were akin to a traditional propeller with pitched blades, not an archimedian screw as is usually depicted in later illustrations (Roland 1977:171).

On 6 September 1776, Bushnell’s boat was used to mount an unsuccessful attack in New York Harbor against either HMS Eagle (flagship of Vice Admiral Richard Lord Howe, RN) or HMS Asia. The record is unclear as to which vessel was the target, except that it was probably a 50 gun ship lying off Governor’s Island. Turtle was piloted on this occasion by Sergeant Lee (Johnston 1893). A second attack was subsequently mounted on 5 October against HMS Phoenix, this time with the boat being piloted by Phineas Pratt, Sr., who had fabricated the clockwork mechanisms for the explosive devices (CHS, Source Materials Relating to David Bushnell, MS 65910; Grant 1976:11fn, 28-29). In both of these engagement attempts, attachment of the explosive charge to the enemy bottoms could not be executed successfully, and the submersible craft returned without effect (NAVDOCS 1:542, 1089; 2:1050, 1099-1100; 3:1101, 1111).

Following the lack of success in these attempts, and hampered by a falling off of support, Bushnell abandoned the Turtle and his submersible vessel development efforts. After being captured and paroled by British forces, Bushnell was appointed an officer in the newly created Army Engineer Corps, and his attentions turned to underwater and subterranean explosives.
THE NAPOLEONIC WARS

Shortly after the War for Independence, the ideas advocated by Bushnell were embraced by
Robert Fulton. Fulton, it must be remembered, was first and foremost a proponent and scholar of
underwater warfare. He was no doubt strongly influenced by the work of Bushnell, and indeed a line of
connection has been established between them through the author and statesman Joel Barlow. Barlow was
a classmate of Bushnell’s at Yale during the time Bushnell was carrying out his early underwater
experiments there, and subsequently became Fulton’s mentor and most valued patron, among other
things. Bushnell and Barlow are also known to have possessed several mutual acquaintances (Hutcheon

With Barlow’s financial support, and operating under the guise of his newly formed Nautilus
Company, in 1797 Fulton proposed a submersible vessel design to France’s Ministry of Marine. This
solicitation was met with approval, and construction of the craft was undertaken in 1799-1800 at the
Periers’ workshops on the Seine. The resulting vessel was named Nautilus (Figure 2). It measured 6.48
meters (21 feet, 3 inches) in length, and 1.94 meters (6 feet, 5 inches) in maximum beam. Its hull was
imperfectly ellipsoidal in shape, and fabricated of copper fastened with iron bolts (which soon came to be
the cause of corrosion requiring a change of materials). Mounted atop the hull was a wooden deck
measuring 6.096 meters (20 feet) in length and 1.8288 meters (6 feet) in width. A hollow iron keel
constituted the boat’s enclosed ballast tank, containing a combination of permanent and displaceable
ballast for regulating the boat’s buoyancy. Ballast displacement was managed by hand pumps. Not
desiring to push the limits of technology too far, Fulton cautiously established the boat’s maximum
operating depth at 25 feet (7.725 meters). The boat required a crew of three, which was usually composed
of Fulton, another American named Nathaniel Sargent, and a native of France identified only as Fleuret.

The small craft employed dual propulsion systems, one for running on the surface, and the other
for running submerged. Surface motive power was provided by a retractable sail that could be run out and
rigged in minutes upon reaching the surface. For horizontal movement beneath the surface, a hand-
cranked stern-mounted screw served as the propulsion source. The propeller measured 1.2192 meters (4
feet) in diameter, had slightly inclined blades, and was capable of 240 revolutions per minute in optimal
seas. Mounted at the bow was a second propeller that was oriented on the horizontal plane in order to act
as an uphauling and downhauling screw, serving to trim the boat’s keel angle. The rudder was mounted
at the aft end, in line with the keel, below the propeller. To address the problem of air supply and
replenishment, Fulton pioneered new technology. He initially augmented the air supply with “jars of
oxygen neutralized with lime” (Hutcheon 1981:41). Later, he created and tested a system by which air
was compressed and carried in portable containers. With these self-contained internal air replenishment
Figure 2. Robert Fulton's Nautilus (from the Archives Nationales de Paris; reproduced in Pesce 1906:183).
systems Fulton was able to successfully provide his crew with a breathable atmosphere lasting for four hours and twenty minutes, with no ill side effects. Additionally, the internally generated atmosphere could be augmented using a traditional air snorkel. This device could draw in air from above the surface while running at shallow depth. The vessel’s interior was initially illuminated by candles. A later modification entailed the installation of a window of “dark glass” topside near the bow. The weapon was a towed mine consisting of a copper housing filled with gunpowder and detonated by a contact fuze.

Nautilus was initially tested in June of 1800, with trials conducted at Le Havre (Furber 1934). On 12 September Fulton and his crew set out from Le Havre on a cruise, shaping a course for the Cap de la Hogue, a peninsula on the Normandy coast. On one occasion during this cruise, the vessel remained submerged in a severe storm for six hours, taking in air via the snorkel. It later sighted and made attack runs on two Royal Navy brigs anchored off the French coast, three leagues off Grouville. Nautilus submerged and approached the brigs but both weighed anchor and foiled the submersible’s effort to engage them, probably because their captains had been warned in an Admiralty circular to be on the lookout for “Mr. Fulton’s plans for destroying ships,” of which there had been intelligence reports (Flexner 1944:274). After five days underway Fulton and his crew put in at Grouville, on the peninsula (Parsons 1922:25-27, Flexner 1944:272-274, Hutcheon 1981:40-49, Philip 1985:94-101).

Displeased with the French government’s vacillating manner, and with his attentions turning away from developing delivery platforms and more toward perfecting the explosive weapons themselves (much as Bushnell had), Fulton had the boat broken up and the pieces sold off. He then traveled to England and in 1804 entered into negotiations with the British Admiralty to build an improved submersible vessel. He designed a vessel for this purpose, but the project he sought never materialized. He later tested underwater explosive weapons in Britain, becoming the first person to sink a large ship with such a weapon when in 1805 he destroyed the Danish brig Dorothea in a demonstration for the Royal Navy. His last project was a large semi-submersible torpedo craft he designed and intended to build for the U.S. Navy at Sackets Harbor, New York in 1815. Unfortunately, he died before it could be realized.

Fulton has come to be recognized for his experiments and advocacy of steam vessels for military and commercial use. Fulton did not “invent” the steamboat, as is the common assumption. Rather, several respected historians have argued that much of Fulton’s genius lay in his ability to research and evaluate past efforts, successfully appropriate existing ideas and technologies, and combine them with his own improvements as part of a successfully funded and publicized enterprise (Flexner 1944:280-293, 371-377; Hutcheon 1981:55-57). This same fundamental analysis could be made in judging the success of his submersible project.
THE WAR OF 1812

The War of 1812 saw further American attempts to sink Royal Navy vessels by stealth and torpedoes. On 3 March 1813, in response to the near bankruptcy of the nation’s military budget, Congress passed what has become known as “The Torpedo Act,” which stated that anyone who destroyed a British warship would be awarded a bounty of half that vessel’s value (Lundeberg 1974:22, Dudley ed. 1992:211-212). Historical evidence indicates that at least two offensive submersible or semi-submersible boats may have been constructed by one or more groups of enterprising Americans in the Long Island Sound area (Guernsey 1889). There is also a fragmentary reference concerning a possible additional effort in the Chesapeake theatre.

One of these boats, possibly a semi-submersible propelled by paddles and employing an underwater boring device for torpedo attachment, was built in Norwich, Connecticut and is thought to have seen operational use in 1813, when it was taken to New London. In August 1813 it reportedly made several unsuccessful attempts to attach a torpedo to the hull of HMS Ramillies, the squadron flagship of Captain Sir Thomas Masterman Hardy, RN, stationed in Long Island Sound. As a result of this and other torpedo attacks, Hardy had an American prisoner of war held aboard the Ramillies as a deterrent to such attempts (Niles’ Weekly Register IV [17 July 1813]:326-327; Roland 1978:121-122).

On 26 June 1814 a similar type of craft, either a submersible or a semi-submersible “torpedo-pilot” vessel, ran aground on Long Island’s northeastern shore at Horton Beach, near Southold, while heading up Long Island Sound to harass the British blockading fleet stationed off the Connecticut coast. The little vessel was possibly driven ashore by a gale. Called the “turtle boat” by some (it was described as “resembling a turtle” and “floating just above the surface”), this vessel was reportedly built by “an ingenious gentleman by the name of Berrian” in New York, and in 1814 was operating out of New London Harbor (Niles’ Weekly Register VI [9 July 1814]:318). It was of wooden construction, plated over on top with iron, 23 feet in length, and driven by hand-cranked side-mounted paddlewheels. One man reportedly drowned in the accident. Following its grounding it was sighted by the crew of HM frigate Maidstone, under the command of Captain Richard Burdett, RN. Captain Burdett recorded that:

Upon rounding a point of land, I discovered this newly invented machine lying in a small sandy bay, in a wash of the beach, with a vast concourse of people around it, a considerable part of whom were armed militia, who took their stations behind the banks, to the right and the left of the turtle boat, which resembled a great whale (Flexner 1944:356).

Burdett in the Maidstone, with another vessel in company, hove to off Horton Beach, sprayed the beach with cannon fire, and dispatched a landing party of Royal Marines under the command of Lieutenant John Bowen to capture the vessel. The local militia who had first reached the craft held off the
British landing party while the Long Island citizenry stripped it of its propulsion and weapon systems. Bowen’s Marine detachment engaged the militia and drove them off. The British subsequently destroyed the craft with an explosive charge, but not before Lieutenant Bowen recorded some aspects of the vessel (Figure 3) (Field 1908:73-76, Roland 1978:121, De Kay 1990:131). The Public Records Office (PRO) in London has preserved in its possession Bowen’s two watercolor illustrations of this boat (PRO, Adm 1/4369).

The vessel sketched by Bowen has on occasion been confused with Fulton’s much larger armored semi-submersible Mute, which had been designed around that time and was intended to be constructed at the U.S. Navy facilities at Sackets Harbor, New York by Noah Brown for use on Lake Ontario by Commodore Isaac Chauncey’s fleet (Hutcheon 1981:145-146). One scholar has suggested, probably in error, that Fulton built the Long Island turtle boat as a small scale prototype for the Mute (Rowbotham 1936, Flexner 1944:356).

There is one other piece of evidence regarding a New London effort, perhaps relating to one of the two already mentioned. Preserved in the papers of gunsmith and underwater warfare innovator Samuel Colt is evidence gathered by him during his research efforts into underwater warfare activities undertaken in the War of 1812. His manuscripts include an undated drawing (probably circa 1842) of a one-person submersible boat, with the note “lost in New London Harbor in an effort to blow up a British 74 in 1814” (Figure 4). It depicts the operator steering with one hand and driving a bow-mounted screw with the other. The boat described to him possessed a conning tower with an air tube running above it, a hand-operated propeller mounted on the bow, an auger with lanyard attached to a detachable torpedo, and a watercock and force pump at operator’s feet. Colt based this reconstruction on information provided by Captain Jeremiah Holmes of Mystic, Connecticut, a Professor Park of Washington College, and others. Colt’s informants stated that this boat had been piloted by Silas Clowden Halsey, and that it was reportedly equipped with a torpedo fabricated by John Sizer (CHS, Colt Papers, Box 6, undated document; cited in Lundeberg 1974:22, 75 and Roland 1978:139-141).

One other obscure reference exists regarding an underwater warfare effort further south. In Maryland, one U.S. sailor from Commodore Joshua Barney’s Chesapeake Flotilla was reportedly lost in an unexplained drowning accident while aboard an unidentified “submarine boat” (Maryland Historical Trust 1997:4). This may have occurred sometime in late 1813 or early 1814, and could feasibly be related to the casualty mentioned previously.

The American efforts to employ unconventional underwater warfare weapons apparently made an impression on the Admiralty, for in 1814 the British government responded by publicizing their involvement in the initiation and development of a “formidable invention to counteract the torpedo system of America.” This invention was the product of an “unknown proprietor” and was described as measuring
Figure 3. One of two extant watercolor sketches of the New London submarine that ran aground on Long Island in 1814. The sketches were made by Lieutenant John Bowen of the Royal Marines, the man who led the landing party that destroyed the boat (from PRO, ADM 1/4369; reproduced in De Kay 1990:130).

Figure 4. Samuel Colt's undated (circa 1842) sketch of a boat attributed to Silas Halsey and "lost in New London Harbor in an effort to blow up a British 74 in 1814" (from CHS, Samuel Colt Papers, Box 6, undated items; reproduced in Roland 1978:140).
27 feet in length, five feet in beam, five feet in depth. It was furthermore described as being oar powered, constructed of wrought and cast iron, arched in appearance and possessing pointed ends, and capable of sustained submergence (Field 1908:76-77).

EFFORTS UNDERTAKEN BETWEEN 1815 AND 1861

Johnstone's Chelsea Submarine

Thomas Johnstone, builder of the mysterious vessel that has come to be known as the “Chelsea Submarine,” has been variously described as an American smuggler (Pesce 1906:240), an “ex-British naval officer” (Field 1908:77), and a combination of smuggler, privateer, spy, and Channel pilot (van der Vat 1995:13-14). Legend places him as having worked with Fulton, possibly as a crewman, during Fulton’s attack on the French brigs, or else during his later work in Dover.

Johnstone is known to have been involved in negotiations with both the British Admiralty and the Commander-in-Chief of the Army around 1814 or 1815, following which he contracted out the fabrication of a submersible. The actual final direction of the negotiations is unclear, but it appears that he ultimately failed to gain approval for the project. Legend has it that he proceeded anyway. The resulting vessel was built at Chelsea Meadows, measured about 27 feet in length, was porpoise-shaped, and had pointed ends. It was constructed of sheet iron, was lined with wood and cork, and was manned by a crew of two. American agents in England may have expressed interest in his work during this time. He also may have been arrested at one point because he refused to halt his construction efforts.

Johnstone’s vessel reportedly underwent trials in 1815 in the Thames River, near Woolwich.

Sometime after his 1815 activities, Johnstone may have been motivated by a substantial reward (£40,000) proposed by Bonapartists to prepare for an attempt to rescue Napoleon from his place of exile on the Southern Atlantic island of St. Helena. For this he may have intended to employ a second craft reportedly under construction in 1821, which has been described as a 100 foot long “Fulton type” vessel “having air-pipes above.” The project was preempted by Napoleon’s death in 1821, perhaps before the boat could be perfected. Government agents subsequently boarded the vessel near London Bridge, took it to Blackwall, and destroyed it (Pesce 1906:240-242, Field 1908:77, Friedman 1994:315 fn, van der Vat 1995:13-14).

Field has suggested that this individual could have been the unnamed “proprietor” whose vessel was previously mentioned in connection with the British government’s response to American efforts in the War of 1812 (Field 1908:76-77). Although it is not known for certain whether Johnstone was American or British, whether or not he had a valid connection with Fulton, or for whom he was working, it
nevertheless appears possible that his designs and ideas were inspired in some way by the efforts of Fulton and other Americans, and that he may have had contact with American agents in England.

A Little Known 1823 Effort

An individual known only as Shudham or Shuldharn, described as "an American officer," may have been involved in the construction of a submersible boat in the United States 1823. This effort was reportedly unsuccessful (Field 1908:79, 291).

Alexandre Lambert and the Submarine Exploring Company

In 1851 an unusual vessel of which little is known was built by a consortium calling themselves the Submarine Exploring Company (Figure 5). Designed by Alexandre Lambert, a native of France, the submersible was intended to retrieve pearls and coral off Panama, and also to be used for treasure salvage. This vessel, referred to in later literature as the New York Submarine Boat, measured 30 feet in length and ten feet in diameter. Its interior was divided into two main compartments. It was constructed of boiler iron, and possessed hinged shelves on its external sides which held jettisonable ballast. Additional buoyancy control was provided by the after compartment, into which waterflow could be regulated. The vessel employed a chemical air repurification system that allowed a seven hour dive duration. It required an overhead support vessel to operate with, to which a telegraphic line of communication was linked. Some accounts state that a hand-driven screw propeller was provided for propulsion. Although an illustration in the collections of the Submarine Force Library and Museum shows such a feature (Figure 6) (Keatts and Farr 1991:7), the vessel more likely constituted more of a mobile enclosed work habitat possessing no means of propulsion (Pesce 1906:101-103). It has been reported that before the vessel was shipped to Panama, it may have been used in 1852 to lay a telegraph line between Brooklyn and Manhattan. The submarine's fate is unknown (Keatts and Farr 1991:7-9).

Lodner D. Phillips

The most overlooked, and perhaps the most important, submersible designer known to have been active during the years between the War of 1812 and the Civil War was a Michigan City, Indiana shoemaker named Lodner Darvontis Phillips. Phillips built his first vessel at Michigan City in 1845, and floated it in Lake Michigan. It has generally been described as being "modeled after the white fish"
Figure 5. Alexandre Lambert's submersible working vessel, constructed in New York circa 1851 (from the Biblioteque National, Cabinet des Estampes Ic. 49; reproduced in Pesce 1906:101-102).
Figure 6. Drawing of the Submarine Exploring Company’s circa 1851 vessel. The vessel reportedly had no propeller, contrary to what is depicted in this print (from SFLM; reproduced in Keatts 1997:7).
27 feet in length, five feet in beam, five feet in depth. It was furthermore described as being oar powered, constructed of wrought and cast iron, arched in appearance and possessing pointed ends, and capable of sustained submergence (Field 1908:76-77).

EFFORTS UNDERTAKEN BETWEEN 1815 AND 1861

Johnstone's Chelsea Submarine

Thomas Johnstone, builder of the mysterious vessel that has come to be known as the “Chelsea Submarine,” has been variously described as an American smuggler (Pesce 1906:240), an “ex-British naval officer” (Field 1908:77), and a combination of smuggler, privateer, spy, and Channel pilot (van der Vat 1995:13-14). Legend places him as having worked with Fulton, possibly as a crewman, during Fulton’s attack on the French brigs, or else during his later work in Dover.

Johnstone is known to have been involved in negotiations with both the British Admiralty and the Commander-in-Chief of the Army around 1814 or 1815, following which he contracted out the fabrication of a submersible. The actual final direction of the negotiations is unclear, but it appears that he ultimately failed to gain approval for the project. Legend has it that he proceeded anyway. The resulting vessel was built at Chelsea Meadows, measured about 27 feet in length, was porpoise-shaped, and had pointed ends. It was constructed of sheet iron, was lined with wood and cork, and was manned by a crew of two. American agents in England may have expressed interest in his work during this time. He also may have been arrested at one point because he refused to halt his construction efforts. Johnstone’s vessel reportedly underwent trials in 1815 in the Thames River, near Woolwich.

Sometime after his 1815 activities, Johnstone may have been motivated by a substantial reward (£40,000) proposed by Bonapartists to prepare for an attempt to rescue Napoleon from his place of exile on the Southern Atlantic island of St. Helena. For this he may have intended to employ a second craft reportedly under construction in 1821, which has been described as a 100 foot long “Fulton type” vessel “having air-pipes above.” The project was preempted by Napoleon’s death in 1821, perhaps before the boat could be perfected. Government agents subsequently boarded the vessel near London Bridge, took it to Blackwall, and destroyed it (Pesce 1906:240-242, Field 1908:77, Friedman 1994:315 fn, van der Vat 1995:13-14).

Field has suggested that this individual could have been the unnamed “proprietor” whose vessel was previously mentioned in connection with the British government’s response to American efforts in the War of 1812 (Field 1908:76-77). Although it is not known for certain whether Johnstone was American or British, whether or not he had a valid connection with Fulton, or for whom he was working, it
nevertheless appears possible that his designs and ideas were inspired in some way by the efforts of Fulton and other Americans, and that he may have had contact with American agents in England.

A Little Known 1823 Effort

An individual known only as Shuldham or Shuldhams, described as “an American officer,” may have been involved in the construction of a submersible boat in the United States 1823. This effort was reportedly unsuccessful (Field 1908:79, 291).

Alexandre Lambert and the Submarine Exploring Company

In 1851 an unusual vessel of which little is known was built by a consortium calling themselves the Submarine Exploring Company (Figure 5). Designed by Alexandre Lambert, a native of France, the submersible was intended to retrieve pearls and coral off Panama, and also to be used for treasure salvage. This vessel, referred to in later literature as the New York Submarine Boat, measured 30 feet in length and ten feet in diameter. Its interior was divided into two main compartments. It was constructed of boiler iron, and possessed hinged shelves on its external sides which held jettisonable ballast. Additional buoyancy control was provided by the after compartment, into which waterflow could be regulated. The vessel employed a chemical air repurification system that allowed a seven hour dive duration. It required an overhead support vessel to operate with, to which a telegraphic line of communication was linked. Some accounts state that a hand-driven screw propeller was provided for propulsion. Although an illustration in the collections of the Submarine Force Library and Museum shows such a feature (Figure 6) (Keatts and Farr 1991:7), the vessel more likely constituted more of a mobile enclosed work habitat possessing no means of propulsion (Pesce 1906:101-103). It has been reported that before the vessel was shipped to Panama, it may have been used in 1852 to lay a telegraph line between Brooklyn and Manhattan. The submarine’s fate is unknown (Keatts and Farr 1991:7-9).

Lodner D. Phillips

The most overlooked, and perhaps the most important, submersible designer known to have been active during the years between the War of 1812 and the Civil War was a Michigan City, Indiana shoemaker named Lodner Darvontis Phillips. Phillips built his first vessel at Michigan City in 1845, and floated it in Lake Michigan. It has generally been described as being “modeled after the white fish”
(Zalinski 1887:474) and employing “pig-lead ballast” (Gruse Harris 1982:3). Phillips’ older brother later recounted the vessel as follows:

The hull was covered with sheet copper. It had no apparatus for propelling except a pole to push it along the bottom of the lake. The pole passed through the hull, the opening being made watertight with rubber gaskets. It is believed a device similar to a crude cylinder was used for submerging and raising the submarine. When the cylinder was filled with water it served the purpose of making the craft go down. Expelling the water from the cylinder by means of a plunger operated by hand was to give it sufficient buoyancy to rise to the surface (Gruse Harris 1982:2-3).

Following trial experimentation, the boat was eventually “allowed...to go to rack from neglect” and sank in the nearby Trail Creek (Gruse Harris 1982:3).

Phillips reportedly built a second boat sometime between 1845 and 1850, and floated it in the Chicago River, where it was subsequently lost to unknown causes. It perhaps retained the same ineffective propulsion design as its predecessor. The sunken boat was purportedly bought and raised in 1890 by a William Nissen, who experimented with it and then mysteriously disappeared with the boat. It was rediscovered in the river in 1915 by divers who were at work rigging the sunken excursion liner Eastland for salvage. A diver from the Great Lakes Dredge and Dock Company named William Deneau recovered the boat in order to make an exhibit of it. A contemporary newspaper account related that upon recovery it was discovered to contain the bones of a man and a dog (Chicago Daily Tribune, 16 January 1916:11, cited in Gruse Harris 1982:4). Billed as “The Fool Killer,” the boat was put on display in Chicago by the Skee-Ball Company, where it could be viewed for ten cents (Figure 7). Its subsequent fate is unknown (Chicago Daily Tribune, 23 February 1916:24, cited in Gruse Harris 1982:3-4).

In 1851 investors funded the building of a third boat (Figure 8) with which Phillips reportedly experienced greater success. Called the Marine Cigar, this vessel had two “sight domes,” two “double hatches,” and “four interrupted keels to prevent it from turning over when submerged.” To ensure that the vessel would not become stuck following any potential collision, it had at the bow a detachable "thimble or outer case which is so constructed that by reversing the screw, the boat would be backed, leaving the thimble." The eight ton vessel could reportedly make a speed of three miles per hour at depth. Phillips intended it for attacking and sinking enemy vessels using either contact mines, manually-attached clockwork torpedoes, or an underwater gun employing a secret method of loading. One account describes the boat as follows:

Fresh air is supplied as necessary from tanks containing many atmospheres compressed. The boat is sunk by admitting water into tanks through pipes and is raised by expelling the same. It can be kept stationary or at any required depth of water from 1 inch to 200 feet, and in this lies the secret which makes the boat effective...It may be propelled by hand power or by electro-magnetism with a screw of Mr. Phillips’ invention, fitted to a shaft on a universal joint by which the rudder is dispensed with. It is to carry 20 to 30
After lying for a generation in the mud bottom of the Chicago River, the submarine "Fool Killer" was discovered by Capt. Deneau—the diver who recovered 250 bodies at the time of the Eastland disaster. This tragic and historic relic is now on exhibition from 9 A.M. to 11 P.M., daily and Sunday, at 208 South State Street, together with the bones of the man and dog who perished when it sank.

Cap. Deneau—Hero of the Eastland—delivers lectures and answers questions through the day and evening. You may inspect the interior at your own risk. This is not a motion picture—it is the real submarine!

In addition to the talks by Capt. Deneau, Professor Horace gives an educational discourse every half hour on the history of submarines from the time of Alexander the Great's "Glass Horse" to the present time.

Special for Children 5 Cents Each

This submarine is genuine—Read what The Tribune said about it! (Similar accounts appeared in all other Chicago papers)

"The Fool Killer," encountered for years in question in the most interesting exhibit ever shown in Chicago. Nearly every woman and child should see it. A rare educational inspiration.

Figure 7. Lodner Phillips' second vessel, the so-called Fool Killer, built circa 1845-1850, lost in Lake Erie, and recovered in 1916 (from the Chicago Daily Tribune, 23 February 1916:24; reproduced in Gruse Harris 1982:4).
Figure 8. Phillips' third vessel, the *Marine Cigar*, built in 1851 and lost in Lake Erie in 1853 during depth tests (from Barber 1875, Plate VII).
men, and is 60 feet long by 7 foot 6 inches in diameter (Guthrie 1970:34-85, cited in Gruse Harris 1982:36).

An 1879 Navy publication also provides information regarding this boat, some of which elaborates upon the above description, and some of which conflicts with it, as in the case of the stated length and the means of mechanical propulsion. According to this source, the vessel measured 40 feet in length, four feet in beam, and possessed a length-to-width ratio of approximately ten to one. Two men were required to work a two-bladed propeller, with which the boat was able to attain a speed of four and a half knots. Phillips was also reported as having experimented with a steam boiler for propulsion, employing a smokeproof coaling system and equipping the boat with a one-way exhaust valve through the hull. Although this method was experimented with, the boat ultimately did not employ it. A double rudder configuration was employed, with one mounted above and one below the propeller shaft. Phillips apparently went to great efforts to ensure longitudinal stability of the vessel. In addition to having multiple external keels, the boat possessed a number of cylindrical ballast compartments that were distributed throughout the vessel’s length. Compressed air was carried in overhead containers connected to the tanks in order to expel water upon demand. The ballast compartments were located at the boat’s ends and were balanced so as to allow the vessel to descend just beneath the surface when filled, while the midships tanks were intended for more careful manipulation following descent in order to fine-tune the boat’s buoyancy while submerged. A “clock” was placed amidships which somehow regulated the ballast ratio by allowing a shifting of water between bow and stern to reverse any unintentional pitch in keel angle, and halting this transfer upon the vessel’s regaining an even keel. For air replenishment, the boat possessed a dual life support system. A telescoping air snorkel was located aft, and was used for working at shallow depth. For sustained submergence at deeper depths, an air purification system was employed which, instead of using compressed air, employed a system by which air was forced through a liquid solution in order to make it rebreathable. One account states that “air pumps forced the air inside the boat to pass through a series of tubes plunged in water tanks and ending in watering can heads.” As the air passed through this water medium, the air reportedly cooled it and generated a carbonic acid. This system was said to be able to sustain a breathable atmosphere for three or four crewmembers for up to ten hours (legend has it that Phillips tested the boat using his wife and children as his crew on at least one occasion). Round anchor weights were located both fore and aft and were connected to chains which could be winched in. A sliding universal joint in the bow compartment allowed the use of interchangeable tools through the hull. Internal illumination was provided by deadlights mounted in the upper deck, and supplemented by an internal lamp of Phillips’ design. For weaponry the boat mounted an upward-firing six pound gun with which Phillips was experimenting (Barber 1875:21-22, 29, and plate VII, cited in Gruse Harris 1982:9-11).
By the time of his work on the third boat, Phillips had initiated contact with the U.S. Navy. In a letter dated 7 April 1852 to Secretary of the Navy William H. Graham, he mentioned the two boats he had already built, and a third that he had under construction. Attempting to solicit the Navy's interest in his projects, he wrote:

I have made application for a Patent for a Submarine boat which I invented in 1847 and two years ago I made application for a Patent for the same through Watson & Renwick as agents to get the Patent for me and have not been able as yet to obtain one I have made two of these boats Which I have experimented to the satisfaction of all who have seen me operate I went down in the depth of Water 20 ft. & for which I have travelled under water at a rate of 4 Miles an hour by use of Screw Propeller -- and now have a machine of the Same Kind which I am confident I can go down with Safety 100 hundred feet with Safety and travel -- 4 or 5 Miles pr. hour. My boat will be completed in about 3 months -- then I will be prepared to make experiments for the Navy -- or elsewhere. My object in writing to you is this I understand you are authorized to examine a machine of this Kind and If approved of by You, to purchase for the Navy if So. I wish you to write me and let me know whether you have one in view -- if So where it was invented & by whom,

Respeckfully Yours,
L.D. Phillips

[Postscript] I have understood that there was a submarine boat Invented in New York by a Frenchman which the cost is very expensive and cost some nine thousand dollars the boat which I have now nearly completed only cost $800 Dollars -- and all I ask is a fair trial and if I can't operate as well or better that any thing I am Very Much Decieved if this Broken description Should make any impression on your mind in the way -- of Submarine boat oligry you can call on Messrs Watson & Renwick Washington City and examine the description of said boat,

Yours

In the Navy Department's response, dated 21 April 1852, Secretary of the Navy Graham replied that Phillips' letter had been referred to the Bureau of Construction, and that the Chief of that department had responded with the statement "no authority is known to this Bureau to purchase a submarine boat...nothing is known of the Boat said to be invented by the Frenchman." It continued "the boats used by the Navy go on and not under the water." Graham concluded the letter with the damning statement "on this report the Department concurs" (NARA, RG 45, cited in Gruse Harris 1982:24).

On 9 November 1852 the U.S. Patent Office granted Phillips patent rights for a submersible boat containing several unique features relating to steering arrangements, depth control, and lateral stability (Figure 9). Evidently finding the traditional steering arrangement of a stern-mounted rudder wanting, he included a steerable propeller shaft mounted through a universal stern bearing (this was probably the same design used in his third boat). It was configured in such a way as to require the cranksman/steeersman to hold onto the crankshaft bearing as if it were a tiller, cranking with one hand and steering with the other.
It also included a seating arrangement for the steersman that provided the optimal foothold for such operation. Still concerned with limiting rolling motion, Phillips devised a keel arrangement in which four keels, located on the top, bottom, and both sides of the boat, were incorporated into the external construction to “render the vessel steady in the water, and easy to guide in any direction.” The upper and lower keels were interrupted at the points where the upper and lower hatches were placed (NARA, RG 241, Patent No. 9389).

In October 1853, Phillips’ third boat was the subject of a newspaper article following its sighting while in transit to Lake Erie. The boat was intended to be used to inspect the wreck of the steamer Atlantic, which had been sunk the previous fall in a collision with the propeller Ogdensburg off Long Point, Ontario, in approximately 170 feet of water (Gruse Harris 1982:11-12). The newspaper account read as follows:

A Sub Marine Propeller — We saw, yesterday, at the Railroad Freight house, a curious looking structure of wood and iron, shaped something like a paddle-wheel at one end and an iron flanged steering paddle at the other. On the sides are small bull’s eye windows, filled with very thick glass. The machine, we were informed, is Phillips’ Sub Marine Propeller, and came over by the railroad from Michigan City, on its way to pay the Atlantic a visit. We know not whether to examine her previous hit by the Ogdensburg on the larboard or starboard side, which is a point on which there is some question yet (Cleveland Herald, 18 October 1853, cited in Gruse Harris 1982:12).

Shortly after the appearance of this article, the vessel was lost in Lake Erie during an unmanned depth test, at which time it reportedly filled with water and the hawser securing it parted. Phillips may have been depth-testing the vessel in preparation for the attempt to reach the Atlantic (Gruse Harris 1982:12).

Phillips proposed at least one other boat for military purposes (Figure 10), but evidently it was never built. Surviving plans indicate that this vessel design possessed an eight-to-one length-to-width ratio. It was heavily plated on its upper surface. It could be anchored from both the bow and stern. A recess was provided on the upper deck through which a gun of some sort could be mounted through the armor plate. This recess may have allowed for the interchanging of several different types of weapons. The boat also possessed a separate bay from which to launch mines. It included a hinged bow through which tools could be manipulated, and also possessed an air-lock mounted in its bottom to allow the passage of a man suited in diving armor for salvage-related work (Barber 1875:25-27, plate VIII; Gruse Harris 1982:12-13).

Beset by recurring financial problems, Phillips fled from Michigan City to Chicago to avoid creditors. While working in Chicago he patented a suit of diving armor and also developed a design for a diving bell (Gruse Harris 1982:25, 31). He subsequently moved to New York City, where he worked as a legal draftsman for some time.
Figure 9. Phillips' 1852 patent for a rudderless submersible vessel steered by a movable propeller shaft mounted through a universal joint (from NARA, RG 241, patent no. 9389; courtesy of Joseph "Coz" Cozzi).
Figure 10. Phillips' last submersible design, not known to have been constructed (from Barber 1875, Plate VIII; reproduced in Pesce 1906:266-267).
In 1859 William Delaney, an associate of Phillips who had probably been involved in previous efforts, traveled to England, taking with him some of Phillips’ designs. The purpose of this trip was alluded to in a *New York Times* article:

The London Times says that an American invention has been taken to England with a view of its being disposed of to the British, or any other European Government...The invention is a submarine boat...The American and French governments are said to have declined to have anything to do with the invention while the British Admiralty was giving it full and prompt attention (*New York Times*, 24 January 1859:1; *Field* 1908:82; Gruse Harris 1982:37).

It is not known if anything ever resulted from this proposal to the Admiralty. The U.S. Navy would hear from Phillips again, however, following the secession of the Southern States and the formation of the Confederacy.

George H. Felt

In 1855 the American George H. Felt proposed to the French government a project entailing the construction of a submersible vessel. All that can be gathered regarding this design is that it was intended to carry weaponry in the form of eight guns. Evidently, nothing came of this proposal (*Pesce* 1906:272).

Wilhelm Bauer

In 1855, Wilhelm Bauer of Bavaria attempted to negotiate the sale of his vessel designs to the U.S. Navy. Bauer, a non-commissioned artillery officer in the Prussian Army, built a small submersible boat in 1850 in Kiel, Germany. Discredited by the loss of his boat during action against the Danes, Bauer tried to sell his vessel designs elsewhere. His inquiry was rebuffed by the Navy, much as Phillips’ had been several years earlier. Today Bauer is seen as the one of the most significant submersible innovators of the nineteenth century, and the creator of “the earliest *Unterseeboot...worthy of the name*” (*van der Vat* 1995:14-16). Bauer’s boat *Brandtucher*, which was lost in an accident in Kiel Harbor in 1851 and recovered in 1887, is presently recognized as the oldest surviving example of a submersible vessel.

Brutus de Villeroi

In 1832 at Nantes, France, the French engineer Brutus de Villeroi built and demonstrated for the his government a small spindle-shaped submarine. This vessel measured ten feet in length and three feet
in width. He continued experiments with it through 1835. It is reported that during one test he stayed submerged for two hours (Field 1908:79, Luraghi 1996:251).

By 1859, de Villeroi had emigrated to the United States and was established in Philadelphia, where his efforts to build an improved submersible vessel were being supported by a member of the wealthy Girard family. The intended purpose of this new boat was for shipwreck treasure salvage, specifically for the planned recovery of $10,000,000.00 in gold thought to have gone down with HMS De Braak, which capsized in 1798 off Lewes, Delaware. The resulting vessel (Figure 11) was described as “fish-shaped,” and “sharkish in appearance.” Fabricated primarily of iron, it measured 33 feet in length, of which 20 feet constituted a cylindrical midbody possessing a diameter of three feet eight inches. The boat was propelled by a stern-mounted screw measuring three feet in diameter that was cranked by hand and protected by an anti-fouling shroud. Mounted near the bow on either side were dive planes measuring 18 inches square. Internal illumination was provided by two rows of deadlights along the top, numbering 36 deadlights total. Located near the bow was a ellipsoidal hatch approximately 8 inches in height over which “a heavy iron flap...was secured in place by numerous powerful screws and hooks.” There was also a bottom egress for divers through which air umbilicals could be run. It could carry a crew of six to twelve men, and was capable of remaining submerged for three hours. It contained a secret chemical arrangement for regenerating the air supply. During trials in the Delaware River, it was reported to have descended to a depth of twenty feet. Buoyancy was regulated by both pumps and fixed pig ballast. Regulating depth control may have posed a problem for de Villeroi, as on one occasion he is reported to have used two surface buoys to suspend the boat at the depth he desired (Philadelphia Ledger, 23 August 1859; The Engineer, 9 Sept 1859:185; Welch 31 May 1959; NHC, Ships’ History Branch, Alligator File). The boat was still at Philadelphia in May 1861, when it was temporarily seized by the Philadelphia Harbor Police to prevent possible misuse and inspected by U.S. Navy officers.

SUMMARY: AMERICAN SUBMERSIBLE VESSEL TECHNOLOGY ON THE EVE OF THE SOUTHERN SECESSION

By the eve of the Civil War, there existed a collective body of knowledge and experience in submersible vessel development that had the potential to be drawn upon by American innovators on both sides in the conflict. The concept of a specialized vehicle for underwater torpedo delivery did not spontaneously evolve at the beginning of the Civil War. It was based upon ideas that had seen development and application beginning with the War for Independence and continuing through the turn of the century, the War of 1812, and the period between 1815 and 1861. The significance of the work conducted in the years between 1815 and the beginning of the Civil War particularly is often overlooked.
Figure 11. Brutus de Villeroi's vessel for salvaging treasure from HMS De Braak, as it appeared in *Frank Leslie's Illustrated News* on 25 May 1861 (from NHC, Photographic Section; reproduced in Keatts 1991:10).
by students of submarine developmental history, as is the question of whether the information about the work undertaken during these years was available to the Civil War submariners. Even the work conducted by Americans overseas possessed the potential to exert an influence. For instance, a line of influence could potentially be drawn from Fulton's French activities to the later work of French nationals in the United States, such as de Villeroi and Lambert. Even so, the information available to be drawn upon was not necessarily restricted to domestic sources. Both sides had access to data concerning foreign efforts, and were likely influenced by it as well.

Essentially, the idea of a manned submersible vessel that could be employed to meet military objectives comprised only part of a larger picture in which three concepts required parallel maturation. These needs were the development of a stable submersible vessel, the design and construction of a practical weapon to be employed by the submersible, and the devising of a tactically effective means of weapon delivery. Innovators like Bushnell, Fulton, and Phillips recognized the need for the integrated development of all these concepts, and worked to make improvements in each.

The submersible vehicle itself saw the most development. The breakthrough in hull design was achieved by Fulton, who devised the cigar-shaped ellipsoidal configuration. The design employed by subsequent builders remained largely unchanged from Fulton's. Systems development and configuration also saw steady improvement. The concepts of mechanical propulsion, air storage and replenishment, ballast arrangement and regulation, configuration of movable surfaces for steering and directional depth control, and instrumentation for navigation and depth determination all saw varying levels of advancement in these intervening years. Perhaps the greatest problem was the recurring inability to devise a self-powered propulsion system capable of operation while running submerged. Bushnell had broken a significant conceptual barrier when he designed into his vessel the new innovation of screw propulsion, a system that would be appropriated by Fulton when he constructed his boat. Better means of propulsion than hand power were subsequently sought, and although several systems were experimented with (employing an auxiliary sail concept, an electromagnetic drive unit, and a compact steam plant), manpower remained the primary means of propulsion. Power was applied in this manner through a number of methods, including the use of a screw, a paddlewheel, oars, or poles.

Work also progressed considerably in regard to weapon systems themselves. Three distinct weapon types evolved over these years: the towed or spar-mounted contact mine, the externally carried and manually attached limpet mine capable of delayed detonation (such as employed by Bushnell), and a vessel-mounted underwater gun that could fire a projectile through the hull of a vessel beneath the waterline. This last idea was the subject of much discussion between Fulton and Captain Stephen Decatur of the U.S. Navy, and later was seized upon by Phillips, but in practical terms the concept may have remained a theory. Additionally, significant advancements on developing galvanically controlled
underwater explosive weapons were made by Samuel Colt in the 1840s, building upon the earlier efforts of Bushnell, Fulton, and others, and the electrical research of Moses Shaw, Robert Hare, and their European contemporaries. Among other things, Colt made progress in the development of contact detonators, remote electrical fire control systems, and multicell voltage storage batteries (Lundeberg 1974).

In terms of the means by which such weapons could be tactically delivered, four general methods were seen as applicable: the manual attachment of a delayed detonation explosive charge, usually carried on the submersible’s exterior, to the enemy hull through remote means; the manual attachment of an explosive device (capable of either remote or delayed detonation) to the enemy bottom by a suited diver staging from the submersible and drawing air from it; the towing of a contact torpedo in the wake of the torpedo craft in which the idea was to detonate the charge by diving beneath the target so that the charge would collide with the target; and variations upon the bow-mounted spar torpedo concept originated by Fulton, in which the charge could be either contact detonated or remotely fired. The concept of projecting shot from an underwater gun was discussed, but did not emerge as a practical possibility. Self-propelling torpedoes would not be available until immediately following the war’s end.

The strategic framework within which these weapons could be employed was also a consideration. The strategic role perceived for the submersible relative to the larger military and naval strategy within which it was to be operated remained largely unchanged between the years 1776 and 1861. That is, such weapons were generally considered as compatible with either coastal and riverine defense, or with attempts to sink blockading naval vessels. In this sense, they were largely perceived as a defensive weapon most useful in the hands of a weaker naval power.

How and if all of this information would be disseminated to the Civil War underwater warfare communities on both sides, and if so what would or not be employed, is another question. Some may have been aware of the history of such efforts, and benefited from knowledge of their predecessors’ experiences. Others may have arrived at their findings independently, as may have been the case in some of Phillips’ ideas. Whichever the case, the information was available to those willing to make the effort to do the same type of research into past efforts that Bushnell, Fulton, Colt, and others had undertaken.
CHAPTER III

AN OVERVIEW OF SUBMERSIBLE VESSEL DEVELOPMENT EFFORTS WITHIN THE
CONFEDERACY

THE PLACE OF THE SUBMERSIBLE WITHIN CONFEDERATE MILITARY AND NAVAL
STRATEGY

The American Civil War was one of the first major armed conflicts to benefit significantly from
the technological advancements made during the industrial revolution. It saw the first widespread use of
ironclad warships, screw-propelled warships powered by steam, torpedo craft, underwater and
subterranean mines, rifled ordnance, rapid troop movements by rail, telegraphic lines of communication,
and reconnaissance aviation. Additionally, one historian has succinctly described this war as “the only
casion in the course of history when at the beginning of a conflict between two nations facing the ocean,
one of the two had incontestable and total dominion over the waters” (Luraghi 1996:61). To counter the
overwhelming naval presence arrayed before him, the strategy ultimately formulated by C.S. Secretary of
the Navy Stephen Mallory was a four-fold one based upon “technical surprise” which used armored
vessels, rifled naval guns, steam-driven commerce destroyers, and underwater mines (then called
“submarine torpedoes”) (Luraghi 1996:68). The development of specialized vessels to act as offensive
torpedo delivery platforms was a variation upon the employment of submarine torpedoes. Three general
classes of such torpedo craft emerged: traditional surface craft modified to some extent, steam-powered
semi-submersible boats with retractable smokestacks (generically called “david boats”), and hand-powered
boats capable of complete submergence.

Efforts to build submersibles began on both sides as early as 1861. Whereas the U.S. Navy’s
submersible development efforts were more deliberate and generally less successful than those of their
Southern counterparts, within the Confederate States there rapidly emerged a widespread interest in
submersible construction that ultimately localized in a number of coastal and riverine cities. Based upon
our present understanding of historical records, submersible construction efforts within the Confederacy
were centered in the areas of Richmond, Virginia; Selma and Mobile, Alabama; New Orleans and
Shreveport, Louisiana; and Houston and Galveston, Texas (Figure 12). Additionally, experiments,
patents, and circulated designs originated from places as diverse as St. Louis, Missouri; Petersburg,
Virginia; Columbia, Tennessee; and Baltimore, Maryland.
Figure 12. Map of the Confederate States of America showing known centers of submersible development or operation (drawing by Richard Wills).
SUBMERSIBLE VESSEL PATENTS

An important source of information regarding Confederate submersible designs are the few surviving records of the Confederate Patent Office. Operating under the auspices of the Office of the Attorney General, the patent office was one of “investigation and decision” rather than one which simply collected fees and filed away applications. Additionally, a five-person congressional Committee on Patents was formed to oversee and entertain proposals (or “memorials”) from citizens on particular subjects, such as items of military technology (Robinson 1941:539). It cost between 50 and 70 dollars to secure a patent, depending on duration of exclusivity sought (Robinson 1941:541). Many applications were evaluated by examiners and denied. Some applications were intended to revive patents formerly granted by the U.S. Patent Office (Robinson 1941:551). The patent office was located in the Confederate Capitol of Richmond, on the third floor of the same building housing the Navy Department. Glass display cases lined the walls of the office spaces, comprising a gallery for the public display of patent models as required by law. A list of patents was published annually in tabular form according to class of item (Robinson 1941:540). The patent office was consumed in one of the many fires that accompanied the evacuation of Richmond in April 1865, and it has been commonly believed that most of the models and original records were lost at that time (Irvine 1939). This may be the reason why no patent records at all survive for the “fragmentary year 1865” (Robinson 1941:554).

A total of 166 patents were issued by the Confederate Patent Office between 1861 and 1864 (Robinson 1941:547). In contrast, thousands of patents per year were granted in the North during this same period (including 4,638 in 1864 alone, for instance) (Robinson 1941:550). Many of the patented Confederate inventions were intended for military use. Surviving records of the C.S. Patent Office are scant, but they reveal that at least five patents were granted which may have related to submersible vessels.

In his study of the Confederate judicial system, legal historian William Robinson, Jr. discussed an “exquisite” miniature model of a submarine that was reportedly discovered “after lying for years unnoticed in the junk of the Navy Department.” Robinson stated that the history of this model was unknown, except that it may have survived the destruction of the Confederate Patent Office. He found the model to be “beautifully done in brass, with fine attention to detail. The principal patentable ideas were, probably, the carriage of deck guns for surface fire and the helicopter-like arrangement for submergence” (Robinson 1941:553). Robinson felt that this model may have been either Patent No. 258 or Patent No. 261, both of which are listed in surviving documents as comprising a “submarine boat,” and both of which were granted to C. Williams of St. Louis, Missouri. Patent No. 258 was granted on 6 October 1864, while No. 261 was awarded on 25 October 1864 (Confederate States of America 1865:4). C. Williams’ patents comprised only two of the 45 total patents issued in 1864. Another patent granted that year was one for a “sea-going vessel” submitted by F.G. Smith of Columbia, Tennessee (Confederate States of America 1865:4). An
earlier patent for a submersible vessel is also known to have been granted, to "Chas. Patton" of Petersburg, Virginia in 1862 (Confederate States of America 1863; Mark Ragan, personal communication, 1 December 1998).

During a 1999 visit to Annapolis, the author was able to locate and study a submersible boat model in the collections of the U.S. Naval Academy Museum that matched Robinson's description. The provenience of this model can be traced back at least as far as 1925, when it was accessioned into the museum's collections as part of a group of items transferred from the Old Seaman Gunners' Quarters at the Washington Navy Yard's Naval Gun Factory. Documentation on this model is comprised of only a few pages of information (Documents Relating to Accession 25.1, Curator's File of Accessions and Catalogue Records). The surviving records suggest that there may have initially been two models transferred. The present location of the other is now unknown.

An inventory of ordnance relics at the Naval Gun Factory was conducted during the first half of 1924 (Inventory of Ordnance Relics, Enclosure C in Second Endorsement 4217/4(R) of Commandant, Naval Gun Factory, 13 June 1924 [this document is referred to in subsequent documents, but could not be located by the author]). A request was made to send a number of historic articles kept in the Old Seaman Gunner's Quarters to the Naval Academy "for exhibition in the Museum." These items were picked out by the Curator of the Naval Academy Museum, and included two listed as follows:

<table>
<thead>
<tr>
<th>SER. NO. 23, Class No. 9</th>
<th>Model of submarine torpedo boat</th>
<th>BOX NO. 42</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Numbers</td>
<td>Submarine boat model</td>
<td>BOX NO. 69</td>
</tr>
</tbody>
</table>

(Memorandum from Superintendent, U.S. Naval Academy to Secretary of the Navy via Commandant and Superintendent Naval Gun Factory, and Bureau of Ordnance, 18 February 1925)

The boxes that were subsequently shipped to Annapolis by truck included one containing the following item:

<table>
<thead>
<tr>
<th>Submarine Boat Model</th>
<th>No Number</th>
<th>BOX 7</th>
<th>QUANTITY 1</th>
</tr>
</thead>
</table>

(Store Invoice No. 5076, Memorandum from Supply Officer, U.S. Navy Yard, Washington, D.C. to Superintendent, U.S. Naval Academy, Annapolis, Maryland, 6 March 1925 [first page only, second page missing]).

The surviving carbon copy of the above referenced memorandum is missing the second page, making it unable to be confirmed whether of not the second model was delivered. However, it seems apparent that the one model referred to in the 6 March 1925 memorandum is the second of the two mentioned in the 18 February memorandum (the one described as having "No Number"). This model was received by the museum as part of Accession 25.1, and was catalogued as follows:

"SUBMARINE, Model of. "Cigar shaped". The type of Civil War "David" as invented and used by the Confederates (?). From the Bureau of Ordnance Museum, Naval Gun
Factory, Washington, D.C., Mar. 7 1925" (Krafft 1925, with additions and new accessions to January 15, 1929:210a).

This is undoubtedly the same model referred to by Robinson, and the same model presently curated by the museum (Figures 13, 14, 15, and 16). The present location of the other model (the one identified as “SER NO. 23, CLASS NO. 9”) is unknown; however, it is possible that further research within the museum’s collections may locate information regarding this item.

Analysis of the model revealed that it is constructed primarily of cast iron and contains finely crafted brass fixtures. It is double-ended with no identifiable bow or stern, and can be disassembled into two halves, upper and lower, in order to reveal the interior details (Figure 16). The model measures 30 inches (76.2 centimeters) in length, 4 13/16 inches (12.23 centimeters) in breadth, and 5 3/4 inches (14.5 centimeters) in depth. The boat’s ends possess pointed prows, presumably for ramming, and its double-ended design includes a helm, rudder, and hand-cranked propeller at each end. The two rudders do not appear to be coordinated, but seem to be intended to move independent of one another, with only one being used at any time in conjunction with whichever propeller was being turned (during which time the other would presumably be held in a neutral setting). In addition to the two screws oriented to move the boat on the horizontal plane, the model also possesses two hollow shafts which run through the boat from bottom to top, containing propellers inside of them intended to act as downhauling and uphauling screws (Figures 14 and 15). These propellers are also capable of being worked by hand. The boat’s weaponry consisted of two guns, one at each end, with muzzle exhaust tubes mounted through the barrels and leading out above the gunports. A few of the model’s components appear to be missing, including the hatch securing mechanism, one of the gun and muzzle exhaust tube assemblies, two of the four handles for turning the uphauling and downhauling screws (both inside ones), the rudder cables, and evidently part or all of a peculiar oversteer preventer device that was located on both helms. Additionally, four of the screws for retaining the internal half decks, and all 12 small screws that fastened the upper and lower halves to one another, are no longer in evidence.

SMITH’S DESIGN

Efforts to encourage submersible vessel construction within the Confederacy began as early as 10 June 1861, when a public letter from Franklin G. Smith of Columbia, Tennessee appeared in that state’s Columbia Herald. Smith’s letter appealed to “men of mechanical turn” to look to submersible torpedo vessel construction for meeting military needs, and stated that a detailed paper and accompanying illustrations of his design for such a craft was being sent to the mayors of major Confederate coastal cities.
Figure 13. The unidentified iron model (side view) of a double-ended submersible vessel in the collections of the U.S. Naval Academy Museum (photograph by Richard Wills).

Figure 14. A top view of the same model. The uphauling and downhauling screws are visible through the tubular housings located on either side of the hatch (photograph by Richard Wills).
Figure 15. A bottom view of the same model. The uphauling and downhauling screws are visible through the tubular housings visible in the boat's bottom (photograph by Richard Wills).

Figure 16. A view of the model with the two portions separated. Note the hand-operated crankshafts, and the deck-mounted gun on the right side (the left is missing from the model) (photograph by Richard Wills).
Shortly thereafter, his letter began to be reprinted in other southern newspapers, including the *Mobile Advertiser and Register*. Smith’s circular read as follows:

From the Chesapeake to the mouth of the Rio Grande, our coast is better fitted for submarine warfare than any other in the world. I would have every hostile keel chased from our coast by submarine propellers. The new vessel must be cigar shaped for speed—made of plate iron, joined without external rivet heads, about 30 feet long, with a central section about 4 x 3 feet, driven by a spiral propeller, a fishtail sculler or (far better) by a steam engine occupying the after part of the boat. When its bottom is tight, the torpedo takes to the surface like any other boat, apart from the top folding back. Closing its top, it sinks on getting a prize fairly within range and within striking distance. A harpoon point, easily separated from the forward end on the boat after being driven into the enemy’s side (about ten feet under water), carries the wire that holds the shell. The shock of the attack disengages the shell from the bottom of the boat and strikes the percussion cap for igniting the half minute fuse. The air pump, the inhalation tube, the eyeglasses, are already used. The new Aneroid Barometer made for increased pressure, will enable the adventurer easily to decide his exact distance below the surface. If not furnished with steam, the torpedo will carry sail when on a cruise. Two of them—each an outrigger to the other—could spread so much canvas as to outsail all competitors (*Mobile Advertiser and Register*, 26 June 1861; cited in Schell 1992:165).

Patent records indicate that “F.G. Smith” of Columbia, Tennessee was granted a patent for a “sea-going vessel” on 18 April 1864 (CSA 1865:4). Exactly what type of vessel this patent pertained to is unknown. Whether or not Franklin G. Smith was actively involved in any of the known submersible construction efforts is a matter still open to question. It has been suggested that he was involved in one early Mobile effort (Schell 1992:164). His designs may have influenced anyone who subsequently built a boat.

**WINANS’ EXPERIMENTAL HULL**

During the years immediately before the war, Baltimore-based railroad locomotive builder Ross Winans was involved, along with his eldest son Thomas Winans, in the construction of an unusual vessel referred to by the press as “Winans’ Cigar Steamer” (White 1968:458). This vessel, also called the *Winans*, was a semi-submerged ship built entirely of iron (Figure 17). It was intended to provide a six day transatlantic passenger service. Upon its launch in the Patapsco River (on 30 September 1858) it measured 180 feet in length and 16 feet in diameter. It incorporated an innovational patented hull form in which the ends were not conical in shape but rather were configured as “parabolic spindles” which offered low resistance and maximum stability. The philosophy behind the hull form was that it would enable the vessel to pass through waves instead of over them. The ship contained watertight compartments and doors, and the hull was illuminated by numerous circular glass deadeyes. It was powered by a unique, sideways-mounted rotating paddlewheel with pitched blades, housed in a midships “drum” of larger
Figure 17. A photograph of the Winans' steam vessel, taken on the shortly before its launching (from NHC, Photographic Section).
diameter than the rest of the hull. Its initial trials in 1859 were followed by a number of tests and alterations. The trials demonstrated that the vessel’s ends needed to be reconfigured. The ends were subsequently removed and new ones were mated on (The Engineer, 9 July 1858:32, 11 February 1859:102, 4 March 1859:157, 8 July 1859:37, 19 August 1859:139, 23 December 1859:440, 13 January 1860:19, 10 February 1860:86-67, 17 February 1860:110, 21 September 1860:189).

At some point during 1860 or early 1861, Ross Winans had the ends that had been cut off of the vessel mated together, either with the intent to subject this assembly to corrosion testing, or for the purpose of assessing its hydrodynamic characteristics. On 19 October 1861, while under tow by the tug Ajax, this experimental vessel hull appeared off Hampton Roads on its way north to Baltimore, and caused suspicion among those who witnessed it. The historian Milton Perry aptly described the situation when he stated that it had “all the characteristics of a submarine” (Perry 1965:91-92). The hull was subsequently seized by the U.S. Navy until its purpose and destination could be confirmed. Further north, a submarine built by Brutus de Villeroy had similarly caused alarm and was seized by the Philadelphia Harbor Police, in May of that year. This concern may have been recalled at the time of the appearance of Winans’ vessel. Flag Officer Louis Goldsborough initially refused to release the vessel because he felt it “could be easily converted into an instrument of destruction if possessed by the enemy” (ORN 1, VI:346-350). After the situation was thoroughly clarified, and communicated to Secretary of the Navy Gideon Welles, the vessel was released. Goldsborough’s suspicions may have been warranted, it appears, as Winans was subsequently jailed by the Federal government as a Southern sympathizer, and the semi-submersible torpedo boat CSS David would later be referred to as having been built on the “Winans Model” (Solomon 1970:43-44).

LEAVITT’S DESIGN

On 21 October 1861, Charles P. Leavitt, a soldier in the Second Virginia Regiment, wrote a letter to C.S. Secretary of War Judah P. Benjamin in which he described a design for a submersible boat he desired to build. He stated his intent as follows:

I have invented an instrument of war which for a better name I have called a submarine gunboat... My plan is simple. A vessel is built of boiler iron of about fifty tons burden...but made of an oval form with the propeller behind. This is for the purpose of having as little draft of water as possible for the purpose of passing over sand-bars without being observed by the enemy. The engines are of the latest and best style so as to use as little steam as possible in proportion to the power received. The boilers are so constructed as to generate steam without a supply of air. The air for respiration is kept in a fit condition for breathing by the gradual addition of oxygen, while the carbonic acid is absorbed by a shower of lime water... I propose to tow out my gun-boat to sea and when within range of the enemy’s guns it sinks below the water’s surface so as to leave
no trace on the surface of its approach, a self-acting apparatus keeping it at any depth required. Within a few rods of the enemy it leaps to the surface and the two vessels come in contact before the enemy can fire a gun. Placed in the bow of the gun-boat is a small mortar containing a self-exploding shell. As it strikes the engines are reversed, the gun-boat sinks below the surface and goes noiselessly on its way toward another ship ....I have written you on this subject in order to obtain an opportunity to draft out my invention, with which the means at command in Richmond can be done in a week... (ORA 4, 1:695-696; CWNC 1971:1-30).

Leavitt's proposed vessel was probably never built. It is unknown whether or not his design exerted any influence upon the boats that were constructed.

THE C.S. NAVY PROGRAM AT THE TREDEGAR IRON WORKS

Building the Boats

Between August 1861 and May 1862 the C.S. Navy had the Tredegar Iron Works build at least two submersible boats. Tredegar was the largest iron foundry and rolling mill in the Confederacy, and was occupied with the task of rolling armor plate for the ironclads CSS Virginia (ex-USS Merrimack) and CSS Richmond during the period the submersible boats were constructed. The boats were built in the sheds at Rocketts Yard, which otherwise was primarily a yard for building ironclads. Rocketts Yard (often referred to as just "Rocketts") became a C.S. Navy shipyard in April 1862 (Still 1987:31, 35).

The submersible boats were constructed under the supervision of Acting Master William G. Cheeney, CSN, a New York-born former U.S. Navy officer (DON 1931:33; Moebus 1991:198; Coski 1996:117). Cheeney was detailed to the Navy's Submarine Bureau (soon to be renamed the Submarine Battery Service), where he was assigned the task of setting up the James River torpedo defenses. As part of this organization he worked closely with its leader, the famed oceanographer Commander Matthew Fontaine Maury, CSN (also head of the Office of Special Services, or OSS). The funding for construction of the boats was provided from the Submarine Bureau budget. The submersibles were probably intended to be used against enemy vessels in conjunction with Maury's torpedo weapons (ORN 2, XII:343; Dew 1966:123).

Construction probably began in early August 1861, which is around the same time that Maury's torpedo program began to receive funding (Coski 1996:114). The expenditures were authorized and dispersed by Lieutenant John M. Brooke, CSN, undoubtedly with Maury's knowledge. Brooke's first payment may have been made as early as 25 July 1861 (John M. Brooke Diary, 25 July 1861; cited in Coski 1996:291 fn15). By September Cheeney was sketching design ideas for possible use with the boats, including one drawing labeled "Sketch of Propeller for Sub-Marine Boat, designed by W. Cheeney"
Figure 18. Sketch by Acting Master W.G. Cheeney, CSN, dated September 1861, of a proposed propeller design probably intended for use with one of the Tredgar submersibles (from VHS, Edward R. Archer Account Book 1861-1863; courtesy of Mark Ragan).
(Figure 18) (VHS, Archer Account Book, drawing dated 25-26 September 1861). The propeller design, which appears to only have incorporated two blades, is shown as possessing a hub measuring six inches in length along its longitudinal axis, and with a shaft entrance measuring two inches in diameter. The propeller was 46 inches in overall diameter with pitched blades measuring 18 inches in width. However, unlike all of the other records which are invoices, there is no indication this design was ever acted upon, if it was molded and cast, or which of the boats was intended to incorporate it.

On 8 November 1861 John Brooke recorded in his diary “Cheeney will be ready to start on his submarine expedition soon. I fear that Com. Maury will alarm the enemy by his attempts — which have already proved unsuccessful” (John M. Brooke Diary, 8 November 1861; cited in Coski 1996:117). Brooke may have been referring to Maury’s earlier attempts to destroy U.S. Navy ships with floating mines, or perhaps he was alluding to previously conducted submersible activity. On 26 November 1861 Tredegar entered into its sales book an itemized expense record totalling $6,500.00 “for the Confederate States Navy Department 1 Submarine boat.” The expenses related to services including “Labour,” “Painting,” and “Hauling.” Materials employed included 7,143 pounds of boiler plate, seven iron castings, 129 bolts (or possibly pounds of bolts), 249 pounds of brass castings, and 26 yards of cloth. Some funds went toward purchasing 1,695 feet of timber, probably used to build the shed that was constructed over the boat “to conceal it” from prying eyes (VSA, Tredegar Company Records, Sales Book, 1836-1900, viii-4, W.R. Anderson to W.G. Cheeney, 26 November 1862; provided by Mark Ragan).

By 11 December 1861 Cheeney may have been working on a second boat. On that day he signed a request for the Navy Department to “Please pay within bills $3199, and charge to account of Sub-Marine boat” (NARA, BM, C.S. Navy Files, miscellaneous, torpedoes). That same day an invoice for $103.69 was entered into the Tredegar account book which stated “Confederate States Navy for W.G. Cheeney” and included expenses for “2 tons pig iron,” “hauling pig iron,” “two double blocks,” “cotton goods,” and “one 60 foot tape line” (NARA, RG45, Subject File (BM), Box 128, Roll 11, Bills of Anderson & Co., 11 December 1861 entry; cited in Dew 1966:123 fn58).

On 13 May 1862 another payment, this one for over $3,000.00, was approved by John Brooke for the following services at Rocketts: “boilermaker labor 42 days,” “machinist fitting work 15 days,” “machinist turning work 10 ¼ days,” “1 wraughts furnace for making [illegible (shaft?)],” “pattern makers making patterns for propeller castings at gas furnace,” “one caster for propeller,” “grinding glass for lights,” “painters 5 ½ days,” and “hauling and handling.” Materials charged included 328 bolts and hinges, bar castings, and an iron frame. “False bows” were put on the boat. Plumbing fixtures were also listed in the form of “six brass castings for air pump,” “1 brass pump,” “16 couplings,” “1 guard for pumps,” “1 pipe for [pumps],” and “brass bolts and fixtures.” All means by which to keep the machinery working smoothly is indicated by “one oil cup with cock.” Also, “four and a half pounds of putty” were
listed, possibly indicating packing and caulking of certain fixtures. The boat appears to have been hoisted up off the ground and painted, as indicated by "1 chain for painting boat," as well as hooks, a ring, a safety spring, and a splicing handle (NARA, RG45, Subject File (BM), Box 128, roll 11, Bills of Anderson & Co., 13 May 1862 entry, cited in Dew 1966:123 fn58).

The 26 November and 11 December 1861 expense records may represent final invoices containing all the basic materials required for the construction of a boat. The work conducted between 11 December 1861 and 13 May 1862 (entered together on the same page) similarly appear to include the materials and services necessary for the construction of one boat. When looked at collectively these records could be interpreted to indicate two vessels, the first constructed sometime before the end of November 1861, and the second initiated in December 1861 and completed sometime around May 1862. The first boat may have been the vessel that Lieutenant Commander Royal Bird Bradford described in his 1882 U.S. Navy publication Notes on the Spar Torpedo, in which he wrote:

The first torpedo boat constructed was built at the Trediger Iron Works, Richmond, in 1861. It was made of boiler iron, twenty feet long, and was to be used as a diving bell, from which a torpedo was to be attached to the bottom of a vessel. It proved an utter failure (Bradford 1882:7).

This statement is significant because it not only seems to agree with other accounts regarding the general characteristics of the vessel, but it provides a length, which is not recorded in any other documents. Where Bradford obtained the information used in this statement is unknown, but it was made soon enough after the war that he may have acquired it firsthand, and other statements by him appear to be well researched and generally reliable.

Rocketts Yard took over construction of the ironclad Richmond in May 1862 and from that point on made that project its priority (Still 1987:35). In June 1862, Cheeney is known to have been employed in working on the James River submarine defenses, taking charge of the torpedoes placed in the river below Richmond (ORN 1, XII:545-546). In September 1862 Cheeney deserted his post and defected through the lines to the Federals, to whom he provided information regarding his activities in underwater warfare (ORN 2, XII:343; Coski 1996:120-121). Commander Maury was reassigned to Europe at about this time as well. With Cheeney and Maury both gone, and Rocketts concentrating on ironclad building, the Navy's submersible vessel building project at Tredegar evidently ended.

In 1908 a memoir was published by longtime Richmond resident Ernest Walthall (under a pseudonym) who mentioned the work undertaken at Tredegar. In it, the author recollected that:

Rocketts is the boat landing. This is about as far as the river is navigable. During the war it became the Navy Yard, but was not closed in till the war had well advanced. It was visited frequently by the writer. Once he saw a submarine boat and some barrels with torpedos in them, it was said, on the wharf. Have wondered why some historian
did not write of it before 1908, when am glad that Mr. Clyton, on Confederate page of Richmond Times-Dispatch has at this late date given a short history of it. My impression it was made at the Tredegar. Thought surely they would go down to fortress Monroe and blow it up. If a spy had been there he might have gotten all particulars. There was no secrets (Walthall 1933:29).

Indeed, the vessel referred to may have gone down to Fortress Monroe in an attempted attack, and a spy did gather some particulars of it. It is hoped that further research into surviving circa 1908 issues of the Richmond Times-Dispatch may reveal the “short history of it” hinted to by Walthall.

The Hampton Roads Attack

On 9 October 1861 an attempt to sink the fifty gun screw-frigate USS Minnesota, flagship of the North Atlantic Blockading Squadron, was made by a Confederate submersible in Hampton Roads (the Chesapeake Bay confluence of the James, Elizabeth, and Nansemond Rivers), while that frigate lay at anchor off Old Point Comfort. The attack was foiled when the guard boat from the USS Lockwood patrolling the anchorage observed the attempt and sounded an alarm signal, which triggered a general quarters alert aboard Minnesota from 9:00 to 10:00 PM. The alert was evidently generated by the submersible boat’s maneuvering against a grappling chain or line hanging from the Minnesota’s jib-boom (possibly a preventative measure against drifting mines) which it evidently mistook for the anchor chain, and its momentary surfacing in the dark before its crew realized their error and resubmerged. The squadron commander, Flag Officer Louis Goldsborough, subsequently reported to Secretary of the Navy Gideon Welles that “an attempt, no doubt, was made by insurgents to get an infernal machine among our shipping here, but it was happily foiled by the alertness of the ‘Lockwood’” (ORN 1, XI:363, 392-393; Welch 24 May 1959).

News of the incident was reported in the New York Herald of 12 October, and reprinted in the 2 November issue of Harper’s Weekly. The New York Herald reported the incident as follows:

Last Wednesday evening [9 October 1861] an infernal machine was sent down from Sewell Point for the purpose of blowing up the flag-ship. She came down to the ship without any difficulty, but she got caught in the grappling always hanging from the jib-boom end of the ship. This was taken by those inside for the chain cable, and when they thought they were under the bottom of the ship they made preparations for screwing the torpedo on the bilge, but, to their surprise, they were sadly mistaken, and they came near losing their lives as well as the machine. They, however, escaped, and worked themselves to shore on rebel ground, and the machine was carted back to Norfolk, to try as an experiment at some future time (New York Herald, 12 October 1861; reprinted in Harper’s Weekly, 2 November 1861:701).
Apparently working with information gathered on both sides of the lines, Harper's Weekly described the submersible boat that staged the attack as follows:

It is built of iron, of a similar shape to the Ross Winans cigar boat, of a sufficient capacity to accommodate two persons, who work it ahead by means of a small screw propeller. It is guided by a rudder, and it is ballasted by means of water, let in and forced out by means of a pump. A compass guides them, and a velocimeter shows how great a distance is run each moment. Bearings and courses are given the men, and they go on a hazardous voyage, with a large chance of accomplishment. An India-rubber tube, which is floated on the surface, furnishes them with fresh air, while a force-pump forces out the foul air. On arriving at the place desired, a grapple catches the cable of the vessel, and the machine is veered away until it is supposed to be near one of the magazines; the water ballast is then pumped out, and the machine floats up under the ship's bottom. By means of an India-rubber sucking-plate this machine is attached to the bottom of the ship, while a man-hole plate is opened and the torpedo is screwed into the vessel. It is fired by the means of a time fuse. As soon as this is set in motion the men inside place a prepared sheet of rubber over the man-hole, and while one lets water into the compartment to sink the machine, the other person screws up the plate, the grapple is let go, and the infernal machine is left to explode, while the machine is worked ashore out of harm's way (Harper's Weekly, 2 November 1861:701).

This attack introduced a new problem in terms of security for the ships of the North Atlantic Blockading Squadron, and demonstrated the necessity of a new defensive tactic for dealing with this threat. In a communication shortly following the incident, the captain of another U.S. Navy vessel at Hampton Roads, Commander William Smith of the 44 gun sailing frigate USS Congress, outlined his plan for taking antisubmarine countermeasures. He described them as follows:

Should such a machine as the one that attacked the Minnesota approach us and come near the cable, it must be caught in the net and held there until we relieve it. Or should it pass outside the net, the tube which floats on the surface to supply the inmates with fresh air would be caught on the A spars, and the supply of fresh air cut off, causing suffocation, and if it should pass outside of the spars it would go entirely clear of the ship, doing no harm. I think this arrangement will secure us against torpedoes (ORN 1, XI:363).

Harper's Weekly printed a drawing of a Confederate submersible vessel intended to operate on the James River for the purpose of destroying Federal vessels, specifically identifying it as the "submarine infernal machine" that had "intended to destroy the Minnesota off Fortress Monroe" (Figure 19) (Harper’s Illustrated Weekly, 2 November 1861:701). The vessel represented in the illustration was shown being crewed by two men and powered by a hand-cranked, four-bladed propeller. A floor was laid over the lower hull area, beneath which was the "ballast-room." Mounted through the floor was a simple T-headed watercock to let water in the ballast compartment, and a force pump for expelling it. The air replenishment system consisted of an "India-rubber air tube" running through the hull overhead, and a "foul-air pump" mounted on the floor at midships. At the hull's top center was a "man-hole plate."
Figure 19. The *Harper's Illustrated Weekly* sketch of the submersible reportedly operating at the mouth of the James River, and which may have attempted to destroy the USS *Minnesota* on 9 October 1861 (from *Harper's Weekly*, 2 November 1861:701).
appearing to be nearly flush with the hull. The “India-rubber suction plate” was a short compartment projecting above and surrounding the access plate. The “torpedo” was carried inside the vessel.

Federal Intelligence Gathering Activities at Tredegar

In early November 1861 Allan Pinkerton, the head of the Secret Service for General George B. McClellan’s Army of the Potomac, dispatched an undercover agent to travel down to Richmond for “the especial purpose of ascertaining as much information as possible about these torpedoes and infernal machines” being built and tested at the Tredegar Iron Works (Pinkerton 1888:395). It seems probable that this mission was at least partly in response to the Minnesota’s experience the previous month. Mrs. E.H. Baker, a veteran operative and former Richmond resident, was chosen to undertake the mission. Her plan was to gain access to the information through renewing an old acquaintance with a Captain Atwater and his wife. Captain Atwater was a Confederate Army officer stationed in Richmond who evidently still possessed Unionist sentiments. Baker arrived in Richmond on 24 November and stayed as a guest in the Atwaters’ home. Within a few days she talked the officer into arranging for her to view a test trial of the submersible boat, as well as a visit to tour the Tredegar Iron Works. In the meantime she busied herself by gathering data on the various defenses set up around Richmond.

The trial was conducted on 29 November “about ten miles below the city” with a large crowd of observers on hand for the test. Baker was informed that the intended objective of the weapon was “to break up the blockading fleet at the mouth of the James River” (Pinkerton 1888:399). A large scow was anchored in the middle of the river for use as the submersible vessel’s target. Pinkerton summarized Baker’s observations as follows:

...the submarine vessel was to approach it and attach a magazine, containing nearly half a bushel of powder, to which were attached several deadly projectiles, and this was fired by a peculiarly constructed fuse, connected by a long wire coiled on board the submarine vessel. At the given signal the boat was sunk into the river, about a half a mile below the scow, and shortly afterwards it began to make its way under the water towards it. The only visible sign of its existence was a large float that rested on the surface of the water, and which was connected with the vessel below, designed to supply the men that operated it with air. This float was painted a dark green, to imitate the color of the water, and could only be noticed by the most careful observer...

It was learned that the vessel was but a small working model of a much larger one, that was now nearly completed, and would be finished in about two weeks, and would be taken to the mouth of the James River, to operate on the vessels guarding that port... With the aid of a strong field-glass, they could distinctly watch the large “float,” which indicated the approach of the vessel...

“How do the men who operate the machine manage to attach the magazine to the vessel they design to destroy?” asked Mrs. Baker. “Two or three men, who operate the boat,” replied the Captain, “are provided with submarine diving armor, which enables them to work under the water and attach the magazine to the ship intended to be
blown up. They then have only to quickly move away to a safe distance, fire their fuse, and the work is done.” While they were talking, my operative was closely watching, by the aid of her glass, the movements of the boat, and she now noticed that having approached to within a few rods of the scow, it stopped, and the large “float” which indicated its position remained motionless. After remaining in this position for a few minutes, it slowly began to recede from the scow, in the direction from whence it came. It moved steadily away some hundreds of yards, and Mrs. Baker was wondering at the seemingly long delay, when suddenly, and without any previous warning whatever, there was a terrific explosion, and the scow seemed lifted bodily out of the water and thrown high in the air... (Pinkerton 1888:399-401).

That evening Baker made detailed notes and sketches of the vessel. The next day, 30 November, she returned with her host to Tredegar, where she was able to inspect the second, larger boat still under construction. She left Richmond the next morning, 2 December, with her recorded information hidden on her person, returned through the lines, and reported to Pinkerton. Pinkerton informed McClellan and Secretary of the Navy Welles, who passed the data on to the Navy squadron commanders with instructions to take appropriate safeguards. Pinkerton heard three weeks later that such a vessel had been encountered at the mouth of the James and either disabled or sunk by one of the blockading vessels (Pinkerton 1888:394-403).

Pinkerton recorded in his memoirs that he still retained Baker’s “hasty, though quite comprehensive, sketch of the vessel, which is still in my possession, which showed the position under the surface of the water, and explained its workings” (Pinkerton 1888:402). A recent examination of the Pinkerton Papers at the Library of Congress yielded no recognizable original documents from Baker (Coski 1996:291 fn16).

McCLINTOCK’S COALITION AND BOATS IN NEW ORLEANS, MOBILE, AND CHARLESTON

The core of the submersible boatbuilding program that ultimately produced Pioneer, American Diver, and H.L. Hunley was formed by a coalition of New Orleans machinists and businessmen probably motivated by both nationalistic feelings and the possibility of collecting prize money for the destruction of enemy vessels of war. The initial New Orleans group consisted of machinists (or “practical engineers” in the parlance of the day) James McClintock and Baxter Watson, lawyer and Deputy Collector of Customs Horace L. Hunley, customs house employee (and diver) John K. Scott, Hunley’s wealthy brother-in-law Robert Ruffin Barrow, and prominent lawyer and newspaper editor Henry J. Leovy. These six men were the driving force behind Pioneer's construction over the winter of 1861-1862 at the Leeds Foundry, near the Government Yard at New Basin. While the composition of this group would evolve during the course of the boats’ operations, McClintock and (until his death) Hunley remained at its core.
The Privateer Pioneer

The effort to construct Pioneer was possibly alluded to as early as 17 August 1861 in the New Orleans Daily Delta (Kloepel 1992:6). Leovy was likely the source of these rumors, as he was on the Daily Delta's editorial staff. The submersible was floated in February 1862 at the government yard at New Basin, taken up the New Canal, and underwent trials in Lake Ponchartrain. McClintock later described this first boat as being built:

...in New Orleans in 1862, of iron 1/4 inch thick, 30 feet long, 4 feet in diameter with cone ends 10 feet long, with a propeller in one end, turned with a crank by two (2) persons inside of the boat. This boat was faulty in shape. Yet it demonstrated the fact that a boat could be built, that would move at the will of the operator in any direction required, and at any distance from the surface of the water. The evacuation of New Orleans occurred before all our experiments were completed (PRO, Adm. Series 1/6236, File 39455, Report on Mr. McClintock's Submarine Torpedo Boat).

According to a letter written in 1871 by McClintock to fellow Confederate underwater warfare specialist Matthew Fontaine Maury, during this shakedown the boat sank a schooner and two target barges by means of a towed torpedo (Perry 1965:95; Kloepel 1987:6-9). On 29 March 1862 application was made by John K. Scott for a letter of marque and reprisal as a privateer, which was issued to Pioneer by Hunley's supervisor, Collector F.H. Hatch on 31 March under the authorization of C.S. Secretary of State Judah P. Benjamin (also a New Orleans lawyer and an acquaintance of Leovy's). The letter of marque records the vessel's name as Pioneer, and the vessel type as a "submarine propeller" armed with a "magazine of powder." The Pioneer was described as measuring 34 feet in overall length, 4 feet in beam, drawing 4 feet of water, and weighing 4 tons. It was painted black and had "round conical ends." To obtain the letter of marque a surety of $5,000.00 was posted by Hunley and Leovy (ORN 1, IX:399-400). The number of crew required was listed as three, with John K. Scott as the vessel commander (the choice of Scott as vessel commander may have been dictated not only by his presumed piloting ability, but also his experience as an undersea diver, which is alluded to in correspondence appearing in ORN 2, I:556).

Perry has suggested that Lieutenant Beverly C. Kennon, CSN (formerly of the Louisiana State Navy), who was in charge of the Navy's Ordnance Dept at New Orleans, probably designed and provided the boat's explosive weapon, or at least the fuze (Perry 1965:95). Kennon was experimenting with torpedoes of his own design in Lake Ponchartrain in August 1861 (Scharf 1887:752). Another possibility is that Pioneer's weapon may have been Arthur Barbarin's "submarine and subterranean torpedo," which reportedly blew up a skiff in experiments in Lake Ponchartrain also around that time (New Orleans Daily Crescent, 7 October 1861, cited in Dufour 1990:65; Beauregard 1878:155).
The *Pioneer* never saw action, for less than a month after its completion New Orleans fell to the combined U.S. forces under Flag Officer David C. Farragut, USN and General Benjamin F. Butler, USA. Most likely sometime between 24 and 28 April 1862, with Farragut and Butler at the city gates, possibly while the levee front and shipyards were ablaze in the destruction of any goods of material value to the enemy, an attempt was made by *Pioneer*’s builders to conceal their boat somewhere in the vicinity of the New Basin, probably by scuttling. At least three of the group, McClintock, Watson, and Hunley, fled to Mobile, Alabama with the intention of building an improved vessel there.

Sometime between April 1862 and April 1864, during the Federal occupation of New Orleans, an abandoned iron submersible boat was “fished out of the canal near the ‘New Basin,’ between New Orleans and the Lake Ponchartrain” (Baird 1902:845). A study of its construction was made by Second Assistant Engineer Alfred Colin, USN and Third Assistant Engineer George W. Baird, USN, both of the USS Pensacola’s engineering department. Baird later recounted that this study was submitted to the fleet engineer of the West Gulf Blockading Squadron, who in turn forwarded it to Engineer-in-Chief W.W. Wood (Baird 1902:845-846). The submersible boat itself remained where it was until after the war.

On 15 February 1868, a notice of auction and sale of the derelict submarine appeared in a New Orleans newspaper:

A torpedo boat, which was built in this city or hereabouts during the war, and which is now lying on the banks of the New Canal, near Claiborne Street, is to be sold at public auction today...The boat in question, which is built of iron and weighs about two tons, was sunk in the canal about the time of the occupation of the city by the Federal forces, in 1862. It was built as an experiment and never fully perfected, and is only valuable now for the machinery which is in and about it (*New Orleans Picayune*, 15 February 1868, morning edition).

The afternoon edition provided an update, stating that the boat was “sold for forty three dollars. It cost, originally, twenty six hundred” (*New Orleans Picayune*, 15 February 1868, afternoon edition).

There has existed a great deal of speculation regarding the dimensions and configuration of this Hunley predecessor, as well as whether or not the Louisiana State Museum Vessel, which was recovered from near the canal’s entrance to Lake Ponchartrain in July 1878 (Scharf 1887:761), may in fact constitute the remains of *Pioneer*. Fortunately, in 1997 the surviving records of Colin and Baird’s wartime documentation of the vessel were located and brought to light by historical researcher Mark Ragan. The documentation uncovered by Ragan includes their drawing of *Pioneer* (Figure 20), conclusively revealing that the Louisiana State Museum Vessel is an entirely different submersible (NARA, RG 45, Entry M148, Letters received by the Secretary of the Navy from Officers below the Rank of Commander, 1802-1884).
Figure 20. Drawing of the "Rebel Submarine Ram" *Pioneer* made by Assistant Engineers G.W. Baird, USN and Alfred Colson, USN during the Federal occupation of New Orleans (from NARA, RG 45, entry M148; courtesy of Mark Ragan).
Figure 21. A page from the sketchbook of Ensign David McNeely Stauffer, USN, displaying a drawing of the "Rebel Torpedo Boat Taken from the bottom of the New Basin, N.O." dated "March 5, 1865" (from LSM, courtesy of Greg Lambousy, Associate Curator).
Several drawings of *Pioneer* also survive in the form of a sketchbook kept by another U.S. Navy engineer in the fleet, David M. Stauffer (Sketchbooks of David McNeely Stauffer, USN, *USS Alexandria*, Mississippi Squadron, 1864-1870 [2 vols.]; Volume One, “Louisiana Sketches. 1864. D.M. Stauffer, USN, USS Alexandria, Lower Mississippi Fleet”). The existence of these books was not known to Civil War naval historians until 1999, when they were brought forward for sale from a private estate and viewed by LSM Associate Curator Greg Lambousy, who recognized their significance. The several sketches of *Pioneer* are contained on a single page, labeled “Rebel Torpedo Boat Taken from the bottom of the New Basin, N.O.” and dated “March 5, 1865” (Figure 21). The boat represented is undeniably the same vessel shown in the drawing made by Colin and Baird. The Stauffer drawings were evidently made after the boat had been removed from the basin and set up on the bank. They reveal several details not apparent in the Colin and Baird diagram, including the definite presence of a reduction gear, the external hull plating and riveting pattern, the presence of a towing and mooring eye on the forward dorsal surface, evidence of a hatch opening in the forward bulkhead, and details of the dive plane control bar and support brackets.

The *American Diver*

Upon arriving in Mobile, McClintock, Watson, and Hunley were joined in their efforts by engineers Thomas Park and Thomas Lyons of the Park & Lyons machine shops, who provided their facilities for the fabrication of a new boat. The group also now began to receive support from the military in the form of Lieutenant William Alexander, CSA, an engineer temporarily detached from the Twenty-first Alabama Volunteer Regiment and detailed to duty at Park & Lyons. According to information from a Confederate deserter who had worked in the Mobile shop around this time, upon its completion the resulting vessel was referred to as *American Diver* (*ORN I*, XV:229).

In a letter to Matthew Fontaine Maury written after the war, McClintock recorded that the original intention was to build a boat capable of mechanical self-propulsion:

To obtain room for the machinery and persons, she was built 36 feet long, 3 feet wide, and 4 feet high, 12 feet at each end was built tapering or modeled to make her easy to pass through the water. There was much time and money lost in efforts to build an electromagnetic engine for propelling the boot... afterwards fitted cranks to turn the propeller by hand, working four men at a time, but the air being so closed, and the work so hard, that we were unable to get a speed sufficient to make the boat of service against vessels, blockading the port (LC, Maury Papers, Volume 46, Items 9087-9094; cited in Ragan 1995:22, 24).

Not long thereafter, McClintock provided more detail in a narrative he gave to officers of the Royal Navy. He wrote that:
In 1863 I built the second boat, also of iron 1/4 inch thick, and in order to obtain more room as well as to correct the faults of the first boat, she was built with square sides. Dimensions was 36 feet long, 4 feet high, and 3 feet across top & bottom, with ends tapered like a wedge for a model, with a 30 inch propeller in the end. I spent much time and money in efforts to work an Electro Magnetic Engine, but without success. I afterwards fitted her up with cranks, to be turned by four men. But her speed was not sufficient to make her of service against blockaders, they being six miles at sea (PRO, Adm. Series 1/6236, File 39455, Report on Mr. McClintock's Submarine Torpedo Boat).

The origin of the American Diver's electromagnetic engine remains obscure, and as a result it has been the subject of much conjecture. Watson is known to have later written a letter to President Davis in which he discussed the engine and sought support to build another boat powered by one (NARA, RG109, Entry M-437, Letter from Baxter Watson to Secretary of War, 10 October 1864; cited in Ragan 1995:154-155). McClintock may have initially been influenced by several descriptions of electromagnetic engines which had appeared in a British technical publication (The Engineer, 11 May 1860:309; 29 March 1861:201; 4 April 1861:216; 5 September 1862:148; 19 September 1862:177). This seems a logical possibility in light of the fact that he later admitted this same publication was the source of more detailed information regarding an ammonia-powered submarine proposed by him to the Royal Navy. Records indicate that during the second boat's construction, Admiral Franklin Buchanan, CSN, informed Secretary of the Navy Stephen Mallory that "within the last week or ten days we succeeded in getting a man from New Orleans who was to have made the 'magnetic engine' by which it was to have been propelled" (Kloeppe 1995:24). This "man from New Orleans" may have been the "Frenchman" referred to in other correspondence, and may have in fact been the mysterious figure named Anstilt or Alstitt (Schell 1992:168-171). At this same time in Mobile in 1863, an electric-powered vessel attributed to Anstilt, sometimes referred to as the American Ram, was also purportedly under construction. Sources regarding this vessel are extremely sketchy, and it seems likely that they may actually have been referring to the American Diver, perhaps confusing Anstilt's proposed designs and propulsion experiments with his possible work with the McClintock group at Park & Lyons (Schell, 1992:169-171). Whatever its origins, when it became apparent that the electromagnetic engine was incapable of providing the amount of power required, it was removed and a small, custom-built steam plant was installed in its place. However, this steam plant was also determined to be unusable and likewise was removed (Ragan 1995:22).

The records from the Public Records Office (PRO) in London documenting McClintock's 1872 visit to Halifax include a three-view sketch of a submersible, drawn by a Captain Nicholson in the presence of McClintock (Figures 22, 23, and 24). While the dimensions and configuration of all three of McClintock's boats are detailed in the accompanying written report, the boat represented in the sketch appears to possess features of both the second and third boats. Some of these discrepancies are acknowledged and explained in the accompanying text. Nicholson and Ellis recorded that "the drawing
Figure 22. Sheer view of James McClintock's described submersible design as recorded in 1872 by Royal Navy interviewers aboard HMS Royal Alfred (from PRO, ADM 1/6236, file 39455; courtesy of NHC and Peter Hitchcock).
Figure 23. Top view of McClintock's described submersible design as recorded in 1872 by Royal Navy interviewers (from PRO, ADM 1/6236, file 39455, courtesy of NHC and Peter Hitchcock).
Figure 25. Commander G.W. Baird's sketch of a submersible vessel, most likely American Diver, which he made following the war in the presence of McClintock, and based upon McClintock's verbal description (from Baird 1902:846).
we enclose is a representation of the boat that effected this destruction [of the USS Housatonic], it is not
drawn to scale, nor did the original boat contain any engine, the only motive power then available being
manual labor..." (PRO Adm. Series 1/6236, File 39455, Report of a submarine boat built by Mr.
McClintock of Mobile, U.S. of America). The PRO drawings bear a close resemblance to the vessel
represented in a postwar sketch by O.W. Baird which was made in the presence of, and based upon
information provided by, McClintock (Figure 25). Baird, apparently assuming that McClintock built only
one boat in Mobile, subsequently identified the boat in this drawing as "the vessel that destroyed the
U.S.S. Housatonic" (Baird 1902:846). Because of this, it has been commonly assumed that he was
attempting to represent the Hunley, when in fact McClintock may actually have been describing to him
the American Diver. In a response to Baird's article written shortly after it appeared, Alexander raised an
objection to this identification, noting of the drawing in question that "after the capture of New Orleans
McClintock went to Mobile and built the submarine in Plate 1. I don't know where McClintock is living,
but hope he will assist in correcting this error" (Ragan 1995:25). Unfortunately, McClintock was never
able to correct the record; he was long since dead by this time, having been killed in Boston Harbor in
1879 in an accidental explosion while demonstrating the use of some of his underwater contact mine
designs for the government (New York Times, 15 and 17 October 1879; Ragan 1995:164). But while
McClintock did not survive long enough to answer Alexander's request, the PRO drawings seem to
reinforce the accuracy of his memory in regard to the configuration of his second boat, left behind in the
form of his letter to Maury and his description as relayed to Baird. One interpretation of the newly
uncovered PRO written descriptions and drawings may be that they may suggest a closer relationship in
design between McClintock's second and third boats than has previously been suspected.

The American Diver was floated in Mobile Bay in February of 1863. It was towed off Fort
Morgan with the intention of manning it there and attacking the Federal fleet, but as the weather grew
worse and the sea became rough, the boat became difficult to manage and foundered. No lives were lost
in this mishap, but the Confederate submariners had been deprived of another vessel in which they had
invested much effort, time, and funding.

The H.L. Hunley

McClintock and Hunley's group was not discouraged. Financially strapped, they sold shares in
the third venture to members of the Singer Submarine Corporation, a government-sponsored organization
under the Mobile-area Army Engineers. The investors who bought into the boat were E.C. Singer, B. Gus
Whitney, R.W. Dunn, and J.D. Breman (Duncan 1965:64). Hunley held one third of the shares, Singer
one third, and the last third was split among Whitney, Dunn, and Breman (Ragan 1995:26). It may have
been at this early stage of the boat’s construction that Lieutenant Alexander was joined by another Army assignee to this detail, his friend Lieutenant George Dixon, CSA, also of the 21st Alabama (Clemmer 1996:280 fn5). The group obtained a long cylindrical steam boiler that the engineers lengthened, deepened, and fitted out to accommodate a maximum crew of nine. The boat was designed to be powered by a long hand-cranked shaft requiring the efforts of eight cranksmen, each stationed at one of eight crank throws, and staggered with “four men on each side” of the boat (Hill 1916).

The boat was launched in July 1863 at Mobile’s Theater Street dock. At this early point before Hunley’s asphyxiation and the subsequent naming of the vessel for him, this vessel may have been referred to by several different names, including “the Fish Boat” (Fort 1914; Stanton 1914), “the fish torpedo boat” (Beauregard 1878:152), and “the Porpoise” (Ragan 1995:42). Trials produced pleasing results. Admiral Franklin Buchanan, CSN noted that the boat was capable of making four knots (Ragan 1995:30). The attention of General P.G.T Beauregard, CSA was evidently captured by the method of illumination; he recorded that “light was afforded through the means of bull’s-eyes placed in the manholes” (Beauregard 1878:153). McClintock described the boat as follows:

In the Spring of 1864 I built the 3rd boat, having abandoned the artificial motive power as not attainable in our situations. I modeled her, and built expressly for hand power. This boat was of an elliptic shape, with modeled ends, and looked similar to surf, or whale boats, placed one on top of the other. She was built of iron 3/8 inch thick, 40 feet long top & bottom, 42 inches wide in the middle, & 48 inches high, fitted with cranks geared to her propeller & turned by 8 persons inside of her. And although she was a beautiful model boat, and worked to perfection just like her predecessors, the power was too uncertain to admit of her venturing far from shore. This boat was taken to Charleston, SC, and destroyed the sloop of war Housatonic. Myself nor the Sub Marine’s gallant commander who lost his life in demonstrating her [illegible, possibly “success”] considered there was any danger in going out and destroying any vessel, but the danger was in having sufficient power to bring the boat back (PRO, Adm. Series 1/6236, File 39455, Report on Mr. McClintock’s Submarine Torpedo Boat).

Interestingly, McClintock’s statement regarding “cranks geared to her propeller” may indicate that the drivetrain included a reduction gear. A similar feature is present in the construction of the U.S. Navy’s Intelligengbt Whales.

Years after the war, Alexander made a sketch of the third vessel’s construction (Figure 26), and described the boat as follows:

We decided to build another boat, and for this purpose took a cylinder boiler which we had on hand, 48 inches in diameter and twenty-five feet long (all dimensions are from memory). We cut this boiler in two, longitudinally, and inserted two 12-inch boiler-iron strips in her sides, lengthened her by one tapering course fore and aft, to which were attached bow and stern castings, making the boat about 30 feet long, 4 feet wide and 5 feet deep. A longitudinal strip 12 inches wide was riveted the full length of
Figure 26. William Alexander’s postwar sketches of the H.L. Hunley (upper illustration from Stern 1967:178; lower illustration courtesy of NHC, Photographic Section).
the top. At each end a bulkhead was riveted across to form water-ballast tanks (unfortunately these were left open on top); they were used in raising and sinking the boat. In addition to these water tanks the boat was ballasted by flat castings, made to fit the outside bottom of the shell and fastened thereto by "Tee" head bolts passing through stuffing boxes inside the boat, the inside of the bolt squared to fit a wrench, that the bolts might be turned and the ballast dropped, should the necessity arise.

In connection with each of the water tanks there was a sea-cock open to the sea to supply the tank for sinking; also a force pump to eject water from the tanks into the sea for raising the boat to the surface. There was also a bilge connection to the pump. A mercury gauge, open to the sea, was attached to the shell near the forward tank, to indicate the depth of the boat below the surface. A one and a quarter shaft passed through stuffing boxes on each side of the boat, just forward of the end of the propeller shaft. On each side of this shaft, outside of the boat, castings, or lateral fins, five feet long and eight inches wide, were secured. This shaft was operated by a lever amidships, and by raising or lowering the needs of these fins, operated as the fins of a fish, changing the depth of the boat below the surface at will, without disturbing the water level in the ballast tanks.

The rudder was operated by a wheel, and levers connected to rods passing through stuffing-boxes in the stern castings, and operated by the captain or pilot forward. An adjusted compass was placed in front of the forward tank. The boat was operated by manual power, with an ordinary propeller. On the propelling shaft there were formed eight cranks at different angles; the shaft was supported by brackets on the starboard side, the men sitting on the port side turning the cranks. The propeller shaft and cranks took up so much room that it was very difficult to pass fore and aft, and when the men were in their places this was next to impossible. In operation, one-half the crew had to pass through the fore hatch; the other through the after hatchway. The propeller revolved in a wrought iron ring or band, to guard against a line being thrown in to foul it. There were two hatchways -- one fore and one aft -- 16 inches by 12, with a combing 8 inches high. These hatches had hinged covers with rubber gasket, and were bolted from the inside. In the sides and ends of these combings glasses were inserted to sight from. There was an opening made in the top of the boat for an air box, a casting with a closed top 12 by 18 by 4 inches, made to carry a hollow shaft. This shaft passed through stuffing boxes. On each end was an elbow with a 4 foot length of 1 1/2 inch pipe, and keyed to the hollow shaft; on the inside was a lever with a stop-cock to admit air (Alexander 1902).

It was decided that the boat should be transported to Charleston, South Carolina for anti-blockade duty under the command of General P.G.T. Beauregard, CSA. Whereas Mobile's defenses were well fortified, Charleston was suffering under a siege of more serious proportions. Charleston's coastal waters may also have presented a more desirable operating environment, especially in terms of providing greater depth. Additionally, General Beauregard in Charleston looked favorably upon unconventional weapons, while General Dabney H. Maury and Admiral Franklin Buchanan in Mobile may not have been so willing to embrace such unproven forms of naval warfare. Furthermore, the move was undoubtedly encouraged by the high bounties being placed upon the naval vessels of the South Atlantic Blockading Squadron. The result was that the submersible was shipped to Charleston by rail in August 1863.
Lieutenant George Gift, CSN of the CSS Gaines, in a letter “inflicted” upon his fiancée, described how he had “been employed during the past day or two in hoisting out of the water and sending away toward Charleston a very curious machine for destroying vessels” which he describes as follows:

In the first place imagine a high pressure steam boiler, not quite round, say 4 feet in diameter in one way and 3-¼ feet the other -- draw each end of the boiler down to a sharp wedge shaped point. The 4 feet is the depth of the hold and the 3-¼ feet the breadth of beam. On the bottom of the boat is riveted an iron keel weighing 4000 lbs which throws the center of gravity on one side and makes her swim steadily that side down. On top and opposite the keel is placed two man hole plates or hatches with heavy glass tops. These plates are water tight when covered over. They are just large enough for a man to go in and out. At one end is fitted a very neat little propeller 3-½ feet in diameter worked by men sitting in the boat and turning the shaft by hand cranks being fitted on it for that purpose. She also has a rudder and steering apparatus.

Embarked and under ordinary circumstances with men ballast &tc she floats about half way out of the water & resembles a whale. But when it is necessary to go under the water there are apartments into which the water is allowed to flow, which causes the boat to sink to any required depth, the same being accurately indicated by a column of mercury. Air is supplied by means of pipes that turn up until they get below a depth of 10 feet, when they must depend upon the supply carried down which is sufficient for 3 hours! During which time she could have been propelled 15 miles!

Behind the boat at a distance of 100 to 150 feet is towed a plank and under that plank is attached a torpedo with say 100 lb of powder. The steersman has a string by which he can explode the torpedo by giving it a jerk. I saw them explode a vessel as an experiment. They approached within about fifty yards of her keeping the man holes just above water. At that distance she the submarine sank down and in a few minutes made her appearance on the other side of the vessel. He pulled the string and smashed her side to atoms... (Turner 1995:5-8).

Alexander later indicated that this towed torpedo arrangement proved unworkable, recording that:

The torpedo was a copper cylinder holding a charge of ninety pounds of explosive, with percussion and friction primer mechanism, set off by flaring triggers. It was originally intended to float the torpedo on the surface of the water, the boat to dive under the vessel to be attacked, towing the torpedo with a line 200 feet long after her, one of the triggers to touch the vessel and explode the torpedo, and in the experiments made in the smooth water of Mobile River on some old flatboats these plans operated successfully, but in rough water the torpedo was continually coming too near the wrong boat. We then rigged a yellow pine boom, 22 feet long and tapering; this was attached to the bow, banded and guyed in each side. A socket on the torpedo secured it to the boom (Alexander 1902).

As can be seen from some of the previous accounts, the historical sources do not agree on the dimensions of Hunley. McClintock’s descriptions of circa 1871 and 1872 emerge as being consistently near the mark, if not perhaps slightly conservative as in the case of Pioneer. Gift is not far off, while
Alexander (who in all fairness cautioned 40 years after the fact that "all dimensions are from memory") seems to be somewhat further off the mark.

Sometime during its operations in Charleston, the boat became the object of an artistic study by the famed artist Conrad Wise Chapman. Chapman has left two informative depictions of the boat in the form of his pencil study and his finished oil portrait (Figure 27).

Following its arrival in South Carolina, the boat experienced a number of operational difficulties. The Army became increasingly unhappy with McClintock's conservative management of the boat, and as a result seized it, replacing the civilian crew with C.S. Navy personnel. It was following this transition that the boat was twice accidently lost in Charleston Harbor with fatalities, being both times subsequently salvaged (Clemmer 1996:279, fn 2 and 4). The first incident killed five members of the crew of nine, most of who were volunteers from the CSS Chicora and CSS Palmetto State. Lieutenant C.L. Stanton, CSN provides the background of this misfortune:

One day when Lieutenant Payne, my friend and shipmate, was aboard the Chicora I arranged to go down under the water with him; but as the boat was obliged to leave before my watch on deck was over, Lieutenant Charles H. Hooker [sic, he means Hasker] took my place. She dived about the harbor successfully for an hour or two and finally went over to Fort Johnson, where the little steamer Etiwan was lying alongside the wharf. She fastened to her side with a light line with the fins in position for diving... (Stanton 1914).

Lieutenant Charles H. Hasker, CSN (a former U.S. Navy hand who had been the warrant boatswain on the CSS Virginia during the Battle of Hampton Roads) was sitting immediately behind Payne in the lead cranksman's position at the time of the accident, and related the following experience:

We were lying astern of the steamer Etowah [one of several names by which this vessel, also called the CSS Etiwan, was known], near Fort Johnson, in Charleston Harbor. Lieutenant Payne, who had charge, got fouled in the manhole by the hawser and in trying to clear himself got his foot on the lever which controlled the fins. He had just previously given the order to go ahead. The boat made a dive with the manholes open and filled rapidly. Payne got out of the forward hole and two others out of the aft hole. Six of us went down with the boat. I had to get over the bar which connected the fins and through the column of water which was rapidly filling the boat. The manhole plate came down on my back; but I worked my way out until my left leg was caught by the plate, pressing the calf of my leg in two. Held in this manner, I was carried to the bottom in forty-two feet of water. When the boat touched bottom I felt the pressure relax. Stooping down, I took hold of the manhole plate, drew out my wounded limb, and swam to the surface. Five men were drowned on this occasion (Fort 1914).

Payne and Hasker escaped through the forward hatchway, while the team's explosives expert, Charles L. Sprague, and Jeremiah Donivan managed to fight their way out through the aft hatchway. Carried to the bottom and drowned were sailors Frederick (Frank) Doyle, John Kelly, Nicholas (Nick)
Figure 27. Conrad Wise Chapman's oil portrait of *H.L. Hunley*, painted at Charleston in December 1863, shortly after its second salvage (courtesy of the Charleston Museum).
Davis, and Michael Kane (or Cane) (all detached from the CSS *Chicora*), and Absolum Williams (detached from the CSS *Palmetto State*) (Ragan 1995:54, Clemmer 1996:281 fn7).

In 1999, an archaeological excavation of a former Mariner's graveyard presently located beneath the Citadel's football stadium revealed the remains of 27 Confederate military service personnel. When the stadium was built in 1948, the headstones on the graves were relocated, but the burials were left in place and covered over (they were ultimately determined to lie five feet beneath the stands and a room used by the academy's booster club). Within the number of recovered remains are believed to be four of the five crewmen killed in a submersible accident. When these individuals' remains were recovered and forensically analyzed, it was concluded that four of the interred individuals had been dismembered and buried in oversized coffins, placed one on top of another. The dismemberment had evidently been conducted somewhat crudely using hatchets or knives. The logical conclusion is that following the submersible's recovery (which took some time to effect), the crew's decomposing and bloated bodies had to be dismembered in order to remove them through the submersible's narrow hatchways following its recovery. The location of the fifth crewmember's burial place has not yet been determined ("Child's Coffin Unearthed," *The Houston Chronicle*, 2 July 1999).

Following the tragedy of the five deaths, the military sent a request to Mobile asking for people more familiar with the boat to come to Charleston to take over its operation upon its recovery. Horace Hunley, Thomas Park's son Thomas W. Park (often misidentified as his father), and approximately six or so other volunteers, probably mechanics from the Park & Lyons shop, answered the call, journeyed to Charleston, and spent some time putting the boat through "diving and raising" tests, possibly for the purpose of testing a new adjusted compass (Ragan 1995:66). When it finally appeared to observers that all the vessel had previously lacked was experienced hands, the boat suffered another terrible disaster. While running submerged, Hunley, acting as vessel commander, made a simple error in regulating the water contained within the forward ballast tank, and the boat buried its bow in the harbor mud, stuck fast, and partially flooded, killing the entire crew of eight. In addition to Hunley, Park, and the stout-hearted Sprague, this crew contained Mobilians Robert Brockbank, Charles McHugh, John Marshall, Henry Beard, and Joseph Patterson (who may be the individual identified as "White" in Alexander's narrative). Even after the passage of nearly fifteen years, General Beauregard's recollection of the events surrounding the recovery of the boat and crew three weeks after the sinking was still vivid when he set it to paper:

Lieutenant Dixon made repeated descents in the harbor of Charleston, diving under the naval receiving ship which lay at anchor there. But one day when he was absent from the city Mr. Hunley, unfortunately, wishing to handle the boat himself, made the attempt. It was readily submerged, but did not rise again to the surface, and all on board perished from asphyxiation. When the boat was discovered, raised and opened, the spectacle was indescribable and ghastly; the unfortunate men were contorted into all kinds of horrible attitudes; some clutching candles, evidently endeavoring to force open
the man-holes; others lying on the bottom tightly grappled together, and the blackened faces of all presented the expression of their despair and agony (Beauregard 1878:153-154).

The divers hired to locate and rig the boat for salvage found it buried bow-first in the mud. Alexander’s insightful attempt to reconstruct the accident provides some detail of the crew’s standard operating procedures.

The position in which the boat was found on the bottom of the river, the condition of the apparatus discovered after it was raised and pumped out, and the position of the bodies in the boat, furnished a full explanation for her loss. The boat, when found, was lying on the bottom at an angle of about 35 degrees, the bow deep in the mud. The bolting-down bolts of each hatch cover had been removed. When the hatch covers were lifted considerable air and gas escaped. Captain Hunley’s body was forward, with his head in the forward hatchway, his right hand on top of his head (he had been trying, it would seem, to raise the hatch cover). In his left hand was a candle that had never been lighted, the sea-cock on the forward end, or ‘Hunley’s’ ballast tank, was wide open, the cockwrench not on the plug, but lying on the bottom of the boat. Mr. Park’s body was found with his head in the after hatchway, his right hand above his head. He also had been trying to raise the hatch cover, but the pressure was to great. The sea-cock to his tank was properly closed, and the tank was nearly empty. The other bodies were floating in the water. Hunley and Parks were undoubtedly asphyxiated, the others drowned. The bolts that held the iron keel ballast had been partly turned, but not sufficient to release it.

In the light of these conditions, we can easily depict before our minds, and almost readily explain, what took place in the boat during the moments immediately following its submergence. Captain Hunley’s practice with the boat had made him quite familiar and expert in handling her, and this familiarity produced at this time forgetfulness. It was found in practice to be easier on the crew to come to the surface by giving the pumps a few strokes and ejecting some of the water ballast, than by the momentum of the boat operating on the elevate fins. At this time the boat was under way, lighted through the deadlights in the hatchways. He partly turned the fins to go down, but thought, no doubt, that he needed more ballast and opened his sea-cock. Immediately the boat was in total darkness. He then undertook to light the candle. While trying to do this the tank quietly flooded, and under great pressure the boat sank very fast and soon overflowed, and the first intimation they would have of anything being wrong was the water rising fast, but noiselessly, about their feet in the bottom of the boat. They tried to release the iron keel ballast, but did not turn the keys quite far enough, and therefore failed. The water soon forced the air to the top of the boat and into the hatchways, where captains Hunley and Parks were found. Parks had pumped his ballast tank dry, and no doubt Captain Hunley had exhausted himself on his pump, but he had forgotten he had not closed his sea cock (Alexander 1902).

McClintock’s caution with the boat may have been excessive, but in hindsight it seems to have been justifiable in light of the two tragedies that subsequently befell the boat. Both accidents seem to have been attributable to personal errors on the part of the vessel commanders; in Payne’s case the result was that five of his crew were drowned, whereas Hunley’s actions may have resulted in not only his own death
but also the death of his entire crew. Gus Whitney additionally died during this period, possibly from exposure related to the operations of the boat (Duncan 1965:66).

Upon the second salvage of the boat, Dixon and Alexander saw some or all of their fellow submariners buried in Magnolia Cemetery. If the entire crew was not buried together, some members are believed to possibly be represented amongst the 13 burials of Confederate military personnel recovered during an early 1990s archaeological excavation of a military graveyard discovered under the parking lot of the Citadel's sports stadium ("Remains of Confederate Soldiers Found," The Daily Journal, 22 July 1999).

The surviving members of the group memorialized Hunley's efforts by naming the boat H.L. Hunley after him. Saddened but undaunted, Dixon and Alexander enlisted another volunteer crew, which ultimately came to include naval personnel James A. Wicks, Arnold Becker, C. Simkins, F. Collins, (first name unknown) Ridgeway, and (first name unknown) Miller, as well as Corporal C.F. Carlston, CSA, of Company A, South Carolina Light Artillery (Ragan 1995:90, 126; Clemmer 1996:285 fn22, 287 fn26). The group moved their operations to Battery Marshall, on Sullivan's Island, where between November 1863 and February 1864 they frequently fought foul weather in attempts to conduct night cruises on the waters off Charleston. On 5 February, fate touched Alexander in the form of orders received to report to another project, and he reluctantly bid Dixon and the crew a farewell. He never saw his friends again.

On 17 February, Corporal Donald W. McClaurin of Battery Marshall was summoned to the boat in order to make adjustments to the on-board machinery, during which time he made note of the Hunley's third and final torpedo configuration:

As I recall, the torpedo was fastened to the end of an iron pipe, about two inches in diameter and twenty to twenty-five feet in length, which could be extended in front and withdrawn at ease by guides in the center of the boat to hold it in place. Lieutenant Dixon landed and requested that two of my regiment, the 23rd South Carolina Volunteers, go aboard and help them to adjust the machinery, as it was not working satisfactorily. Another man and I went aboard and helped propel the boat for some time while the Lieutenant and others adjusted the machinery and the rods that held the torpedo and got them to working satisfactorily (Ragan 1995:130).

The manner in which the spar was rigged has been the matter of some debate. Lieutenant Stanton recorded his views on this subject as follows:

Lieutenant Payne, although a willing volunteer for this dangerous service, never at any time had faith in the success of the enterprise. I heard him say time and again that if he struck a vessel with the torpedo staff projecting horizontally he feared the boat would enter the hole made by the explosion in the ship's side, and the machinery would not be powerful enough to back the boat out before it was carried down by the wreck. His idea was that if the torpedo staff was lowered to an angle of forty-five degrees when the ship was struck the torpedo would explode near the keel, and the Fishboat's bow, striking the solid planking of the ship, would recoil sufficiently to make the machinery effective in
backing out of danger of being drawn down by the wreck. I have always felt very certain that the torpedo staff was in this position when the Housatonic was struck...Besides, when the boat lay alongside the Chicora on the night of 14th of February, I examined it closely... (Stanton 1914).

On that same day as Corporal McClaurin was helping to fine-tune the boat’s machinery, a recognition signal using a blue lamp was arranged between Dixon and the men of Battery Marshall for the purpose of guiding the boat back to port after dark:

The day of the night the perilous undertaking was accomplished, the little war vessel was taken to Breach Inlet. The officer in command [Dixon] told Lieutenant-Colonel Dantzler [in command of Battery Marshall] when they bid each other good-by, that if he came off safe he would show two blue lights (Cardozo 1866:124; cited in Ragan 1995:132).

On the evening of 17 February 1864, running on the surface and with Dixon at the helm, Hunley set out on patrol. Approximately two and a half miles off Charleston Bar, the Hunley observed and shaped a course for the steam sloop-of-war USS Housatonic, an inviting target moored nearby on blockade duty. Housatonic had become a well-known presence in the South Atlantic Blockading Squadron since being attached to it in September 1862, having participated in the capture of several vessels, most notably the securing and salvage of the blockade runner Princess. It had also seen combat against the ironclad rams CSS Chicora and CSS Palmetto State in a nasty engagement the previous winter, and had provided support during the failed 10 July 1863 assault on Fort Wagner in the form of amphibious assault teams and naval gunfire. Since then it had been participating in the bombardment of Charleston’s outer defenses, conducting close-in shoreline reconnaissance with its small craft, and performing blockade functions (DANFS 2:370-373). Nearly everything we know of Housatonic’s last action is found in the transcripts of the court of inquiry held following its loss (Proceedings of the Naval Court of Inquiry, 26 February 1864, Case #4345, Commission of Inquiry on the Sinking of the Housatonic, U.S. Navy Area Files [M-265], NARA).

The evening of Housatonic’s last engagement was a clear and moonlit one, with the ship slip-moored approximately six miles east-southeast of Fort Sumter. The Officer of the Deck that night was Acting Master John K. Crosby, who was standing his watch on the bridge with an enlisted quartermaster. He was being assisted in his deck watch duties by Acting Master’s Mate Lewis A. Cornthwait, who was performing duty as Officer of the Forecastle. The deck watch also included six enlisted lookouts, mostly African-American rated landsmen, posted with muskets at the port and starboard catheads, gangways, and quarter horseblocks.

The first Housatonic crewman to recognize that something was afoot was Landsman Robert F. Flemming, the lookout stationed at the starboard cathead. Around 8:45 PM, enjoying good visibility
conditions, the vigilant Flemming spotted something unusual about 100 yards distant, approaching the
ship off the starboard bow. After studying it, he voiced a warning to Acting Master’s Mate Cornthwait,
reporting “there is something coming that looks like a log, it looks very suspicious.” Cornthwait looked at
it and responded that it appeared to be nothing but a log. Not satisfied with this judgement, Flemming
stated that it was an unusual looking log, and it was moving against the tide and parallel to the ship.
Flemming then called over the lookout posted across from him on the port cathead, fellow African-
American Landsman C.P. Slade, to have him also take a look at it and provide his opinion. By this time
the object had approached closer, and seemed to be moving toward the area of the ship’s after pivot gun.
The ship’s cooper, George W. Kelly, was also on the forecastle during this exchange, and at this point his
attention was caught by Flemming’s vocal and highly unusual remark that “if no one is going to report
this, I will cut the buoy adrift myself and get ready for slipping.” Upon hearing this, Kelly decided
something out of the ordinary was happening, and immediately headed aft toward his battle station. By
the time Kelly reached his station, he saw the submersible only about fifteen yards from the ship and
cutting a circular wake toward the starboard quarter.

Meanwhile, perhaps prompted by the unusual steps taken by Flemming, Cornthwait looked at the
object again with the benefit of a spyglass and, now sensing the immediacy of the situation, perceived the
threat and began hurrying aft to report the object to the Officer of the Deck. Flemming meanwhile cut
away the ship’s buoy on his own initiative, following which he asked Coxswain Henry S. Gifford, who
was acting as the second-in-command of the forecastle watch, whether he had permission to open fire
upon the suspicious object. Gifford responded in the affirmative, and as Flemming began the defensive
action, the coxswain also began heading aft toward his battle station.

By this point, Cornthwait had missed his window of opportunity to warn the Officer of the Deck.
Acting Master Crosby had spied the approaching object on his own, later stating that it resembled “a
porpoise coming up to the surface to blow.” Crosby called it to the attention of Quartermaster James
Timmons, at first thinking it might only be a tide ripple. Before Timmons could even respond, Crosby
quickly realized that it was making an unusual speed, decided it posed a potential threat to the ship, and
immediately called out “beat to quarters, call the captain, and slip the chain.” As the gong began to sound
Crosby then yelled out “all hands to quarters” to everyone within earshot. Quartermaster Timmons ran
forward nearly as far as the foremast and echoed Crosby’s order to slip the chain. The shacklepin was
quickly knocked out of the anchor chain, which began running out.

Seaman Thomas H. Kelly, doing duty as quarter gunner and stationed near the after pivot gun,
had heard the earlier exchange going on forward between Flemming and Cornthwait, but had not given
any credence to the discussion until he heard the beginning of a similar discussion aft of him between
Crosby and Timmons. Following the sounding of quarters, he headed to the after port of the starboard
pivot gun to look for himself, and saw the submersible only about ten yards from the ship’s side, practically right under him and heading toward the mizzen rigging. Upon witnessing this, he called out “that’s a torpedo!” Someone else then sang out “shoot at the boat, it’s a torpedo and coming to blow us up!”

It was about 8:55 PM when the signal to quarters was sounded, several crucial minutes after Flemming had first voiced his warning. The lookout on the starboard quarter horseblock, Landsman John Saunders, spied the craft when he heard the Officer of the Deck’s warning. The African-American sailor twice tried to fire his musket at it, but the weapon misfired on both attempts. The ship’s executive officer, Lieutenant F.J. Higginson, then climbed up next to Saunders and took his weapon from him, successfully snapping off a shot at the submersible. Higginson later recorded that upon hearing the alarm for general quarters:

I went on deck immediately, found the Officer of the Deck on the bridge, and asked him the cause of the alarm; he pointed about the starboard beam on the water and said “there it is.” I then saw something resembling a plank moving towards the ship at a rate of 3 or 4 knots; it came close alongside, a little forward of the mizzen mast on the starboard side. It then stopped, and appeared to move off slowly. I then went down from the bridge and took the rifle from the lookout on the horse block on the starboard quarter, and fired at this object. It had the appearance of a plank sharp at both ends; it was entirely on awash with the water, and there was a glimmer of light through the top of it, as though through a dead light.

Saunders, after receiving his musket back from Higginson, started aft toward the target and fired on it through the starboard port of the pivot gun between the fore and main masts. When he fired his weapon, the submersible was only about ten yards from the ship’s side, and still heading toward the hull. By this time the *Housatonic*'s commanding officer, Captain Charles W. Pickering, had also rushed on deck, instinctively ordering “slip the chain, and back her,” which his well-disciplined crew had already done. At this point, Saunders could see that the torpedo craft was practically under the ship. Higginson jumped down, and Captain Pickering immediately leaped up and took his place with his double-barreled shotgun. Saunders jumped down onto the deck and went over to the port side to uncover the helm. Pickering later recounted that:

On reaching the deck I gave the order to slip, and heard for the first time it was a torpedo, I think from the Officer of the Deck. I repeated the order to slip, and gave the order to go astern, and to open fire. I turned instantly, took my double barreled gun loaded with buck shot, from Mr. Muzzey, my aide and clerk, and jumped up on the horse block on the starboard quarter which the first Lieutenant had just left having fired a musket at the torpedo. I hastily examined the torpedo; it was shaped like a large whale boat, about two feet, more or less, under water; its position was at right angles to the ship, bow on, and the bow within two or three feet of the ship’s side, about abreast of the mizzenmast, and I supposed it was then fixing the torpedo on. I saw two
projections or knobs about one third of the way from the bows. I fired at these, jumped down from the horse block, and ran to the port side of the Quarter Deck as far as the mizzen mast, singing out “Go astern Faster.”

Acting Ensign F.H. Crandall arrived on deck to witness sailors firing down onto something directly alongside the ship. He caught a glimpse of the boat, which he later recounted was only “about five or six feet off, when the explosion occurred.” Ensign Charles Craven was another who contributed to the defensive field of fire laid down at the attacking vessel. He recording that:

I heard the Officer of the Deck give the order “Call all hands to Quarters.” I went on deck and saw something in the water on the starboard side of the ship, about thirty feet off, and the Captain and the Executive Officer were firing at it. I fired two shots at her with my revolver as she was standing toward the ship as soon as I saw her, and a third shot when she was almost under the counter, having to lean over the port to fire it.

Coxswain Gifford, after leaving Flemming’s position, began heading aft and got as far as the pivot gun between the fore and main masts when he saw the strange craft only about 30 or so yards from the ship, “rounding to towards the starboard quarters.” By the time he had arrived at his post at the Number Six gun, the crew had responded to the alert. After emptying half of the rounds in his Navy Colt into the submersible, Craven had also run to the four broadside 32-pound guns located in the waist of the ship. He and Coxswain Gifford worked together in training the Number Six gun on the torpedo craft as it was backing away from the ship. They had just about depressed the gun as much as it would traverse, and as the submersible was backing away from the ship, with Craven’s hand on the lock string, the torpedo detonated. To him, the sound resembled “a report like the distant firing of a howitzer.” Craven was thrown back into the topsail sheet bitts by the force of the detonation, causing him to prematurely activate the trigger, which did not fall with enough force to explode the primer. He went back to the gun and replaced the primer, and was trying to regain visual sight of the target when he felt water rising around his ankles. Realizing the ship was rapidly sinking stern-first, he headed toward the bow. He then felt the ship lurch to port, hit the bottom, and begin to settle. About four minutes after the stern had hit the bottom, the entire ship was under water. He later recollected that:

Afterwards, in looking about aft for the body of Mr. Hazeltine, I saw that the starboard side of the quarter deck abaft the mizzen mast, and the furniture of the wardroom and cabin were floating within the ridge rope so that I supposed the whole starboard side of the ship abaft the mizzen mast was blown off.

About three and a half minutes had elapsed from the time the gong was sounded to the moment the torpedo detonated. The ship was just beginning to make sternway. Lieutenant Higginson later said “it sounded like a collision with another vessel.” On duty in the engine room, Third Assistant Engineer J.W.
Holihan, who had given the order to stop the valves upon hearing three bells, was standing by the throttle valve when the explosive detonated. Staggered by the shock, Holihan saw the engine take off so rapidly he assumed the machinery had come apart and instinctively moved to close the throttle valve, to no effect. Second Assistant Engineer C.F. Mayer, Jr. related his experiences as follows:

The engine was immediately backed, and had made three or four revolutions when I heard the explosion, accompanied by a sound of rushing water and crashing timbers and metal. Immediately the engine went with great velocity as if the propeller had broken off. I then throttled her down, but with little effect. I then jumped up the hatch, saw the ship was sinking and gave the order for all hands to go on deck.

Just before the explosion, Gifford overheard Crosby sensibly tell the men around him that they “better go forward as it was a Torpedo and they would all be blown up.” Not all of the crew managed to escape from harm’s way. When the torpedo detonated, Landsman Theodore Parker was still standing his watch position on the starboard gangway. The African-American sailor was reportedly killed instantly, and his body flung into the air; while others moved forward to safer places, this sailor evidently stood his post to the end, in spite of the obvious commotion going on around him. Captain’s Clerk Charles O. Muzzey, who had so expeditiously brought the captain his double-barreled shotgun, may also have been killed as a result of the blast, for he was not among those rescued. Captain Pickering, who did not run forward, and one other crewman suffered serious injury. The wounded Pickering later stated:

The men were then huddling forward, I would not call them aft to the guns, as they could not be trained until the ship had got some distance from the Torpedo, and they were in a safer place. I thought of going forward myself to get clear of the Torpedo, but reflecting that my proper station was aft, I remained there, and was blown into the air the next instant from where I stood on the Port side abreast of the mizzen mast. I found myself in the water about where I stood previous to the explosion amongst broken timbers, the debris of panel work and planking.

Further forward, Acting Master Joseph W. Congdon had drawn his revolver to fire at the attacking boat, but before he could aim, he was rocked by the explosion. Feeling that the ship was sinking, and assuming that the captain and executive officer, whom he knew to have been aft, were dead, he gave the order to abandon ship. Quickly realizing that there might not be time to get everyone into the launches, he began driving crewmembers up into the rigging, which he knew would not go completely under. He then took charge of the efforts to rescue men from the water.

Upon hearing the beat to quarters, Flemming, the sailor who had first voiced the warning, had begun running aft to his post at the Number Four gun, but before he could reach it, the ship’s aft starboard end exploded, and timber fragments began raining down around him. Saunders was taking the hood off the helm when the blast occurred. Shocked by the explosion, Saunders later related “I do not remember
anything until I found myself under where the wheel was." Knowing where the target was but lacking a weapon, Quartermaster Timmons had run over to the sailor standing the port gangway watch and grabbed his musket, but before he could get back across the deck to fire at the attacker, the explosion occurred.

After the explosion, Flemming turned around and began running back toward the bow, and upon arriving there, spied the attacking craft sitting stationary near the starboard quarter. Flemming aimed his musket at it and took one last shot, then climbed up into the foretop stubbornly carrying his weapon, which he was still in possession of when rescued. In addition to being the first sailor to see the H.L. Hunley that night, the sharp-eyed Flemming may have been the last person to see that craft before it was lost. While in the fore rigging, he saw the crew of the H.L. Hunley signaling to shore. He later recorded:

When the Canandaigua got astern, and lying athwart of the Housatonic, about four ship lengths off, while I was in the fore-rigging. I saw a blue light on the water just ahead of the Canandaigua, and on the starboard quarters of the Housatonic.

Lost with the Housatonic were two if its officers and three of its enlisted men: Ensign Edward C. Hazeltine, Captain’s Clerk Charles O. Muzzey, Quartermaster John Williams, Second Class Fireman John Walsh, and Landsman Theodore Parker. As per the tradition upon the loss of a ship, a naval court of inquiry was convened following the incident. During the proceedings, Seaman Kelly, the quarter gunner of the watch, stated that “if the object had been reported when it was first discovered, [the number four] pivot gun...might have been trained on it.” Pickering’s actions were judged to have been adequate by the court of inquiry, but he later lamented “if I had had two minutes to work in, I probably could have saved the ship and sunk the torpedo craft” (Proceedings of the Naval Court of Inquiry, 26 February 1864, Case #4345, Commission of Inquiry on the Sinking of the Housatonic, U.S. Navy Area Files [M-265], NARA).

A steep toll was exacted in exchange for the H.L. Hunley’s tactical victory. Dixon and his crew never returned to Sullivan’s Island, even though they evidently survived long enough to successfully send the prearranged lamp signals requesting a light to guide them safely back into port (ORN 1, XV:335). The vanishing of the Hunley with all hands subsequently became one of the Civil War's enduring mysteries, remaining unsolved until the wreck was definitively relocated in 1995 by archaeologists Ralph Wilbanks, Wes Hall, and Harry Pecorelli III of best-selling author Clive Cussler’s National Underwater Marine Agency Foundation (NUMA) (Figure 28). During the 1996 archaeological assessment of H.L. Hunley, the wreck was determined to be located approximately 1,000 feet (about 305 meters) east, or to seaward of, the wreck of Housatonic. The submersible came to rest on the bottom with its bow pointing shoreward, roughly in the same orientation as Housatonic’s mooring configuration. The archaeological site assessment concluded that H.L. Hunley’s ultimate location seaward of Housatonic may have been the result of tidal influences that acted upon the vessel during its sinking (Murphy ed. 1998:94).
Figure 28. Diagram of the wreck of the *H.L. Hunley* based upon documentation collected during the 1996 assessment survey by NPS-SCRU, NHC-UA, and SCIAA archaeologists (courtesy of NPS-SCRU).
In the roughly 130 years between *H.L. Hunley*’s loss and discovery, a number of theories have been put forward regarding precisely when, where, and how the boat was lost. Alexander for a long time believed that *H.L. Hunley* had been caught in or beneath *Housatonic* as the Navy warship rapidly sank (Alexander 1902), this belief being based partially upon the incorrect observations by government divers that they had found the submersible. But upon hearing from authoritative Navy sources that these reports were not authentic, Alexander still continued to believe that the wreck must have nevertheless come to rest not far away, having like *Housatonic* rapidly settled five feet beneath the seabed. Alexander noted that an agreement existed between the crew members that if the boat should for any reason be unable to surface, “the sea cocks were to be opened and the boat flooded” in order to prevent the suffering of slow asphyxiation known to have been experienced by Hunley’s crew (Alexander 1903). It has been theorized that the agreement Alexander spoke of may have represented the romanticized interpretation of a practical last-ditch escape strategy, in which an attempt would be made to equalize the pressures on the hatch surfaces in order to allow the crew to open them and ascend from the wreck (Ragan 1995:168).

It has also been conjectured that the boat succumbed to structural damage or crew injuries sustained as a result of the contact and explosion. The submersible was approximately 50 feet from the hull of *Housatonic* when the torpedo exploded. While the potential effects of the detonation on the submersible’s hull integrity remain a question mark, the force of the explosion’s shock wave in the water may certainly have started some hull seams (Murphy ed. 1998:93). Structural damage to the forward conning tower was observed during the 1995 assessment excavation by divers, including the author.

Based on the amount of *Housatonic*’s defending small arms fire, it seems very likely that the *Hunley* did absorb some degree of projectile damage, in light of the amount of defensive fire and the close range of the two vessels at the time the fire was laid down. The boat drew fire from a variety of light weapons, including Flemming’s musket, Saunder’s musket (also fired by Higginson), Craven’s revolver, Pickering’s double-barreled shotgun (fired at the conning towers, based upon his testimony), and possibly the musketry fire of several other sailors, including perhaps Parker, who was readily armed and had an excellent firing position, but did not live to contribute to the after-action report. It seems particularly feasible that Pickering’s spread of buckshot at the “two projections” may have provided a good chance for damage to occur to some of the deadlights, and perhaps could even have inflicted crew injury.

Another theory put forward to account for the boat’s disappearance is that swift seas and worsening weather prevented the exhausted crew from successfully regaining port, and ultimately caused their delicately balanced boat to founder. McClintock’s opinion, recorded in 1872, is as follows:

I would here state that I do not believe that the Sub Marine Boat was lost in the operation of destroying the Housatonic, but was lost in a storm which occurred a few hours after. I am aware that the Federals has made diligent search for her, and have made three different reports of having found her, yet no descriptions that I have ever
heard are correct (PRO, Adm. Series 1/6236, file 39455, Report on Mr. McClintock’s Submarine Torpedo Boat).

During the late 1950s researcher Louis Genella conducted research into the climatological conditions of the night of 17 February, 1864, and concluded that on the 17th tidal conditions in the vicinity of Fort Sumter were probably as follows (all times are local): high water occurring at 3:40 PM, low water occurring at 9:45 PM (less than an hour following the attack); beginning of ebb current occurring at 4:30 PM, maximum ebb occurring at 7:45 PM; and the beginning of flood current occurring at 10:50 PM (Genella Collection, Tulane University Library, Letter, Chief, Tides & Currents Division, U.S. Coast Geodetic Survey, Department of Commerce to Louis J. Genella, 13 March 1958). The attack took place at approximately between 8:45 and 9:00 PM. The time that the blue signal light was witnessed and answered by Battery Marshall may have been sometime around 9:30 PM, which is when a blue light was observed on the water near the assisting USS Canandaigua by Flemming in the rigging of the sunken Housatonic (Ragan 1995:139-140, 170). It seems evident that the crew of the H.L. Hunley had timed the attack to allow their return to coincide with the incoming tide.

Flemming’s recollection that the blue light was “just ahead of the Canandaigua” raises another possibility, that the Hunley may have been run down by the Canandaigua as that ship was coming to assist the Housatonic survivors.

Finally, the possibility must be considered that the Hunley’s loss may be attributable to more than one of these factors.

McClintock’s Postwar Development Efforts

One of the most valuable sources of information on McClintock’s submersible boatbuilding activities has turned out to be several documents and sketches recently uncovered at the Public Record Office (PRO) in London (the author was apprised of their existence by archaeologists Peter Hitchcock and Brett Phaneuf during their 1996 research activities on the Intelligent Whale). According to these records, in late October of 1872 McClintock journeyed from Mobile to Halifax, Nova Scotia to attend a discrete meeting with Royal Navy officers aboard the HMS Royal Alfred. The purpose of the trip was to discuss his work in submarine warfare and express his wish to build a submersible torpedo vessel for the Royal Navy. Captain F. Nicholson, RN and Chief Engineer J.H. Ellis, RN of the Royal Alfred were instructed to meet with him, gather information, and report their findings and recommendations to the Admiralty in writing. The meeting was secret, probably at least partly for McClintock’s sake, as divulging such sensitive technical information to a foreign power could have been construed as treasonous (especially if
he had been required to swear an oath of allegiance following Appomattox. In their subsequent report, Nicholson and Ellis recorded that they were:

...thoroughly impressed with the intelligence of Mr. McClintock, and with his knowledge of all points chemical and mechanical connected with torpedoes and submarine vessels...He is, I believe, entirely self-taught, and was much employed by the Confederates on torpedo work, on which he has much practical information which he seems ready to communicate. He hates his countrymen, Americans, and hopes to some day be a British subject (PRO, Adm. Series 1/6236, File 39455, Report on a submarine boat invented by Mr. McClintock of Mobile, U.S. of America).

Accompanying the report and enclosures are three detailed sketches showing different views of a boat of McClintock’s design (Figures 22, 23, and 24). The vessel depicted in this representation appears to have the Hunley’s overall dimensions, but possess elements of the American Diver’s internal arrangements. Essentially, it comprises the vessel McClintock desired to build, incorporating what he considered as the best elements of all his boats. McClintock freely admitted that his boats suffered from three basic problems: the lack of a self-propelling motive power, inaccurate compass readings, and an inability to measure the horizontal movement while running submerged. Nicholson and Ellis qualified the drawing as follows:

The drawing we enclose is a representation of the boat that effected this destruction [of USS Housatonic], it is not drawn to scale, nor did the original boat contain any engine, the only motive power then available being manual labor...It will be seen by the enclosures that the attempt to attain a proper motive power resulted in failure, only about two knots being accomplished. Mr. McClintock now proposes to use an engine [illegible, possibly “driven”] by ammoniacal gas, which he explained to us, and which he has seen in successful operation as a propelling power for street cars in New Orleans; as a very fair description of this invention is given in “The Engineer” of “Aug 70” and “January 72”...One difficulty which Mr. McClintock very frankly pointed out was the uncertain action of the compass in such a vessel...He also pointed out another requirement which he had not succeeded in applying - rather from want of means than from want of skill, or from any great difficulty in the requirement [illegible]. He states that when under weigh beneath the surface, it is quite impossible to ascertain whether the vessel is progressing as there are no passing objects by which to recognize the fact of motion; on several occasions when experimenting with his boat they continued working the crank while all the time the boat was hard and fast in the mud (PRO, Adm. Series 1/6236, File 39455, Report on a submarine boat invented by Mr. McClintock of Mobile, U.S. of America).

Enclosed with their intelligence summary were copies of letters endorsing McClintock from former Confederate officers Matthew F. Maury, James E. Slaughter, James D. Johnston, Raphael Semmes, and Peter Murphey. But perhaps the most valuable piece of historical evidence is the four page narrative, written in McClintock’s own hand, describing the construction of the three boats he designed and saw built during the war.
HALLIGAN'S BOAT AT THE SELMA NAVAL GUN FOUNDRY AND IN MOBILE

The submersible boat *St. Patrick* was built in 1864 at the Selma Naval Gun Foundry in Selma, Alabama. It was designed by John P. Halligan, and built by him under contract for the Navy Department (Still 1969:64). The *St. Patrick* measured 50 feet in length, six feet in beam, and ten feet in depth. Described as “shaped like a trout,” it possessed a cylindrical body that tapered to pointed ends, and required a crew of seven to operate it (Perry 1965:183). The Navy’s commanding officer at Selma described it as “propelled by steam (the engine is very compact), though underwater by hand. There are also arrangements for raising and descending at will, for attaching torpedoes to the bottom of vessels, etc.” (Bergeron 1991:169-170). With Halligan acting as the boat’s commander, it sailed down the Alabama River from Selma to Mobile sometime between September and November 1864 (*ORN* 1, **XXI**:902-903, 748; *ORN* 2, **I**:265).

Upon its arrival at Mobile, it became the subject of conflict between Halligan and the military authorities, including Major General Dabney H. Maury, CSA (*ORN* 1, **XXI**:930-931; *ORA* 2, **XXXXV**:735). Due to dissatisfaction with the performance of Halligan as contractor and commander, Maury seized the vessel in January 1865. A substantial amount of legal and service jurisdictional wrangling followed (*ORN** XXI**:568; *ORA** XXXXV** pt 2:649, 720, 781), following which the boat was finally turned over to Army, but placed under the command of Lieutenant John T. Walker, CSN. Walker, upon assuming command, discovered that Halligan had removed essential components of the vessel’s machinery, which the new vessel commander energetically recovered (*SHSP IX*:81). By this time a spar torpedo was adopted as the vessel’s weapon of choice, replacing the previously employed concept of manual attachment.

In the early morning hours of 28 January 1865, Walker and his crew ran out into Mobile Bay, where they intended to attack either the sidewheel gunboat USS *Octorara* or the monitor USS *Chickasaw*, both of which were lying in the upper portion of bay. Walker selected the *Octorara* as the target, approached it at close quarters, and attempted to make contact, upon which the torpedo either misfired or had its blast deflected by the shallow mud bottom. Before Walker could back off, a quick-thinking U.S. sailor grabbed the *St. Patrick*’s smokestack in an attempt to hold it in place, but was forced to release it upon being fired at by Walker’s crew (Figure 29). The *Octorara*’s watch returned small arms fire, but the submersible made good its withdrawal. No serious damage to either side was suffered (*Harper’s Weekly*, 25 February 1865:124; *ORN* 1, **XXII**:267-269; *ORA** XXXXIX, pt 1:13; Bradford 1888:14).

Shortly after this action, *St. Patrick* was used in an attempt to create a diversion to allow the escape of a blockade runner that the West Gulf Blockading Squadron had pent up in Mobile Bay. The captain of the Greenock-built blockade runner *Red Gauntlet*, Lieutenant Joseph Fry, CSN, proposed a
Figure 29. An illustration that appeared in *Harper's Illustrated Weekly* depicting the *St. Patrick*'s 26 January 1865 attack on the USS *Octorara*, and the astute reaction of one of the *Octorara*'s crew (*Harper's Weekly*, 22 February 1865:124, reproduced in Stern 1962:173).
plan whereby the *St. Patrick* would make motions to attack the fleet, drawing attention away from the *Red Gauntlet* and allowing it to run out into the gulf. The submersible managed its part of the plan and successfully opened a hole in the lines, but the *Red Gauntlet*’s dash was called off because the risk appeared too great (Walker 1875:175-189; cited in Schell 1992:181).

The *St. Patrick* was last reported as ferrying supplies out to the garrison at Spanish Fort, which was at that time under siege (Perry 1965:183-184; Schell 1992:179-181).

**OTHER EFFORTS IN MOBILE, REAL AND IMAGINED**

**An Unidentified Effort**

Only very scant evidence exists regarding what is possibly the earliest known Mobile effort to build a submersible boat. During the last week of December 1861 in Mobile, it was noted that “the submarence apparatus in the river was boarded and sunk by some reprobate during some night of last week” (private letter, Charles H. Poolen to General D. Leadbetter, 5 January 1862, Dr. Thomas M. McMillan Collection, Mobile City Museum; cited in Schell 1992:164). The “submarine apparatus” referred to in this letter may have been a submersible vessel.

There may have been a connection between this effort and Franklin G. Smith, who is credited with having built a submarine in Mobile early in the war (Statement of Isaac Bell, 26 July 1919, as to Civil War activities of Franklin G. Smith; cited in Schell 1992:164).

**Albert Pierce’s Boat**

During the summer and fall of 1864, Mobile Bay saw the presence of another strange torpedo craft. It is not clear whether this boat was a submersible or a semi-submersible. It has been stated that in addition to being steam powered it may have been either hand or foot powered as an alternate means of propulsion for use while running submerged (Schell 1992:177-178).

In an attempt to attack Farragut’s fleet, the pilot lost his reckoning, and the crew was forced to jettison the torpedo due to additional problems. They made it back into Mobile Bay safely, but determined that the vessel’s boiler was untrustworthy. The boat underwent the installation of a new boiler. Shortly thereafter, while the boat was traveling en route to Fort Morgan, the boiler exploded, killing all but one of the crew and running the boat aground (*ORN* 1, XX:700; *ORN* 1, XXI:187; von Scheliha 1868:314). Bradford may have been referring to this boat when he noted that a torpedo vessel (which he misidentified as the *St. Patrick*) “attempted to run out from Mobile, in May, 1864, on a trial trip, preparatory to
Figure 30. A U.S. Navy sailor's sketch of a Confederate vessel run aground in Mobile Bay and captured in August 1864 (from Harper's Weekly, 24 September 1864:609).
attacking a blockading vessel, but burst her boiler after running a short distance, killing one man and wounding another badly" (Bradford 1888:14).

This incident was the subject of an article appearing in Harper's Weekly, which reported that "the boat was made of wood, covered with sheathing of one-fourth inch iron. Her length was 38 feet, and her diameter 7 feet. The boat will be repaired for use by the federal fleet." An illustration of the boat, drawn by "R. Wier, United States Navy," accompanied the article (Figure 30). The drawing was annotated with notes identifying the craft's "deadlight," "torpedo projector," "crane in elevating or lowering the torpedo," "cleats," "smoke stack," "sight holes for the pilot or helmsman," and "covering of steam-drum" (Harper's Weekly, 24 September 1864:609).

The crewmember who survived the explosion, Albert Pierce, lost his leg as a result and was confined to the hospital at Fort Morgan during the Battle of Mobile Bay. He was still at the hospital when the fort was captured, and was made a prisoner of war (Schell 1992:177-178).

The Mysterious Anstilt and his American Ram

A somewhat fanciful sketch of a boat attributed to a Mobilian named "Anstilt" (also referred to in print as "Alstitt") appeared in several newspapers in mid-1864. According to the correspondent, A.M. Olivier de Jalvin, the vessel was made of iron, measured 23 yards in length, possessed a "hermetically sealed deck," and had its depth control provided by a "horizontal rudder" mounted at the bow. Information regarding this vessel was purportedly conveyed from Mobile to France through the crew of a blockade runner. This information appeared in the French magazine Le Monde Illustre, from which it was picked up and reprinted in Harper's Weekly (Figure 31) (Harper's Weekly, 30 January 1864:77-78). The drawing has subsequently appeared in a number of French publications relating to the history of submarines (Figure 32) (Gaget 1901, Villon 1901, Burgoyne 1903, Pesce 1906:301, Delpuech 1907).

Sources regarding this vessel are extremely sketchy, and Schell has pointed out that they may have been referring to the American Diver, confusing Anstilt's proposed designs and propulsion experiments with work undertaken by the New Orleans group at Park & Lyons. It is significant that Anstilt's vessel was described as electric-powered, and that experiments were going on in Mobile at this time to fit American Diver with such a means of propulsion (Schell 1992:169-171).

THE TRITON COMPANY IN RICHMOND AND THE TRANS-MISSISSIPPI

In late November 1863, a Federal foraging party captured a Confederate mail courier attempting to cross the Mississippi River into Texas, near Tunica Bend. In this mail shipment were two letters
Figure 31. The unconfirmed *American Ram* attributed to "Alstitt" or "Anstilt" (from *Harper's Weekly*, 30 January 1864:77-78).
Figure 32. Pesce's later redrawing of the so-called *American Ram*’s longitudinal cross-section (from Pesce 1906:301).
relating to underwater warfare and submersible construction. One of the letters, posted from Richmond and dated 13 October 1863, was from James Jones, a practical machinist who provided details of recent torpedo experiments and torpedo locations in certain areas. The other letter was one “giving a description and covering a diagram of a proposed submarine torpedo vessel, suggested to be used on the coast of Texas” (Figure 33). It was noted that this letter “seems to be from the principal contractor for building torpedo vessels, [and] gives instructions for the building of some west of the Mississippi River and for Texas.” These letters were forwarded to Headquarters, Department of the Gulf on 27 November 1863, and from there were forwarded to Secretary of the Navy Welles on 18 January 1864 (ORN 1, IX:411-412; CWNC 1971:IV-8).

Although this design has been previously attributed to James Jones (Perry 1965:94), recent archival research by Mark Ragan indicates that the drawing of the submersible vessel in the second letter was actually the work of C. Williams. James Jones and C. Williams were both involved in the activities of the Richmond-based Triton Company, a corporation that focused on underwater warfare activities and included among its sponsors C.S. Senator A.J. Marshall (Mark Ragan, personal communication, December 1998). The letters may also allude to the possibility that members of this group had some connection in the construction of the earlier-built Tredegar boats (Perry 1965:94).

Described as a “persistent petitioner,” Williams was one of a flood of inventors who seemed to be constantly forwarding ideas to the War Department and Chief Engineer (Perry 1965:29). Among the plans and letters he forwarded to the government was the design for “a torpedo and submarine apparatus” (JC VII:82; NARA, RG 109, Register of Letters Received Confederate Engineers, Vol. 7, Letters from C. Williams to Engineer Bureau dated 28 December 1863, 30 December 1863, and 2 June 1864; cited in Perry 1965:29). He is known to have enlisted the aid of a Major J.A. Williams, CSA, who is described as possibly being a relative (Perry 1965:29). This relationship may have provided his Richmond connection.

James Jones is probably the “Jimmie Jones” listed as a member of the Singer Submarine Corporation along with E.C. Singer, B. Gus Whitney, R.W. Dunn, and J.D. Braeman, all of whom invested in the H.L. Hunley (Duncan 1965:61-62). It may be significant that E.C. Singer, head of the organization and also a H.L. Hunley investor, was from Lavaca, Texas (Hill 1916). The Singer Submarine Corporation was formed in March 1863 in Mobile and operated in cooperation with the Army Engineers. It may be that the Triton Company was formed about the same time.

By a little over a year later, Jones had evidently made his way to Texas. On 13 March 1865, Major A.M. Jackson, USA of the Tenth Colored Heavy Artillery dispatched a message to Lieutenant Colonel C.T. Christenson, Assistant Adjutant General, Military Division of West Mississippi, in which he outlined selected information found in recently-intercepted Confederate communications. The subject
Figure 33. Document found by Federal forces in a captured Confederate mail shipment. It contains the design of a Triton Company submarine boat designed by C. Williams and intended to operate in Trans-Mississippi Department waters (from CWNC 1971:IV-9).
regarded the activities of Ike Hutchinson and James Jones, both operating out of Lavaca, Texas, where they were conducting mining operations in the Red River and possibly involved in the construction of a peculiar sort of torpedo vessel. In his dispatch Major Jackson stated:

The following is a description of the torpedo boats, one of which is at Houston and four at Shreveport: The boat is 40 feet long, 48 inches deep, and 40 inches wide, built entirely of iron, and shaped similar to a steam boiler. The ends are sharp pointed. On the sides are two iron flanges (called fins), for the purpose of raising or lowering the boat in the water. The boat is propelled at the rate of 4 miles an hour by means of a crank, worked by two men. The wheel is on the propeller principle. The boat is usually worked 7 feet under the water and has four dead lights for the purpose of steering or taking observations. Each boat carries two torpedoes, one at the bow, attached to a pole twenty feet long; one at the stern, fastened on a plank 10 or 12 feet long. The explosion of the missile on the bow is caused by coming in contact with the object intended to be destroyed. The one at the stern, on the plank, is intended to explode when the plank strikes the vessel. The air arrangements are so constructed as to retain sufficient air for four men at work and four idle two or three hours. The torpedoes are made of sheet iron three-sixteens of an inch thick, and contain 40 pounds of powder. The shape is something after the pattern of a wooden churn, and about 28 inches long. Jones, the originator and constructor of these boats, also constructed the one which attempted to destroy the New Ironsides in Charleston, S.C. (ORN I, XXII:103-105).

In a letter dated 27 March 1865, Lieutenant Henry Wilson, USN of the USS Cayuga reported to Captain Benjamin F. Sands, USN, Commanding Officer of the West Gulf Blockading Squadron's Second Division (off Galveston), that he had picked up seven Confederate artillerymen who were in the process of deserting in a small boat. Wilson wrote that:

They know nothing definite about the torpedo boats, but have heard that such boats were being built on the San Jacinto River, at Lynchburg. One of the men saw what was shown to him as a torpedo boat lying in the main channel at Galveston. It was shaped like a box, with square corners, and was quite low in the water. He could not tell whether she was plated or not, and did not seem positive that she was a torpedo boat (ORN I, XXII:124).

The fate of this boat is unknown. It is conceivable that the interviewees might have witnessed a semi-submersible boat rather than a submersible boat.

SUMMARY

Between 1861 and 1865, many Confederate submersible boat design concepts were put forward in the form of circulated ideas and proposals, Congressional memorials, and through other means. At least four vessel designs successfully completed the patent process. But only some of the many proposed concepts reached a state of actual construction. These projects displayed a wide regional diversity,
ranging from Maryland and Virginia to all the way around the Gulf Coast as far as Texas, with support coming from as far inland as Tennessee and Missouri. They demonstrated flexibility of movement, with some efforts ending far from where they began.

If Winans' experimental hull is considered, at least nine vessels reached the building stage in some form. Of these, at least six reached some level of operational readiness, and at least three demonstrated minimally adequate seaworthiness. Of the boats that commenced beyond the fabrication phase, one was captured, two were scuttled, two were lost in operational accidents (not including the Hunley's first two loss incidents), and one was lost in combat. The fate of the Tredegar boats, and of St. Patrick, remains a mystery. These figures do not take into consideration any of the boats that may have reached some level of fabrication in the Trans-Mississippi Department. It is important to note that these are only the known attempts. When we consider the limited and ambiguous nature of evidence available for known efforts, there exists a good possibility that more were built, or at least reached the design stage, for which there is simply no evidence at all.

These projects were spurred by a variety of motives, and came to pass as a result of private, government, and military support. Naturally, the C.S. Navy was a major sponsoring agent, undertaking building programs at Tredegar and Selma. Other projects entailed a combination of independent and C.S. Army support (such as the Singer Submarine Corporation's work with the Army in Mobile and Charleston, and the Triton Company's efforts to develop boats in the Trans-Mississippi). But despite the role of the military in the building of these boats, it remained to individuals to shepherd these abstract ideas and designs into physical reality. It required inventive entrepreneurs like Winans, who was willing to underwrite elaborate experiments and in doing so offer encouragement to others. It needed open-minded engineering visionaries like McClintock, Williams, and Cheeney to initiate the process and share the vision. Also crucial were people possessing foresight and capable of forming support bases, individuals like Hunley, Singer, Whitney, and Marshall. These people had the ability to take an idea and follow it through into execution, and in the process to personally assume the financial or physical risks necessary. It additionally needed military strategists and tacticians who were capable of overseeing the operation of the boats, allowing flexibility of movement within the changing theaters of combat, adapting the boats to changing tactical missions, and willing to offer opportunities for their employment in the larger context of military operations, or if they couldn't, to recognize the limitations and reassign the resources somewhere else where they could be employed. It furthermore required disciplined crews willing to perform the unusual missions asked of them. Finally, and most importantly, it required leaders who possessed faith in the enterprise, who could inspire the trust of their crews, who could seek out opportunities and bend changing situations to their advantage when practicable, and when they couldn't do this, to forge ahead anyway and assume reasonable risk. Ultimately, only three boats were able to
embody all of these factors and effectively engage enemy vessels (the Tredegar boat off Fortress Monroe with an unknown crew; the St. Patrick under Lieutenant Walker, CSN; and the H.L. Hunley under Lieutenant Dixon, CSA), another was lost in an attempt to engage enemy vessels (the American Diver), and one was damaged in an attempt (the boat upon which Albert Pierce was a crew member). Only a single boat, the H.L. Hunley, was able to attain the goal of completely destroying an enemy vessel in combat, and it was running on the surface at the time.
CHAPTER IV

THE HISTORY OF THE LOUISIANA STATE MUSEUM VESSEL FROM 1878 TO PRESENT

The mystery of the Louisiana State Museum Vessel began with its discovery in July of 1878. While working in the waters of Lake Ponchartrain and the canals that connect it to the city of New Orleans, the channel dredge *Valentine* was notified by a swimming boy that a sunken metal boat lay in the vicinity of its work area. The vessel was evidently discovered off the southern shoreline of Lake Ponchartrain somewhere between the mouth of Bayou St. John, and the lake entrance to the New Canal. A local newspaper account published years afterward stated that it was recovered in the mouth of Bayou St. John ("First Torpedo Boat," *New Orleans Picayune*, 2 April 1909). J. Thomas Scharf, in his *History of the Confederate States Navy*, displayed knowledge of this event in his statement that "a torpedo boat was dredged up in July, 1878, in the canal, near Spanish Fort, New Orleans. It had undoubtedly been built by the Confederates and sunk when they evacuated the city in 1862" (Scharf 1887:761). Most sources indicate that it was encountered during the installation or maintenance of "a canal along the Lake Ponchartrain shoreline just west of Spanish Fort" (Kloeppe11992:9). From 1878 to 1895, the submarine lay on shore where it had been deposited by the dredge.

Sometime during the summer of 1895, the boat was reportedly seen by four boys somewhere "along the marshy shores of Lake Ponchartrain...hidden by tangled underbrush and partially sunk in the mud" (Kloeppe11992:9-10). One of these boys, Alfred Wellborn, suspected that this vessel represented a Confederate submersible. The boys reported their find to a group of workmen who were building a wharf nearby. That fall it was moved to the old fortification and amusement park known as Spanish Fort, situated at the junction of Lake Ponchartrain with the western bank of Bayou St. John. It was placed on the lawn right next to the bayou, where it was propped up on wooden blocks as a sort of local tourist attraction. Over time it became known as "a curiosity to amusement seekers" (Arthur 1942). A number of photographic images of the boat were made during this period, among which are several taken by local photographer Georges Francois Muguier (Figures 34, 35, and 36). Surviving photographic evidence indicates that at the time it was set up at Spanish Fort, only one of its four original propeller blades was still in place, and that sometime during its stay at this location, it lost this last blade. A turn of the century-era photograph of the vessel was also published in a book written by Simon Lake (Figure 37) (Lake 1918:152).

By 1902, the vessel was again neglected, had fallen over on its side, and was becoming overgrown with untended vegetation. When surviving Confederate submariner William Alexander's recollection of his submarine service appeared in the 29 June 1902 *New Orleans Picayune*, a short note
Figure 34. Late-19th century view of the Louisiana State Museum Vessel, probably made by Georges Francois Mugnier (from LSM, reproduced in Friedman 1994:14).

Figure 35. Late-19th century view of the Louisiana State Museum Vessel, probably made by Mugnier (courtesy of LSM).
Figure 36. Another late-19th century view of the Louisiana State Museum Vessel, possibly also made by Mugnier (courtesy of LSM).

Figure 37. Turn-of-the-century view of the Louisiana State Museum Vessel (from Lake 1918:152).
accompanying it identified the boat “half submerged in the weeds and flowers growing on the bank of Bayou St. John” as *Pioneer*. This is the earliest known instance of the vessel being identified with *Pioneer*, an assertion that would be accepted and repeated in many subsequent publications.

On 19 June 1907, the *New Orleans Times-Democrat* printed a letter from Alfred Wellborn, one of the four boys who had seen the boat alongside the water in 1895. In this letter he decried the lack of care and attention given to the submarine boat and suggested it be moved from Spanish Fort to a place of greater respect (Kloeppe 1992:10). By 11 December 1907, the boat had been taken control of by a local chapter of the United Confederate Veterans, Beauregard Camp 130.

On 2 April 1909, in a move sponsored by Beauregard Camp 130, the vessel was transported to the Louisiana State Home for Confederate Soldiers. The “Soldiers Home,” as it was commonly called, was situated at Camp Nicholls, at the end of Esplanade Avenue, on Bayou St. John (UCV 1892:145). Upon its arrival there, the boat was set upright and mounted in a concrete base (Figure 38), and partially filled with cement to stabilize it. This is the cement that it still contains today. Photographs indicate that by the time it arrived at this location, the surviving rudder (at the bow) had disappeared. The official presentation was made with a ceremony on 10 April. A bronze plaque commemorating the event was affixed to the port bow of the hull. This plaque is still mounted on the vessel, and reads:

**FIRST SUBMARINE TORPEDO BOAT**  
**Donated by Camp Beauregard, No. 130, U.S.C.V.**  
**To the Soldier’s Home, December 11, 1907**  
**Officers of the Camp:**  
W.O. Hart, Commandant  
W.T. Army, First Lieut. Commander  
E.K. Huey, Second Lieut. Commander  
G.K. Ronsud, Adjutant  
A.A. Bursley, Treasurer  
C.J. Chapotin, Quartermaster  
Rixford A. Lincoln, Historian  
Rev. J.W. Caldwell, Jr., Chaplain  
Dr. G.H. Tichenor, Jr., Surgeon  
W.J. Snow, Color Sergeant  
**Placed in Position, April 10, 1909**  
**Committee in Charge:**  
Gordon S. Levy, Edward A. Fowler

Two of these camp officers, Gordon S. Levy and W.O. Hart, subsequently published articles about the boat, Levy in the magazine *Confederate Veteran* (Levy 1909), and Hart in the *Louisiana Legal News* (Hart 1923). A photograph of the boat appeared in another *Confederate Veteran* issue in conjunction with an article written by Confederate Navy veteran James Tomb (Figure 39) (Tomb 1914:168).
Figure 38. Poor quality 1909 image of the vessel at the time of its being dedicated at the Soldier's Home on Bayou St. John (from the *New Orleans Daily Picayune*, 2 April 1909).
Figure 39. Poor quality image of the vessel, circa 1914 (from Tomb 1914:168).
In February 1926, historian William M. Robinson, Jr. traveled to Camp Nicholls and inspected the vessel. He subsequently discussed the boat in his book *The Confederate Privateers*, identifying it as *Pioneer* (Robinson 1928:165-178). He took three photographs of the vessel at this time (Figure 40). Another image of the boat, probably dating to the 1930s, appeared in a later newspaper article (Figure 41) (Arthur 1942).

In June 1942, with the passage of the generation that included the veterans of the Civil War, the boat was moved yet again, to historic Jackson Square in the heart of the French Quarter. There it was set upon two new concrete supports as an outdoor exhibit. At this time it was officially turned over to the custody of the Louisiana State Museum. While in Jackson Square it was the subject of much tourist attention (Figures 42, 43, and 44). Surviving photographic evidence reveals that at some point during this period the starboard dive plane was damaged, resulting in the loss of the leading edge portion.

Sometime after the end of the Second World War, the boat was moved across the street into the Louisiana State Museum’s historic Pontalba Building on St. Ann Street, which faces Jackson Square (Figure 45). For this move both the vessel and its concrete supports were rigged as one unit and lifted together. A photograph of the event reveals that the boat was rigged in such a way so as to allow the steel cable to pass beneath the keel. This method probably accounts for the inward kink that is presently visible in the keel’s midships portion. When the boat was lifted, the deteriorated hull probably suffered a slight distortion under its own weight and that of the concrete. Following arrival at its destination, the vessel was placed just inside one of the Pontalba Building’s main doors (Figure 46). On 24 April 1957, the boat journeyed to its most recent home, and new concrete supports, at the Louisiana State Museum’s Presbytere Arcade, on the northern corner facing Jackson Square (Figure 47). It resides in the Presbytere Arcade today (Figure 48). A map is provided for reference in tracing the boat’s journeys around the city (Figure 49).

Although the vessel can be seen to suffer from a variety of structural problems, it nevertheless survives in an unusually good condition when its age and history are taken into consideration. Visible problems include advanced iron oxidation, a loss of structural integrity in the lower hull portion containing cement, and the presence in various places of an unidentified type of plastic body filler that was added as part of some past attempt to shore up the vessel and to improve its aesthetic appearance. Additionally, wire mesh has been attached using filler at some of the hull openings in order to prevent access to the boat’s interior. A flat metal plate has been secured over the hatch opening using four machine screws placed through four drilled holes. The stack located on the external upper hull surface has been sealed with an unidentified consolidant. An unidentified material has been stuffed into the external bow spar socket, preventing full access to it.
Figure 40. Photographs of the Louisiana State Museum Vessel taken in 1926 by William M. Robinson, Jr. (from Robinson 1928:172).
Figure 41. Photograph of the Louisiana State Museum Vessel, probably taken in the 1930s (from Arthur 1942:4).
Figure 42. Photograph of the Louisiana State Museum Vessel, circa the Second World War (from Burgess 1975:50).
Figure 43. Photograph of the Louisiana State Museum Vessel, circa the Second World War (from Barnes 1946:12).
Figure 44. Photograph of the Louisiana State Museum Vessel, circa the Second World War (from Arthur 1942:4).
Figure 45. Photograph of the Louisiana State Museum Vessel being moved from Jackson Square to the Louisiana State Museum's Pontalba Building on St. Ann Street (courtesy of the LSM).
Figure 46. The Louisiana State Museum Vessel on display at the Pontalba Building on St. Ann Street (from Compton-Hall 1983:37).

Figure 47. The Louisiana State Museum Vessel being moved to the Arcade of the Presbytere (from NHC, Operational Archives, Williams Collection; reproduced in Lawliss 1991:37).
Figure 48. The Louisiana State Museum Vessel today (photo by Alan Flanigan).
Figure 49. Map of New Orleans showing the past locations of both *Pioneer* and the Louisiana State Museum Vessel (drawn by Kyra Bowling, Mike Fitzgerald, and Richard Wills).
The curatorial staff of the Louisiana State Museum has recently demonstrated an awareness of the need to stabilize and preserve the vessel through taking preliminary steps to create a long-term conservation and preservation plan. In 1987 a preservation and conservation assessment of the boat was made by conservator Curtiss Peterson with the sponsorship of the American Association for State and Local History (Peterson 1987). As of 1996, discussions regarding possible further assessment and conservation were being held between the Louisiana State Museum and the staff of Northwestern Louisiana University's Archaeological Conservation Laboratory (Dr. Tommy Hailey, personal communication, 1996).
CHAPTER V

AN ARCHAEOLOGICAL ANALYSIS OF THE LOUISIANA STATE MUSEUM VESSEL

THE DOCUMENTATION PROJECT

The project to document the Louisiana State Museum Vessel was conducted in New Orleans, Louisiana with the permission and cooperation of the Louisiana State Museum. The boat was recorded in place at the museum’s Presbytere Arcade on Jackson Square, where it is presently displayed. Documentation activities took place on three separate occasions during February 1992, November 1993, and December 1993. These activities were undertaken as a collective effort by a team of seven students from Texas A&M University’s Department of Anthropology, Nautical Archaeology Program. The recording team consisted of Alan Flanigan, David Robinson, Juan Vera, Greg Cook, Colin O’Bannon, Elizabeth Baldwin, and the author. Curator Tom Czekanski acted as the museum’s primary liaison with the team during the process. Subsequent to the recording project, Nautical Archaeology Program student Taras Pevny analyzed the collected hull data and mathematically calculated the boat’s estimated weight, buoyancy, and proportional characteristics.

The vessel was assessed in terms of three basic categories: general design and performance characteristics, hull construction, and individual systems configuration. Documentation methods included the compilation of a comprehensive photographic catalog of its external and internal construction, the gathering of direct measurements and drawings of internal and external features, and the recording of the hull’s form with offsets to aid in reconstructing its lines on paper. All dimensions were recorded using English standard measurements, as this undoubtedly was the system of measurement employed during the boat’s design and fabrication. Metric equivalents are included in parentheses.

An attempt was additionally made to identify and gather for analysis as much extant historical documentation as possible concerning the boat. This effort took into consideration both textual and photographic evidence. One result of this research was that a number of early photographs of the boat were located which revealed structural features that have since been lost. This evidence shed light on the original configuration of the rudders, dive planes, and propeller blades.

The condition of the boat’s iron components was also assessed, but only insofar as it affected our access to the structure. One factor that particularly influenced the availability of information was the presence of the cement beneath and within the vessel. The cement stands beneath the hull prevented the recording of some midbody sections. The cement contained within the boat prevented full documentation of its internal materials and arrangements. Because many components are no longer present, and other
features are now obscured by cement, it is impossible to gain a complete picture of precisely what is represented by certain of the remaining materials.

DESIGN AND PERFORMANCE CHARACTERISTICS

The vessel's design and performance characteristics are discussed in terms of six basic categories: principal dimensions, hull form, weight and displacement, hull coefficients, buoyancy, and stability. Weight and displacement are often considered the same statistic in the cases of most surface craft, but because we are dealing with an experimental submersible vessel which could theoretically be heavier than the amount of water it displaces, they will be treated here as separate concepts.

Principal Dimensions

The hull measures 19 feet 5 inches (5.92 meters) in overall length from the tip of the bow end piece to the aft face of the stern end piece, and 20 feet 2 inches (6.15 meters) in extreme length from the tip of the bow end piece to the aft face of the propeller hub boss nut. The hull measures 3 feet 2 1/2 inches (97.79 centimeters) in overall beam and 3 feet 2 inches (96.52 centimeters) in molded beam at its widest section. In their original configuration, the dive planes would have added an additional 17 1/4 inches (43.82 centimeters) in overall width to either side of the boat. Estimating the boat's precise depth is difficult because it appears that the highest point of hull elevation would fall within the open area once occupied by the now-missing hatch cover. The hull measures approximately 6 feet 1/4 inch (1.835 meters) in depth from the forward shoulder of its hatchway entrance to its deepest portion; however, this measurement does not correct for its present level of bottom distortion. Taking this into consideration, the original maximum depth is projected to have been approximately 6 feet 1/2 inch (1.842 meters), and the original molded depth is projected to have been at least 5 feet 11 3/4 inches (1.82 meters) from the hatchway rim to the internal keel surface. Neither of these dimensions take into consideration the missing hatch cover or the stack structure located topside. The boat's original overall height cannot be precisely determined due to the possibilities that it may have possessed a raised conning tower, the stack may have initially been taller, and the unidentified components mounted adjacent to the stack are now missing and their dimensions cannot be estimated. Its height was probably not much more than what it is presently, as the conning tower would likely have only added an additional overall height of between 1 and 2 feet (between 30.48 and 60.96 centimeters).
Hull Form

The hull's lines were recorded with offset measurements. This entailed erecting around the vessel a three-dimensional framework of baselines consisting of fiberglass measuring tapes. On the horizontal plane, baselines were established below and above the hull on both sides. The horizontal longitudinal baseline was delineated in one-foot (30.48 centimeter) increments from aft to forward, with the aft face of the stern end piece stuffing box seal serving as point zero. On the vertical plane a baseline was established along each side of the hull. These baselines essentially suspended the hull within an imaginary box, enabling sets of horizontal and vertical offset values to be taken along measured intervals at each desired section using a leveled and plumbed portable framework.

The sections selected for recording were those which best served to capture the variation in hull curvature. The cement stands supporting the boat were a factor in selecting which sections would be recorded, for they made it difficult to accurately record the lower hull offsets in certain areas. Sections were recorded at every foot at each end, the transitional sections approaching the midbody were spaced two feet apart, and the roughly consistent midbody section required the recording of only a single section located in the midships area. The forwardmost section recorded was the forward face of the bow end piece. This was the only section for which offsets were taken that did not occur at a natural one-foot increment, rather, it was taken at the point of longitudinal baseline termination. At each section, the vessel's points of maximum height, depth, and beam were established, and measurements were taken at 3 inch (7.62 centimeter) intervals from the points of maximum width to both the uppermost and lowermost points of hull surface. A total of 15 sections were recorded in this manner.

The resulting sections enabled the creation of a lines plan that conveys the three-dimensional shape of the vessel's hull curvature (Figure 50). Because the lines represent the outer surfaces of the plating, the external plate seams are represented in the lines drawings (as dashed lines). In drafting out the lines on paper, the boat's slight lean to starboard upon its cement stand was corrected. The kink visible in the keel, and the lower hull deformities resulting from the presence of cement and plastic consolidants, were not corrected. The lines display the hull curvature as recorded, showing the keel deformity in the sheer plan and the lower hull deformities in sections. A dotted line indicates the conjectural reconstruction of the keel's original midbody form prior to deformation.

The lines reveal a vessel constructed in a shape much like that of a fish. The hull is sharply V-bottomed and possesses a rockered keel. The keel displays a roughly consistent form along the midbody portion, with transition to an increasingly extreme angle of rise terminating at the end pieces. The lower hull displays considerable lateral deadrise extending up to the lower joins of the side strakes. The midbody changes only slightly in breadth and form over its centermost 6 feet (1.83 meters). While the
Figure 50. Lines plan of the Louisiana State Museum Vessel, drawn based upon documentation gathered during the 1 diagonals. The dashed lines indicate the locations of external plate seams, while dotted lines represent the keel's project.
The 1992 recording project. The boat's port side is represented in sheer, mid-body breadth, and section views, as well as upper and lower hull projected original form before it suffered deformation (drawing by Richard Wills, inked by Taras Pevny). 

LOUISIANA STATE MUSEUM VESSEL LINES PLAN
(PORT SIDE REPRESENTED)

LENGTH 19 FEET 5 INCHES (5.92m) (NOT INCLUDING SHAFT)
MAX.BEAM 3 FEET 2.5 INCHES (0.98m)
DEPTH 6 FEET 25 INCHES (1.94m) (NOT INCLUDING STACK)

RECORDED 1992 - 1993 BY STUDENTS OF TEXAS A&M UNIVERSITY, NAUTICAL ARCH. PROGRAM
RECONSTRUCTION BY RICHARD WILLS
hull midbody has no definable widest point, it is in close proximity to the designated midships section. The boat's ends show an extreme reduction in their volume relative to the body. The boat possesses a length-to-beam ratio that slightly exceeds 6:1, a length-to-depth ratio of 3.2:1, and a breadth-to-depth ratio of 0.53:1.

In addition to the visible keel and bilge deformities acquired by the boat over time, the reconstruction drawings also reveal that the entire hull structure is almost imperceptibly bent out of true on the longitudinal axis, with both ends trending to the port side. The hull may not have been symmetrical at the time of its fabrication, but it is also possible that the distortion is attributable to the boat's recovery from the lake, years of resting on one side, repeated mounting and reinforcement activities, and movement under uneven strain.

Weight and Displacement

In a surface vessel, displacement is the volume of water occupied by the submerged portion of the hull, and the vessel's weight is equal to the weight of the displaced water. Essentially, in order for a vessel to float its total weight must be less than the weight of the volume of water it displaces; if it weighs more than what it can displace, it will sink. Because the Louisiana State Museum Vessel is unidentified, no historical reference is available to indicate its original hull weight and displacement. In this section the concepts of weight and displacement will be discussed in separate mathematical terms, and in the following section they will be compared for the purpose of determining whether or not the boat was capable of achieving positive or neutral buoyancy, and whether it would have theoretically been able to regulate and maintain its level of buoyancy.

According to a recent estimate by the museum's curatorial staff, in its present state (not including the cement) the vessel is believed to weigh roughly 2,500 pounds (approximately 1.125 metric tons) (Tom Czekanski, personal communication). The boat could not be precisely weighed during our recording project, but a more accurate approximate weight was mathematically determined with the hull data collected.

Hull plate thickness and types of metal treatment are factors in calculating hull weight. As a standard rule, hard-rolled cast iron plate of 1/4 inch thickness weighs 9.386 pounds (4.26 kilograms) per square foot, while hard-rolled wrought iron plate of 1/4 inch thickness weighs 10.07 pounds (4.57 kilograms) per square foot (Desmond 1919:213). For estimating the weight of this hull, the weight for wrought iron will be used.

There are various methods by which wetted surface area of a hull may be calculated. Before any precise calculations were made, however, preliminary minimum and maximum area parameters were projected in order to judge the general range within which the precise calculations should fall. A minimum potential surface area was calculated by counting the number of square inches on a gridded scale drawing,
without any correction for hull curvature. This exercise yielded 192 square feet (17.28 square meters). A maximum potential surface area was calculated by taking the maximum dimensions of the overhead plate at midships and extending it as a half-cylinder for the complete length of the boat, and assuming the remaining strakes and end pieces on each side would form a flat square equaling their maximum horizontal and vertical dimensions. This exercise yielded 286.6 square feet (25.79 square meters). Thus, it may be concluded that the hull of the Louisiana State Museum Vessel can possess a hull surface area totaling no less that 192 square feet (17.28 square meters), and no more than 286.6 square feet (25.79 square meters), and therefore its true hull surface area lies somewhere in between these two numbers.

The hull’s precise wetted surface area was calculated using two different methods: through the expansion of sections and diagonals using the method provided in Phillips-Birt (1957:199) and Chapelle (1994:219-220), and by employing the Mumford Formula provided in Phillips-Birt (1957:198). The first method essentially allowed the hull curvature to be “unbent” on paper in order to measure its total area. By expanding the lines sections and then girding the diagonals, and dividing this length by the number of section spaces (for this calculation, section lines were added to a surface area curve diagram in order to generate an adjusted multiplier), a multiplier was arrived at which could then used in a trapezoidal calculation of area. This method resulted in a total wetted hull surface area of 199.86 square feet (17.99 square meters). In using the Mumford Formula, a total wetted surface area of 223 square feet (20.07 square meters) was arrived at; however, it must be noted that the Mumford Formula provides a more simplistic estimate than the other area measurement methods, and is known to produce an average margin of error of 7% (Phillips-Birt 1957:198). (The Taylor Method, provided in Phillips-Birt 1957:198-199, was additionally employed, but because it did not take the submersible’s unique dimensional characteristics into consideration, it produced a severe underestimate and was determined not to comprise a desirable method in this case; therefore, the results were discarded and are not provided here.) Therefore, rounding the figure generated by the first method, a total hull surface area of approximately 200 square feet (18 square meters) will be assumed for this vessel.

The hull weight of the Louisiana State Museum Vessel can thus be calculated by multiplying estimated hull surface area (200 square feet) by Desmond’s weight estimate for 1/4 inch thick wrought iron plate (10.07 pounds per square foot). This results in a total hull weight of approximately 2,014 pounds (906.3 kilograms). This estimate, however, does not take into consideration the additional weight present from overlapping plate seams, fastener surfaces, and internal components both present and missing. If an arbitrary increase of 10% more is allowed for plate overlap and additional fastener weight, and 30% more is allowed for additional external and internal fittings (control surfaces, line attachment points and stuffing box covers, conning tower, stack and associated equipment, screw and hub assembly, shaft and drivetrain fittings, pump and plumbing, seats and brackets, weaponry, etc.) and a crew of two, this provides a total weight of approximately 2,819.6 pounds (1,269 kilograms, or 1.269 metric tons).
In submerisible vessels, it is traditional to calculate both surface displacement and submerged displacement. In the case of the Louisiana State Museum Vessel, because its surface flotation line cannot be reliably determined, only a submerged displacement was estimated. The submerged displacement of a vessel can be calculated by determining the immersed area of its body lines plan sections and multiplying this total by the common interval between them shown in the sheer and half-breadth lines plans (Chapelle 1971:203). In the case of this vessel, this meant that before any calculation could be made, the original approximate keel and bottom dimensions had to be estimated. Because of the fact that six hull sections could not be documented during the hull lines recording phase, the existing sections were used to generate a displacement curve. The area of this displacement curve was then measured using a planimeter to determine the displaced volume of the hull. The resulting hull line calculations give an internal hull volume of 138.2 cubic feet (4.15 cubic meters). When an additional 3.8 cubic feet (.11 cubic meter) of displacement is allowed for the estimated original volume of the conning tower, control surfaces, stack, external eyes, protruding shaft, and propeller area, this provides an estimated total displacement of 142 cubic feet (4.26 cubic meters).

Hull Coefficients

Four mathematical coefficients (waterplane, midship, block, and prismatic coefficients) may be derived using displacement and specific hull area data. These coefficients can provide a basis for comparing a particular vessel with other vessels of similar design in order to identify relative relationships in hull size, proportions and general morphology. The coefficient formulae used here are those provided in Gillmer and Johnson (1982:197).

In order to obtain a vessel’s waterplane and midship coefficients it is necessary to first determine its waterplane and midships sectional areas. The waterplane area is the horizontal area of the hull at the plane of full-load immersion (Steffy 1994:254). Because it is presently impossible to determine the Louisiana State Museum Vessel’s intended flotation line when in ballast, its waterplane area cannot be reliably established. As it can be reasonably assumed that this boat was intended to be nearly submerged when ballasted with solid ballast, and thus it likely possessed a relatively low to nearly nonexistent waterplane area, it will be presumed that the boat’s entire hull, or nearly the entire hull except for the conning tower and snorkel assembly, were likely submerged when in a state of positive buoyancy. Therefore, the waterplane area used in arriving at its waterplane coefficient will be its maximum submerged waterplane area, represented by the waterline transecting its point of maximum beam. The horizontal plane area of the Louisiana State Museum Vessel at its maximum immersed waterline is 43.77 square feet (3.94 square meters). Its maximum submerged midships area is 12.47 square feet (1.12 square feet).
The waterplane coefficient is a mechanism for determining the relative horizontal "fullness" of the hull at the waterline. It is calculated by enclosing the waterplane area within a rectangle whose sides are equal to the hull's length and breadth at the load waterline, and determining the ratio between the areas of the waterplane and the rectangle (Steffy 1994:254-255). The fuller the hull at the waterline, the larger the resulting coefficient. As the Louisiana State Museum Vessel was capable of complete submersion, the waterline used for this determination is the one occurring at its maximum horizontal hull dimension. The Louisiana State Museum Vessel's waterplane coefficient when fully submerged is 0.7.

The midship coefficient is a mechanism for determining the ratio between the molded area of the immersed midships section at full load to the area of a rectangle whose sides represent the vessel's maximum molded draft and breadth at the midships section (Steffy 1994:254-255). The greater the area of the midships section, the larger the coefficient which results. The midship coefficient of the Louisiana State Museum Vessel when fully submerged is 0.64.

The block coefficient is a mechanism for determining the relationship between the displacement volume of a hull and that of a block whose volume is a product of the draft, beam, and waterline length, using molded dimensions throughout (Steffy 1994:254-255). As a rule, the greater the displacement of a particular vessel (with the overall dimensions remaining unchanged), the larger the resulting coefficient for that vessel will be. The block coefficient of the Louisiana State Museum Vessel when fully submerged is 0.37.

The prismatic coefficient is a mechanism for determining the relationship between the displacement volume of a hull and that of a prism whose sides are equal to the full-load waterline length, using molded dimensions throughout (Steffy 1994:255). The prismatic coefficient of the Louisiana State Museum Vessel when fully submerged is 0.57.

When checked against one another using formulae to verify the proportionality of their relative relationship (provided in Gillmer and Johnson 1982:197), it is seen that the coefficients derived from this hull can each be reproduced using the other coefficients. Thus, they are reasonably proportionate to one another.

Buoyancy

For a surface watercraft to stay afloat, it must maintain a reserve of buoyancy, or positive buoyancy. A submersible vessel, on the other hand, is designed to be capable of transitioning back and forth between positive buoyancy, neutral buoyancy, and negative buoyancy. A reserve of buoyancy is a state in which there is a volume of watertight hull above the waterline (in a submersible vessel, this state is of course only achieved when the vessel is surfaced). A vessel's reserve of buoyancy can be calculated by subtracting the volumetric displacement of the vessel while on the surface from the total effective volume
(Burcher and Rydill 1994:276). A state of neutral buoyancy occurs when an equal balance is achieved between weight and buoyancy, delineating the relationship of weight to displacement. In a submerged vessel, neutral buoyancy is attained when a controlled amount of flooding is allowed to the point where, when a vessel is submerged, the remaining total of buoyant volume just supports its weight (Burcher and Rydill 1994:24-25). Negative buoyancy is exactly what it implies: a vessel will sink when its weight is greater than its buoyancy.

Buoyancy calculations are affected by differences in water salinity. As a standard, fresh water is assumed to weigh 62.43 pounds per cubic foot (1000 kilograms per cubic meter), whereas salt water is assumed to weigh 64 pounds per cubic foot (1035 kilograms per cubic meter) (Chapelle 1971:203-204). Actual salinity levels vary between temperatures and localities, however. An object is always more buoyant in seawater than freshwater, and consideration must be given to this difference when ballasting a vessel in order to attain a state of neutral buoyancy.

Based upon the previously discussed volume estimate of 142 cubic feet (4.26 cubic meters), the total displacement of the Louisiana State Museum Vessel when in fresh water would be 8,865 pounds (4,021.2 kilograms), and in salt water would be 9,088 pounds (4,122.3 kilograms). This places it well within a positive buoyancy range for either environment, giving it a reserve buoyancy of 6,046 pounds (2,742.5 kilograms) in fresh water, and 6,268.4 pounds (2,843.35 kilograms) in salt water. In either case, the internal volume of the vessel would have provided the minimum practical space necessary to offset this reserve of buoyancy through the combined use of solid and variable liquid ballast. This conclusion is verified when the vessel’s displacement is checked against a simple formula in which hull length, breadth, depth, and block coefficient are all multiplied together and then divided by the weight of a cubic foot of water, providing a weight in long tons (Taggart 1980:197). The result of this calculation is 3.99 long tons, or 8,075.76 pounds (3,663.16 kilograms), and is close enough to the previously calculated displacement weight to confirm its correctness.

This conclusion conflicts with the one reached by submersible builder Simon Lake. At the beginning of the century, Lake had a brief encounter with “the New Orleans Submarine.” He summarized his evaluation of the boat’s buoyancy qualities in stating “it is evident that the designer of this vessel miscalculated and made his boat so much overweight that she could not be given sufficient buoyancy to bring her to the surface by the means provided” (Lake 1918:152). This belief has been perpetuated over the course of the century, and is often the traditional assumption when discussing the question of the vessel’s seaworthiness. It is now evident that the submersible was more than capable achieving positive buoyancy, and in fact, its designer provided it with reserve buoyancy to spare.

Having established that the boat possessed a more than adequate degree of positive buoyancy, a remaining question is where the boat’s surface flotation line would have been located. It could not have been intended to be much higher than the approximate level of the hatchway entrance’s highest point, as it
appears that the pilot's line of sight would have been just above that level when sitting upon the thwart indicated by the two seat brackets below the hatch opening. It can also be reasoned that the propeller was intended to be at least partially immersed when the vessel was surfaced, otherwise, the boat would have been incapable of moving efficiently on the water under its own power (a partially submerged propeller will provide thrust as long as it is not rotated too fast). Judging from the earliest surviving photographs of the boat, the screw is estimated to have measured approximately 36 inches (91.44 centimeters) in diameter (Figures 34 and 35). The height of the the brass through-fitting on the starboard side (the fittings on H.L. Hunley were similiarly located) also provides an indicator, as this feature would have required the ability to allow water to enter the boat in order to fill any water ballast reservoir.

Due to the relatively high degree of positive buoyancy possessed by this boat (evident in the ratio between positive buoyancy and weight, which is over 3:1), it likely that it would have required the use of a significant amount of solid ballast, probably at least two tons worth, to bring it within a close enough proximity to neutral buoyancy for fine tuning with variable ballast. The variable water ballast would probably have been intended to occupy a reservoir not measuring any more than 30 cubic feet (.9 cubic meter) of the boat's lower hull, or roughly one fourth of its internal space.

Stability

Stability in a watercraft design is generally defined as the tendency of a hull to safely maintain and return to an upright position (Steffy 1994:9). This characteristic may be evaluated in terms of the degree of both transverse and longitudinal stability possessed. In a properly designed surface vessel, the center of buoyancy should be located in the submerged portion of the hull, directly below the center of gravity (Steffy 1994:9). In a submersible vessel, hydrostatic stability (both transverse and longitudinal) is achieved through precisely the opposite - keeping the center of buoyancy above the center of gravity (Burcher and Rydill 1994:27).

Submersible designer and builder Simon Lake provided his opinion regarding the stability characteristics of "the New Orleans Submarine" nearly a century ago, when he recorded: "another submarine built by the Confederates shows a much safer design...From a study of the form of this vessel, she should have been very stable, and I am of the opinion that she could have been successfully navigated submerged had she been properly ballasted" (Lake 1918:152).

Unlike his earlier-discussed assessment of the boat's buoyancy characteristics, Lake was correct on this point. Because we do not know exactly how the vessel's weight was distributed, its center of gravity cannot be precisely determined. Still, some general conclusions may be drawn. The overall shape and configuration of the Louisiana State Museum Vessel suggest that it was designed with the specific intent to provide a high level of lateral stability. When viewed in cross section, it can be seen that a high center of
buoyancy was intended, suggesting that a premium was placed upon transverse stability and the ability to self-right and maintain its intended vertical orientation. Likewise, a moderately low center of gravity is evident in the design of the boat, and the significant amount of solid ballast used by the boat (and almost certainly located in the keel space) must have lowered this center of gravity even further.

The full degree of actual longitudinal stability possessed by the vessel is less certain, although the longitudinal distribution of weight generally seems balanced in terms of the boat’s internal construction; specifically, the fore and aft rudder assemblies counterbalance each other, and the placement of the dive plane assembly would appear to offset the weight of the drivetrain somewhat. Additionally, the presence of the bow socket may indicate that the weight was distributed with a spar assembly in mind. If the boat was slightly heavier at one end, this may have been mitigated by selective placement of portable solid ballast within the boat. Once submerged, the boat’s stability characteristics would have furthermore been influenced by the effectiveness of whatever system of water management it used to sustain the delicate balance between positive and neutral buoyancy. The vessel’s relatively short length in comparison to its draft suggests that it may have been prone to pitching when underway submerged, which in turn may have led to some difficulty in coordinating dive plane movements.

HULL CONSTRUCTION

The Louisiana State Museum Vessel’s hull construction is addressed here in six distinct categories: the materials employed in its fabrication, the keel construction, the hull plating and fastener arrangement, the hatchway and conning tower configuration, the construction of the end pieces, and the external rigging attachment points. All other features and components will be discussed separately in the context of individually identifiable systems.

The construction drawings generated as a result of the documentation project portray the external architecture of the vessel from the perspectives of port and starboard side, bottom, topside, and bow and stern end views (Figure 51). The internal construction drawings show the boat in longitudinal interior profile (revealing the starboard side), longitudinal top and bottom interior plan views, and transverse section views at the locations of key features (Figure 52). In both the external and internal construction plans, dashed lines are used to indicate components which are known to have been associated with the vessel in the past, but which are now missing, while dotted lines are used to indicate the keel’s projected approximate original midbody form. All measurements were taken to the nearest 1/8 inch (.38 centimeter). However, the overall structural representation may possess a margin of error in the relative locations of some features measuring between 1 and 2 inches (2.54 and 5.08 centimeters) in certain areas. A simplified hull plating arrangement diagram is also provided which displays the reference designations given to each hull plate during the recording project (Figure 53). These reference designations are used in the following sections.
Figure 51. External construction plan of the Louisiana State Museum Vessel, showing port and starboard side profiles, topside and photographs of the boat are represented by dashed lines (drawing by Richard Wills, inked by Taras Pevny).
Louisiana State Museum Vessel
External Construction Plan

Recorded 1892-1893 by Students of
Texas A&M University Nautical
Archaeology Program
Reconstruction by Richard Wills

...topside and bottom plan views, and bow and stern end views. Components that are now missing but which may be reconstructed from early
Figure 52. Internal construction plan of the Louisiana State Museum Vessel, showing views in longitudinal interior profile (revealing the end pieces, which are sectioned), and transverse section views at the locations of nine key features (all viewed from aft looking by dashed lines (drawing by Richard Wills, inked by Taras Pevny).
file (revealing the starboard side), longitudinal top and bottom interior plan views (separated along naturally occurring plate joins except for at aft looking forward). Components that are now missing but which may be reconstructed from early photographs of the boat are represented
Figure 53. Simplified diagram of the Louisiana State Museum Vessel's port and starboard sides, showing the reference designations assigned to each hull plate during recording (drawing by Richard Wills).
Materials

The Louisiana State Museum Vessel’s hull is composed of wrought iron plates assembled upon a keel of bar iron and capped at the fore and aft extremities with conical wrought iron end pieces. The individual components are fabricated primarily out of wrought iron plating, wrought iron shafting, and worked iron bar stock. The plates appear to be of standard boilerplate stock based upon their size, quality, and thickness. They were likely cut, drilled, shaped, and fitted specifically for this vessel, as no evidence of previous use or modification is displayed. Only a few cast iron components are recognizable. Identifiable cast pieces include the drive shaft flywheel, and possibly the dive plane control and fore and aft rudder steering handles. Other components that may be cast iron are the dive plane shaft packing boxes and shaft banding, the rudder shaft packing boxes and sleeves, and the drive shaft packing box contained within the aft end piece.

Two types of iron fasteners, rivets and threaded bolts, were used in the boat’s construction. All of the hull plates are fastened to one another, and to the keel, by rivets. These rivets are all of a largely consistent dimension and form. Several different lengths and diameters of threaded through-bolts and securing nuts were employed in various features of the boat’s construction, including the external line attachment eyes, seat brackets, dive plane stuffing boxes, forward drive shaft bearing mount and cover assembly, and stack assembly. Threaded eyebolts secured the now missing hatch cover and conning tower assembly to the hull. The propeller hub is secured to the drive shaft by a large boss nut. These various fastener components will be discussed further on in the context of their individual applications.

Very little evidence survives of materials other than iron. Only a single cupreous fitting remains in the boat. It seems likely that the submersible originally contained a number of brass subassemblies and threaded fittings, particularly for pumps and related plumbing. These were probably removed and recycled for their relatively higher scrap value. India rubber may have been used as a sealant around the joins between the hull and some stuffing boxes; a bead of what could be this substance is still visible around the interface between the dive plane control stuffing boxes and the internal hull plating. Gaskets composed of some sort of rubber or textile may also have been employed. Fragmentary evidence of paint is additionally still in evidence on the hull exterior, and has been determined to represent multiple coats applied in over the decades since the hull’s recovery (Peterson 1987:1).

The Keel

The vessel’s keel appears to consist of a single iron member that was bent prior to plating in order to achieve its desired form. The keel measures 1 inch (2.54 centimeters) in its sided dimension, and approximately 2 inches (5.08 centimeters) in its molded dimension. It was perforated laterally throughout its
length with centered holes through which the garboard strakes are riveted to one another. The rivets are consistently spaced approximately 2 inches (5.08 centimeters) apart along the keel. The rivets shafts and holes measure approximately 5/8 inch (1.59 centimeters) in diameter. The exact points at which the keel terminates beneath the end pieces cannot be determined due to presence of the cement within the boat.

On the starboard side of the bow, the deterioration of the vessel has caused some pulling away of the garboard strake from the keel (Figure 54). It has also caused a high degree of hull plate material loss in the lower midbody area of the boat, exposing the sides of the keel and contributing to its deterioration (Figure 55). The keel has a very distinct kink in its centermost portion, giving the illusion that the vessel’s ends are hogging (Figures 50 and 51). In fact, this deformity is likely an artifact of the boat being suspended by an underslung steel cable during a mid-century moving event, and probably is directly related to the 1957 episode captured in a photograph (Figure 45).

The Hull Plating and Fastener Arrangement

The vessel’s hull essentially consists of six basic subassemblies: the bottom (composed of the keel and garboard strakes), two center strake assemblies, a common topside plating arrangement joining the sides to one another, and the fore and aft end pieces. The iron plates uniformly measure approximately 1/4 inch (.64 centimeter) in thickness. All of the vessel’s plates are lapped toward the stern. The plates do not appear uniformly shaped on all edges, indicating that they may have been trimmed down to provide a better fit as they were each formed and joined to the hull. The riveting process appears to have slightly flattened or misshapen some plate edges at various points of hammerfall. All of the rivets employed in the hull construction appear to be of a relatively uniform nature, measuring approximately 5/8 inch (1.59 centimeters) in shaft diameter.

The rivet heads are in most cases nearly flush with the hull’s exterior surface, but this is due to differential corrosion. Some immediately surrounding external hull areas display what may be planishing marks. Internally the rivets project more prominently, and often display a flat headed appearance (Figure 56). This suggests that they were hammered down from outside while being firmly backed from inside, probably by a second worker using a bucking bar. The advanced level of deterioration in nearly all of the external rivet heads may be the result of several factors, including the higher level of stress absorbed by them during the riveting process, a difference in the quality and grade of iron stock that was used in their composition relative to that used in other components, and possible exposure to metal treatment processes different from what the plates were subjected to.

For the purpose of this project, each hull plate was given its own reference designation. The plates composing the garboard strakes on each side were individually designated as G-1 through G-3, with the numbers increasing in value from forward to aft, and when referred to were prefixed by the side they were
Figure 54. Detail of the keel form and construction (photo by Alan Flanigan).
Figure 55. Detail of the external lower starboard hull showing the keel, hull plating and fastener arrangement, as well as the deteriorated condition and attempted consolidation of the garboard strake (photo by Greg Cook).

Figure 56. Detail of internal plating lap seams and fastener arrangement (photo by Greg Cook).
located on (for example, port G-1 or starboard G-1). The plates composing the side strakes on each side were individually designated as S-1 though S-4, with the numbers increasing in value from forward to aft, and when referred to were prefixed by which side they were located on (for example, port S-1 or starboard S-1). The overhead plates were designated as O-1 through O-9, with the numbers increasing from forward to aft. The end pieces were simply referred to by their location at either the bow or the stern. A detailed portrayal of the overall hull plating and fastening configuration is provided in Figures 51 and 52, and a hull plate reference diagram is provided in Figure 53.

The garboard strakes are composed of at least three and possible four plates on each side. Due to the high level of deterioration present in their midships area, it is impossible to determine whether the center portion of the strake is composed of one long plate or two shorter plates. The garboard strakes were fastened to the keel in such a way that they covered each side of the keel, but not its bottom, which remained visible between flush plate edges. Rivets passed completely through the garboard plates and the keel on a lateral axis, joining the starboard and port strakes not only to the keel, but also to one another (Figures 54 and 55). The center plates (G-2) are longer and deeper than the end plates, measuring approximately 8 feet (2.44 meters) in length and 24 inches (60.96 centimeters) in depth along their vertical seams. If these plates are actually each comprised of two plates, their center seam is likely located immediately beneath the similar seam joining plate pairs S-2 and S-3. Plate pairs G-1 and G-3 measure between 40 and 45 inches (between 1.02 and 1.14 meters) in length, and possess a maximum depth of 24 inches (60.96 centimeters) at their vertical seams. The garboard strakes are greatly deteriorated due to the cement in contact with their internal surfaces, and from the boat’s long history of being mounted in a solid cement base or on concrete stands. The lower hull displays numerous points where plastic body filler and other consolidating compounds have been sloppily applied in attempts to shore up the corroding bottom plates.

The side strakes are each composed of two center plates (S-2 and S-3) which are joined by common end plates (S-1 and S-4) that wrap around the boat’s stem and stern areas beneath the end pieces. Plate pairs S-2 and S-3 are relatively long and narrow in their dimensions, with each strake measuring approximately 95 inches (2.41 meters) in length by 22 inches (55.88 centimeters) in depth at their inside seam, and between 15 and 17 inches (between 38.1 and 43.2 centimeters) in depth at their outside ends. The sides of plates S-1 and S-4 are smaller and more squarish, measuring between 10 and 15 inches (between 25.4 and 38.1 centimeters) in length and between 15 and 17 inches (between 38.1 and 43.2 centimeters) in depth at their inside seams. These peculiarly shaped outer pieces were precisely patterned, cut, and bent to wrap around the boat’s ends, providing apron-like transitional plates between the flat-sided lower hull and the end pieces. As primary longitudinal elements, the center strakes serve to join the upper and lower hull portions to one another, and provide the points at which the keel merges into the bow and stern end pieces. At their horizontal seams, the edges of these plates lap over both the garboard and
overhead strake edges. The upper center strake edges in the midbody region provide the vessel’s widest point of beam. A brass plaque commemorating the boat’s 1909 dedication as a monument is fastened to the port side of plate S-2 with three slotted machine screws (the fourth is missing), and is positioned just aft of where the heads of the through-bolts securing the dive plane stuffing box cylinders to the internal hull surface are located.

The topside portion of the hull is composed of nine individual plates. These were carefully shaped by bending so as to provide a surface possessing a high degree of camber athwartships while at the same time sloping gradually downward toward the fore and aft ends. The dimensions of the individual plates are not consistent between their port and starboard horizontal seam lengths. Their base widths range from 30 to 39 1/2 inches (76.2 centimeters to 1 meter) for plate O-5; approximately 25 inches (63.5 centimeters) for plates O-2, O-3, O-4, O-6, O-7, O-8; and approximately 12 inches (30.48 centimeters) for plates O-1 and O-9.

The hatchway is situated in the center plate, O-5. A stack structure is mounted through the top forward portion of plate O-4, and is positioned slightly off center to the port side. Two identical circular mounting features located on both the forward and aft sides of the stack are incorporated into plates O-3 and O-4. A threaded brass pipe fitting is mounted through the starboard side of plate O-3, at its forward lower corner. Two rigging attachment points are each transfixed though two adjoining plates, with the eye portions of each located above the seams. The forward eye is located at the join of plates O-2 and O-3, and the aft eye is situated at the join of plates O-7 and O-8.

The Hatchway and Conning Tower Configuration

The hatchway for the crew is located at the top of, and set slightly forward within, the centermost overhead plate (O-5) (Figure 57). This opening is presently covered by a rectangular sheet of steel (not original to the boat, nor present in the photograph) fastened to the hull with four machine screws. The hatchway opening is ellipsoidal in shape due to the camber of the topside plate, and measures 32 5/8 inches (82.87 centimeters) in length by approximately 20 inches (50.8 centimeters) in width. The hatch cover and related conning tower assembly are now missing.

A strip of flat wrought iron is riveted around the circumference of the underside of the hatchway rim, overlapping it so as to leave the inner edge of the strip exposed. This strip measures 2 inches (5.08 centimeters) in overall width and 1/2 inch (1.27 centimeters) in thickness, and essentially provides a recessed circular collar around the inside of the hatch opening (Figure 58). The collar’s exposed surface area measures 1 inch (2.54 centimeters) in width, while the difference in depth between the topside plate surface and the upper face of the inner rim is 5/8 inch (1.59 centimeters). This collar may have originally seated a waterproof gasket to seal the hatch edges and the missing hatch cover. Historian William Robinson
Figure 57. Detail of the external hatchway construction (photo by Greg Cook).
Figure 58. Detail of the internal hatchway construction (photo by Greg Cook).

Figure 59. Detail of the hatch hinges (photo by Greg Cook).
suggested that the hatch cover was a simple hinged lid that closed on a rubber gasket (1928:173-174). But this is unlikely. The position and height of the pilot seat’s thwart brackets places the hatch opening at a seated pilot’s neck level, indicating that the boat possessed a conning tower, perhaps containing one or more portholes for visual navigation. Alternatively, the designers may have intended that the bench only be used when conning with the hatch open, but this seems less likely.

Evidence of the hatch cover hinges survives in the form of two eyebolts, both located at the aftermost edge of the hatchway (Figure 59). The bolts are spaced 4 inches (10.16 centimeters) apart and are mounted through both the deck plate and the recessed collar at the point of where they overlap one another. They measure 4 7/8 inches (12.38 centimeters) in overall height and 3/4 inch (1.9 centimeters) in bolt shaft diameter. The enlarged eye portions project above the hull surface to a height of approximately 1 5/8 inches (4.13 centimeters), and measure approximately 2 inches (5.08 centimeters) in width and 1 inch (2.54 centimeters) in thickness. The through-holes measure approximately 3/4 inch (1.9 centimeters) in diameter.

The ends of the bolt shafts are threaded, and are secured in place by square nuts measuring 1 1/2 inch (3.81 centimeters) in width by 1 inch (2.54 centimeters) in thickness. The starboard eyebolt still retains a bolt threaded through its eye horizontally. This bolt measures approximately 1 inch (2.54 centimeters) in shaft length, approximately 3/4 inch (1.9 centimeters) in diameter, and possesses what appears to be a pentagonal head (or perhaps an eroded square head) measuring 1 inch (2.54 centimeters) in width and 5/8 inch (1.59 centimeters) in thickness. This element may comprise evidence of the means of attachment for a hatch cover. Because the eyebolts freely rotate within the bolt holes, it is impossible to determine their precise original intended orientation in relation to the now-missing hatch cover. However, it seems likely that they were oriented with the bolt heads oriented outboard and the threaded ends pointing toward one another.

The End Pieces

The bow and stern ends of the boat are composed of small, conical iron end pieces. The bow end piece is constructed of a shaped plate of wrought iron which contains a socket set within it (Figures 60). This piece measures approximately 8.5 inches (21.6 centimeters) in maximum (aftermost) width and approximately 12 inches (30.48 centimeters) in depth at the point where the piece joins the hull, and gradually tapers down to approximately 3 inches (7.62 centimeters) in diameter at the extreme nose. The longitudinal seam of the plate occurs on the upper surface of the end piece and is oriented slightly to the port side. This seam does not extend along the piece for its complete length. On the forwardmost portion of the piece above the socket structure, the seam has been obscured, perhaps by welding. A small rectangular piece of plate completely covers the rivet seam, and is secured to the larger component by two parallel rows of four rivets each. As with the seam, the cover plate is oriented slightly to the port side of the
Figure 60. Detail of the external construction of the bow end piece and socket (photo by Greg Cook).
Figure 61. Detail of the internal construction of the bow end piece and socket (photo by Greg Cook).

Figure 62. Detail of the stern end piece (photo by Greg Cook).
centerline. The cover plate measures 9 1/2 inches (24.13 centimeters) in length and 4 inches (10.16 centimeters) in width at the aft edge, narrowing to 3 inches (7.62 centimeters) in width at the forward edge.

The socket (Figure 61) is an integral part of the bow end piece, and may have been welded to the nose of the piece. It measures approximately 1 1/2 inches (3.81 centimeters) in inner diameter at the nose, extends into the hull for a total length of at least 19 7/8 inches (50.48 centimeters), and terminates in a slightly concave after end measuring 2 inches (5.08 centimeters) in exterior diameter. It appears to measure approximately 1/8 inch (.32 centimeter) in thickness. The socket now has refuse material stuffed into it, obstructing access to most of its interior surface and making the acquisition of an accurate measurement difficult. The concave after end of the socket has been pierced, leaving a hole measuring approximately 1/8 inch (.32 centimeter) in diameter and positioned slightly off center. The purpose of this perforation is unknown; it may be a post-salvage artifact. It is impossible to gather a complete picture of the bow end piece's structural interaction with the components that adjoin below it due to the cement and debris encountered during documentation activities.

The stern end piece, like its bow counterpart, is also constructed of wrought iron plate that was shaped by bending (Figure 62). It measures 8 inches (20.32 centimeters) wide at its point of forward join, and maintains a conical shape for a length of approximately 8 inches (20.32 centimeters), reducing in diameter as it extends aft. It terminates in a cylindrical form consistently measuring 3 7/8 inches (9.84 centimeters) in diameter for its last 4 1/2 inches (11.43 centimeters) in length. In this aft cylindrical portion, the piece appears to be bent around a stuffing cylinder through which the drive shaft passes. The seam between the plate edges runs longitudinally along the bottom of the piece. As on the bow, this seam is externally covered by a small tongue-shaped plate that extends from the forward join aft to the termination of the cone. This plate measures 7 3/4 inches (19.69 centimeters) in length and approximately 4 inches (10.16 centimeters) in width. The lack of an obvious seam beneath the stuffing cylinder housing suggests that a welding process might have been employed in fabricating this component also.

A circular plate measuring 4 1/8 inches (10.48 centimeters) in diameter and 1/2 inch (1.27 centimeters) in thickness is secured over the after end of the stuffing cylinder by three fasteners. This piece forms a seal around the propeller shaft where it exits the hull, and has an opening in its center measuring the same diameter as the shaft (about 1 1/2 inches, or 3.8 centimeters). The seal fasteners appear to be secured directly to the end piece plate edges. The exact nature of these fasteners cannot be determined due to their advanced state of corrosion, but they are smaller in diameter (approximately 3/8 inch, or .95 centimeter) than most other fasteners seen in the hull. They possess a pin-like appearance and project aft from the seal surface approximately 3/8 inch (.95 centimeter). A portion of metal that appears to represent the remains of a sleeve element projects from the seal plate beneath the exposed driveshaft portion. It is possible that this sleeve may have been related to a protective shroud or basket for the propeller.
The External Rigging Attachment Eyes

Two robust rigging eyes are mounted on the upper surface of the external hull, both being oriented roughly along the boat's longitudinal centerline. One is positioned near the boat's fore end (Figure 63), and one is similarly located near the aft end (Figure 64). These eyes are composed of worked iron straps with raised spaces at their centers, and are bolted to the hull. At the eye sections, the pieces have been rounded, probably to eliminate sharp corners and minimize line chafing. The pieces each measure approximately 30 inches (76.2 centimeters) in overall length. The base portions measure 12 1/2 inches (31.75 centimeters) in length and 3 inches (7.62 centimeters) in width. The eye portions measure 1 1/2 inches (3.81 centimeters) in diameter. The eyes project to a height of 3 5/8 inches (9.21 centimeters) above the hull surface.

Each eye is attached to the hull by six threaded through-bolts, with three on either side. The bolts measure 1/2 inch (1.27 centimeters) in shaft diameter and possess square heads measuring 1 1/2 inch (1.27 centimeters) in width and 3/4 inch (1.9 centimeters) in thickness. The bolts are secured internally with nuts and washers (Figure 65). The nuts measure 1 1/8 inches (2.86 centimeters) in width and 3/8 inch (.95 centimeter) in thickness. The washers measure approximately 1 1/2 inches (3.81 centimeters) in diameter and between 1/16 and 1/8 inch (.16 and .38 centimeter) in thickness.

These eyes are rigging attachment points, and were probably intended for mooring, towing, or lowering and hoisting the submersible. They may also have been intended for use with an outrigged spar at the bow, or a snorkel or float assembly extending from the stack structure.

Construction Analysis

The boat’s hull construction indicates that forethought was required in determining the order in which the plates were assembled. The order of construction can largely be determined from a critical analysis of the arrangement and overlap of the plate seams. Essentially, the hull was fabricated from the bottom up. Because the garboard strakes were joined not only to the keel but also to one another, their plates must have been laid down in port and starboard pairs. In order to attain the sternward overlap that the garboard plates possess, they must have been joined from aft to forward, starting with plates G-3 and ending with plates G-1. The side strakes possess this same pattern of overlap, likewise indicating an aft-to-forward order of fastening. The topside plates, however, were joined from forward to aft. A rivet fastened through the aft corner of the port side of plate O-4 is partially overlapped by the edge of the next plate aft (O-5) (Figure 56). This indicates that the forward plate was already in place on the side strakes when the next plate aft was added. The hatchway entrance was probably cut out of plate O-5 before it was shaped, but the collar may have been added following the plate’s bending, probably before it was joined to the adjacent plates. The end pieces appear to have been the last plates added. The bow end piece, which is
Figure 63. Detail of the forward external eye (photo by Greg Cook).
Figure 64. Detail of the ait external eye (photo by Greg Cook).
Figure 65. Internal detail of the through-bolts securing the forward external eye (photo by Greg Cook).
overlapped by the forward edges of both plate S-1 and plate O-1, is the only exception to the hydrodynamic pattern of aft-facing plate laps seen throughout the rest of the vessel. Plate O-1 must have been added before the bow end piece based on the pattern of plate overlap. This is indicated at the forward corner of plate O-1, which is sandwiched between plate G-1 and the bow end piece. Following the completion of the boat’s plating, the stack structure, external eyes, and internal brackets were bolted to the topside plates. Some of the internal components were likely installed before the addition of the topside plates.

SYSTEMS CONFIGURATION

The rest of the vessel’s surviving components may be viewed in terms of the systems within which they functioned. These systems are addressed according to the following categories: propulsion, horizontal steering control, vertical steering control, buoyancy control, air replenishment, crew accommodations, and weaponry. Each system is individually discussed below.

The Propulsion System

Propulsion for this vessel was provided through a manually powered shaft driving a stern-mounted, axially located four-bladed propeller. The complete propulsion configuration is no longer present, making it difficult to reconstruct exactly how it operated. Internally, the boat still retains a drive shaft, the drive shaft’s forward bearing and cover assembly, and a geared wheel (Figure 66). Externally, the shaft hub and propeller base assemblies are still present on the end of the shaft (Figure 67). Detailed drawings of the surviving propulsion system features are provided in Figures 51 and 52.

A weightbearing member passes laterally beneath the forward portion of the drive shaft at the point just aft of the geared wheel, supporting and anchoring the shaft mount and cover assembly. This bearing is formed from a narrow strip of wrought iron plate stock that measures 2 inches (5.08 centimeters) in width, and 3/8 inch (.95 centimeter) in thickness. It spans the breadth of the hull and its ends, which are bent upward at a 90° angle, are riveted to port and starboard plates S-3 just below their horizontal seams with plate O-7. At the starboard side internal attachment point, a small metal block measuring 1/4 inch (.64 centimeter) in thickness has been added to fill extra space between the bearing and the hull. Two 3/4 inch (1.9 centimeter) holes spaced approximately 8 inches (20.3 centimeters) apart have been drilled vertically through the bearing, both located on the port side of the shaft mount.

The shaft was originally partly enclosed within a pillow block and cap assembly that was mounted upon the upper surface of the bearing, and which allowed the shaft to rotate securely within it. The pillow block is still present, but the cap element is now missing. The shaft possesses two small circular collars just aft of where it enters the flywheel, one set against either side of this mount, which together serve to prevent
Figure 66. Internal detail of the gear wheel and drive shaft forward bearing (photo by Greg Cook).

Figure 67. External detail of the drive shaft stuffing box, drive shaft, propeller hub, and boss nut (photo by Greg Cook).
it from migrating longitudinally in its bearing. These circular stops measure 3 inches (7.62 centimeters) in diameter and 1/2 inch (1.27 centimeters) in thickness. The mount's base element is fixed to the bearing by a pair of threaded through-bolts, positioned one on each side with the threads pointing down. These bolts are each secured by two nuts, one backing the other. While the upper cover of this retaining assembly is now missing, the bolts that secured it to the mount remain. Unlike the downward-pointing bolts that secure the mount, these bolts are oriented with their threaded ends pointing up.

The geared wheel measures 8 1/4 inches (20.96 centimeters) in diameter, 1 3/8 inches (3.49 centimeters) thick in cross-section at both its 3 inch (7.62 centimeter) diameter center portion and its outer rim, and is half that thickness between the hub and the rim. The wheel and shaft are secured to one another with a key driven into a pair of aligned keyways in the wheel and shaft. The wheel possesses a total of approximately 60 teeth on its outer rim, spaced approximately 3/8 inch (.95 centimeter) apart. These teeth have suffered a significant degree of wear or corrosion.

An unidentified feature protrudes 2 inches (5.08 centimeters) from the forward face of the gear wheel. It is composed of at least two and possibly three elements. A square shaft measuring approximately 1 inch (2.54 centimeters) square and 3/8 inch (.95 centimeter) thick projects forward from the wheel. The base of an armature, now broken, is mounted around the shaft, and the remaining arm fragment extends laterally toward the shaft centerline for a length of approximately 1/2 inch (1.27 centimeters). What may be a cylindrical sleeve, measuring 5/8 inch (1.59 centimeters) in length and 1 inch (2.54 centimeters) in thickness, appears to cover the length of the square shaft extending between the wheel and the armature. Looked at together, this group of components may represent the remnants of a crank handle, the base of which was possibly sleeved with a freely rotating cylinder.

The propeller drive shaft measures approximately 5 feet (1.52 meters) in overall length and 1 1/2 inches (3.8 centimeters) in diameter. The shaft exits the hull through the cylindrical stuffing box and seal plate, and terminates externally in a propeller hub assembly (Figure 67). The shaft is exposed 5 inches (12.7 centimeters) of its length between the stuffing cylinder and the propeller hub assembly. Projecting aft of the plate and located immediately beneath the shaft is a remnant of some sort of sleeve that may have enclosed the now exposed shaft portion. Its purpose is unknown; it may be related to a now-missing protective shroud or basket for the propeller.

The propeller hub assembly consists of two circular plates that sandwich the propeller hub. Both plates are rounded on one surface and flat on the other, and are oriented with the flat sides facing toward one another with the propeller in the center. The plates measure 4 1/2 inches (11.43 centimeters) in diameter and 1 inch (2.54 centimeters) in center thickness. The hub assembly is secured on the shaft by a large boss nut that is 2 inches (5.08 centimeters) square and 1 inch (2.54 centimeters) thick (Figures 68). The propeller hub assembly possibly consists of three distinct elements (two plates and one propeller), but damage and corrosion make this difficult to determine, and the possibility exists that it is comprised of a
Figure 68. External side view of the drive shaft stuffing box, drive shaft, propeller hub, and boss nut (photo by Alan Flanigan).

Figure 69. Detail of the disassociated component found within the vessel (photo by Greg Cook).
single component. Alternatively, the forward plate may be permanently attached to the shaft, while the aft plate could be capable of adjustment or removal through the loosening of the boss nut.

The propeller originally possessed four blades, all of which are presently broken off near the hub, leaving only stubs. The stubs indicate that the blades measured approximately 1 1/2 inches (3.8 centimeters) in width at their base, and about 1/8 inch (.32 centimeter) in thickness. Fortunately, the original propeller configuration is indicated by two early surviving photographs of the boat (Figures 34 and 35), in which a single surviving blade is visible. This last blade (evidently broken off around the turn of the century) indicates a sizable screw with pitched blades that were very wide at their end, but narrow at their base. The overall diameter of the propeller is estimated to have measured approximately 36 inches (approximately 91.44 centimeters), with each blade measuring approximately 18 inches (45.72 centimeters) from the center of the propeller shaft to the tip. The precise degree of blade pitch possessed by the prop cannot be accurately determined.

A single disarticulated component resembling a flat link from a bicycle chain was found loose within the vessel (Figure 69). This item measures approximately 2 1/2 inches (6.35 centimeters) in length, approximately 1 inch (2.54 centimeters) across at its widest points, 3/4 inch (1.9 centimeters) across at its waist, and roughly 3/8 inch (.95 centimeter) in thickness. It contains two square holes, one at each end, measuring approximately 3/8 inch by 3/8 inch (.95 centimeter by .95 centimeter) in width. The documentation team turned this item over to the museum curatorial staff. Although it was initially thought to be a component of a chain drive, we could not fit this component with any surviving element of the propulsion system. The provenience of this item is uncertain, and its function remains unknown.

The vessel's original drivetrain configuration cannot be fully reconstructed with any degree of certainty from surviving evidence. Questions remain regarding the precise method through which power was transferred to the geared wheel and driveshaft, the exact location of this point of transfer, and how the propulsion system interacted with other systems.

The fact that the attachment point on the wheel is not located at its center suggests that it did not comprise the base of an extended crankshaft possessing multiple throws such as the one that powered H.L. Hunley. One potential explanation is that this feature served as a base for mounting a simple crank handle to which hand power was directly applied. As a general rule, the further a crank handle is located from the center of the wheel, the more effectively it provides torque. In this case, the feature is not positioned on the wheel to provide the most efficient configuration for such a use. It is possible that the crank handle may simply not have been located in such a way to provide maximum operating efficiency, and that the wheel may have constituted a recycled piece from another machine, with the teeth serving no function on the submersible. Surviving representations of other Confederate submersibles indicate that a short crank handle or a small-diameter wheel with a handle was perceived as adequate by some designers. However, it seems more likely that the feature on the wheel was intended for another purpose.
Another question is the function of the teeth on the wheel. A rotating disc with an off center handle may have been helpful for a direct hand-cranked design, but this simple configuration would seemingly not require a flywheel possessing teeth. One possibility in that power was transferred from a second gear that is now missing. The small diameter of the wheel in comparison to the large diameter of the propeller, and its awkward location in relation to the cranksman's bench, both suggest that the drive shaft may have been powered through a reduction wheel geared to a pinion gear (the surviving wheel) and possessing a separate handle. If this was the case, the primary wheel would have likely been mounted above the extant one, and probably would have been equal or smaller in diameter that the extant one (perhaps possessing a ratio of 2:1), and may have possessed a crank of moderately long throw. Any mounting arrangement for such a second wheel may now be hidden by the cement in the boat.

If not related to a crank handle assembly, the feature on the wheel's forward face may have served as a sort of power take-off point for running an auxiliary mechanism via an armature. An air forcing pump related to the air replenishment system would have been the most likely recipient of such power. Alternatively, the wheel may have directly powered an auxiliary device with its teeth, and any such device may have been capable of disengagement from the wheel.

The Horizontal Steering Control System

The vessel possessed two vertically-oriented control surfaces for controlling horizontal motion, one at the bow and one at the stern. Both rudders are now gone, but evidence remains of the steering yokes, stuffing box cylinders, and shafts of each. The forward rudder steering assembly (Figure 70) and stuffing box external cover (Figure 71) are nearly identical in construction to the aft rudder steering assembly (Figure 72) and stuffing box external cover (Figure 73). The bow rudder yoke is positioned beneath and just slightly forward of the dive plane control mechanism (they are practically in line with one another), while the stern rudder yoke is positioned beneath the driveshaft and behind the gear wheel. Both rudder shafts survive only to the point where they exit the stuffing boxes. The stuffing cylinders and shafts appear to be mounted through the keel, with the bow rudder passing between port and starboard plates G-1, and the stern rudder passing between port and starboard plates G-3. Detailed drawings of the surviving and reconstructed horizontal steering control system features are provided in Figures 51 and 52.

Rudder orientation was regulated by sets of control arms (or yokes) mounted directly atop the rudder shafts (Figures 70 and 72). Each yoke consists of a pair of arms projecting laterally from an enlarged center portion that encloses the shaft through-fitting. The cast iron yoke assemblies span 1 foot 5 1/2 inches (44.45 centimeters) in overall width. Each arm of the control assembly measures approximately 7 inches (17.78 centimeters) in length and is curved toward midships at the end. The ends of the arms are enlarged and contain eyes measuring 1 1/2 inches (3.81 centimeters) in diameter. The eye located on the aft
Figure 70. Detail of the forward rudder steering mechanism (photo by Greg Cook).

Figure 71. Detail of the forward rudder shaft's stuffing box external cover (photo by Greg Cook).
Figure 72. Detail of the aft rudder steering mechanism (photo by Greg Cook).

Figure 73. Detail of the aft rudder shaft's stuffing box external cover (photo by Greg Cook).
port side steering arm is partially broken. The enlarged center portion of each control assembly measures 2 inches (5.08 centimeters) in diameter, and possesses a diamond-shaped hole at the center measuring approximately 1 inch (2.54 centimeters) square. These holes enabled the yokes to be mounted and centered directly onto the rudder shafts, which are topped with square heads measuring approximately 3/4 inch (1.9 centimeters) square. The control arm center portions are seated upon the upper face of the round shaft portion, which possesses a larger diameter than the hole in the control arm. The yoke assemblies are both locked in place by a pin passing laterally through the shaft.

Beneath the bases of yoke assemblies, both rudder shafts are exposed approximately 5 1/4 inches (13.3 centimeters). The rudder shafting consistently measures 1 1/4 inches (3.18 centimeters) in diameter. The shafts enter into cylindrical stuffing boxes measuring 2 1/2 inches (6.35 centimeters) in outside diameter. At the point just above where they enter into the stuffing cylinders, the shafts are secured by adjustable collars capable of being moved up and down their length. These collars measure approximately 2 inches (5.08 centimeters) in diameter, 1/2 inch (1.27 centimeters) in thickness, and are held tightly in place by square-headed set screws mounted through their sides. Some sort of gasket was probably once located between the adjustable collars and the upper faces of the stuffing box cylinders. The adjustable collars indicate that not only did the rudder and shaft possess the capability to have their vertical attitude adjusted, but also that the rudders may possibly have been disassembled and unshipped entirely when desired (such as during dry maintenance or for transportation of the boat overland).

The external covering plates that provide protection for the stuffing boxes are of single-piece construction, and are bent to provide a tight fit over the keel and adjoining plates (Figures 71 and 73). These covering plates measure approximately 8 inches (20.32 centimeters) in length over the portion which runs along the keel, and they extend upward for 6 inches (15.24 centimeters) over the garboard strake on either side. They both are through-fastened to the keel and hull by seven rivets uniformly spaced approximately 1 1/2 inches (3.81 centimeters) apart around the outer cover edges.

Four of the earliest surviving photographs of the boat reveal that it still possessed its bow rudder when they were taken (Figures 34, 35, 36, and 37). In the photographs, the rudder is fixed in such a manner as to be incapable of turning far enough in either direction to clear the keel, and it would have been impossible to align it with the keel. However, the setting of the rudder captured on film was probably the result of maladjustment and subsequent “freezing” in place by corrosion. Internally, both adjustment collars are set so as to permit several inches of each shaft to be exposed above the stuffing cylinder. If the forward collar were moved upward, it would undoubtedly have allowed the bow rudder to drop far enough to clear the keel. The photographs also indicate that the leading edge of the bow rudder was longer than the trailing edge, undoubtedly again to prevent it from coming in contact with the hull. Furthermore, the entire bow rudder assembly is tilted slightly up and forward by about 10°, providing it with further space aft.
The photographs indicate that while there was some similarity in the construction of dive planes and the rudders (the starboard dive plane is likewise complete in some early photographs, including Figures 34, 35, 36, 37, 40, and 44), there were also distinct differences. While the dive planes were secured in a fork-like assembly that only extended partway across their width, the rudders possessed more of a sleeve that completely covered their shafts. Based upon the dimensions of the surviving (starboard) dive plane, the rudders probably measured approximately 30 inches (76.2 centimeters) in length and 15 inches (38.1 centimeters) in depth. The forward rudder component visible in some photos is no longer available for firsthand analysis, evidently having disappeared around 1909 when the boat was mounted in its first cement base.

Compared to some other systems for which little survives, relatively good evidence of the horizontal steering control system remains. Nevertheless, the system's entire configuration cannot be reconstructed with any degree of certainty. Unresolved questions include: what was the rationale behind the concept of dual rudders; how effectively did the bow rudder function in relation to the stern rudder; were they intended to operate in unison or independently of one another; and by what exact means was the vessel steered by the pilot? Answers to some of these questions may be ventured.

At first glance, this highly unorthodox rudder configuration would appear to be overly complicated and possibly counterproductive. The steering controls appear to be configured so that either rudder, or both together, could be steered from the pilot's position amidships, and the rudders may have been slaved to one another in order to provide simultaneous coordination. The orientation of the control arms, and the probable configuration of the wheel ropes or tie rods employed to connect them to the pilot's steering mechanism, suggest that the rudders were purposely prevented from rotating any further than 90° in either direction, as the control arms would barely have cleared the sides of the hull at that attitude.

In an experiment, a rudimentary model of a vessel with such a dual rudder configuration was constructed, and with the rudders set to various steering combinations, it was subjected to hydrodynamic surface tests in a basin of water. It was concluded that when trimmed in some combinations the rudders proved counterproductive, but in others they produced a higher level of maneuverability than a traditional single stern-mounted rudder configuration.

Four general steering configurations (each consisting of multiple, slightly differing variations upon these general configurations) were tested. In the first, one rudder was turned while the other was kept secured in a neutral setting. This was undertaken with the neutrally-fixed rudder alternating between the fore and aft rudders, and with both forward and backing travel. The effect of the fixed rudder on the vessel was similar to that of a centerboard in that it increased lateral resistance, but the stabilizing effect was experienced at one end of the vessel instead of amidships. In the second configuration, one rudder was set at various angles while the other was fixed at a 90° angle to the keel. When making headway with the bow rudder turned to 90°, or sternway with the stern rudder turned in the same manner, the trailing end of the
vessel displayed a tendency to swing around the leading end. However, when the vessel was traveling in a manner in which the traditionally angled rudder led and the rudder oriented to 90° trailed, this had the effect of permitting slow, tight turns with the leading end of the vessel swinging around the trailing end. Generally, this configuration appeared to be counterproductive, and the resulting spoiler effect had the potential to lead to longitudinal instability of the model. In the third configuration, the rudders were kept in identical settings. When oriented in settings in the range of 45° in either direction, this resulted in an ability for the vessel to travel on angles without the longitudinal orientation of the vessel changing, in other words, the tendency of one end swing around through the course heading was minimized, rather, the vessel continued to move in a longitudinal orientation even though it was traveling on a path at an angle to its orientation. This ability was present when making both headway and sternway. In the fourth configuration, the rudders were turned to opposite angles of one another. This resulted in an ability of the vessel to effect a very tight turning radius, with the relative closeness of the radius dependent upon the degrees of opposing rudder pitch used. This ability was present in making both headway and sternway.

The first conclusion drawn from this is that the two rudders must have possessed the option of turning independently of one another. A second is that the forward rudder must have required the ability to maintain a neutral setting in order for this configuration to work effectively in any combination (meaning that the position indicated in the early photographs does not reflect its correct adjustment). Third, the level of maneuverability of this design, and the many variations of movement available to the pilot, indicate that not only was maneuverability valued over speed in this vessel, but also that a great deal of piloting ability (coupled with accurate planesmanship when necessary) was required to effectively operate it. Perhaps the most obvious conclusion which could be drawn from this evidence is that the boat may have been intended to execute some degree of double-ended operation while submerged. Of course, this would have been complicated by the fact that there was a propeller mounted only at one end, and that the vertical control surfaces were mounted well forward.

A likely explanation for the dual rudder system was the intention of increasing maneuverability for specific tactical activities such as positioning beneath a target. Specifically, minor adjustments of the boat’s orientation relative to a target while limiting longitudinal motion may have been required. Although the additional rudder added to the boat’s total wetted surface area and would have resulted in an increase in submerged drag, this would not have been a significant factor due to the vessel’s undoubtedly slow speed to begin with. It may also have been intended as a stabilizing element in reducing the degree of roll (sideways movement) and yaw (rotation in heading). The extra control surface may feasibly have also been intended to occasionally act as a spoiler (to provide resistance in braking and lateral maneuvering), although this would likely have led to hydrodynamic instability in practice.

While the simplistic hydrodynamic tests used liberal operating angles on the control surfaces, in practice the effective operating angle of the rudders would only have needed to be approximately 10°
(higher angles would have created drag). It must be stated that all of these conclusions are conjectural in nature as they were not drawn from actual vessel hydrodynamic data, but from limited scale surface modeling only. The mass, balance, and momentum of the actual vessel when submerged may have resulted in quite different behavior when employing the rudder configurations tested.

The Vertical Control System

The vessel’s vertical orientation while under power was controlled by a set of dive planes positioned forward of amidships. The planes shared a common shaft assembly that passes through both sides of the boat and is covered internally by a complex cylindrical sleeve assembly which terminates at the stuffing box cylinders located on either side of the hull. The setting of the dive planes was regulated by a handle mounted at the center of the sleeve assembly and extending aft to within reach of the pilot (Figures 74, 75, and 76). Detailed drawings of these features are provided in Figures 51 and 52.

The dive plane control handle and sleeve assembly (Figure 74) together measure 2 feet 3 3/4 inches (70.49 centimeters) in overall length. The sleeve assembly measures 1 foot 8 inches (50.8 centimeters) in length athwartships between the stuffing box cylinders, and is of variable thickness depending upon which portion of it is measured.

The handle portion extends 1 foot 11 3/4 inches (60.33 centimeters) in length and measures approximately 1 inch (2.54 centimeters) in diameter. At the handle’s aft end is a flattened and widened portion measuring 1 1/2 inches (1.27 centimeters) in width and 1/2 inch (1.27 centimeters) in thickness. This end contains an irregularly-shaped eye measuring approximately 3/4 inch (1.9 centimeters) in internal diameter. At the base of the handle is a thick, vertically oriented ring mounted on the shaft assembly. This ring measures 4 inches (10.16 centimeters) in overall diameter, and 1 3/8 inches (3.49 centimeters) in width. The base ring’s inner diameter measures approximately 2 1/4 inches (5.72 centimeters), providing an aperture through which a cylindrical sleeve passes. The handle element appears to be mounted upon this sleeve in a slightly off center attitude, leaving 2 1/4 inches (5.72 centimeters) extending outward on the port side, and 2 1/8 inches (5.40 centimeters) extending outward on the starboard side. The cylindrical sleeve that passes laterally through the handle base has two threaded holes tapped into it. Square-headed set screws are threaded through both of these holes. These set screws probably provided a means of setting the sleeve/handle assembly’s orientation on the shaft in relation to the pitch of the dive planes. An additional set of cylindrical sleeves appear to be mounted on the shaft at the points between the handle sleeve and the stuffing boxes, one on either side. These sleeves are each composed of two portions, a larger diameter cylinder on the inboard sides, and a smaller diameter cylinder on the outboard sides. At their inboard portion the sleeves measure 2 inches (5.08 centimeters) in length and approximately 2 inches (5.08 centimeters) in external diameter, and at their outboard portions they measure 2 inches (5.08 centimeters) in
Figure 74. Detail of the pilot's dive plane control mechanism (photo by Greg Cook).

Figure 75. Detail of the damaged starboard dive plane (photo by Greg Cook).
Figure 76. External detail of the port dive plane's stuffing box through-bolts and surviving shaft component (photo by Greg Cook).
length and 4 inches (10.16 centimeters) in external diameter. The thickness of the cylinder walls, and precisely what element of the assembly they are mounted upon, could not be determined.

The core shaft which passes through this sleeve assembly and to which the dive planes are joined measures approximately 1 1/4 inches (3.18 centimeters) in diameter. Upon emerging from the handle and sleeve assembly, the shaft passes through a cylindrical stuffing box mounted on each side of the hull’s interior. The stuffing boxes are cylindrical pieces of iron measuring 5 inches (12.7 centimeters) in outer surface diameter and 3 1/4 inches (8.26 centimeters) in wall thickness. They are mounted against the hull interior surface on each side by four bolts, which are oriented with their heads on the outside and their threaded ends pointing inboard. These bolts pass through both the hull and the cylinders, being secured at the backs of the cylinders by nuts measuring 1 inch (2.54 centimeters) in width and 5/8 inch (1.59 centimeters) in thickness. The heads of the through-bolts measure 1 inch (2.54 centimeters) in width, and are not flush with the hull surface, projecting outward for their thickness of approximately 5/8 inches (1.59 centimeters). At one point in time there likely were seals or gaskets mounted between the outboard faces of the shaft sleeve and the inboard faces of the stuffing box cylinders.

The holes in the hull through which the shaft exits are small and oval in shape, measuring between 1 and 1 1/2 inches (between 2.54 and 3.81 centimeters) in diameter. Part of the starboard dive plane survives, indicating the means of attachment to the shaft and providing for analysis slightly more than half of the control surface, consisting of the portion extending from the shaft to the trailing edge (Figure 75). Upon exiting the hull, the starboard shaft forks into two flat strips, between which are held the dive plane. These flat portions of the shaft measure 10 3/4 inches (27.3 centimeters) in length, 1 1/4 inches (3.18 centimeters) in width, and approximately 1 inch (2.54 centimeters) in thickness. The plate is fastened in the fork by three rivets. The dive plane’s surviving control surface possesses a rounded trailing edge extending aft from the fork for approximately 15 inches (38.1 centimeters), and outboard of the hull for approximately 15 inches (38.1 centimeters). Before being damaged, the leading edge surely extended forward for a length of 15 inches (38.1 inches) as well, as indicated by early photographs (Figures 34, 35, 36, 37, 40, and 44). The port dive plane is completely missing, only the stub of the shaft projects through the hull (the stuffing box through-bolts are still present) (Figure 76). Early photos of the completely intact starboard dive plane can in turn be used to reconstruct the original shape of the port dive plane (Figure 51).

As with the horizontal steering control system, the vertical control system survives fairly intact, and missing portions can be reconstructed with the assistance of photographic evidence or from surviving elements. The dive planes were positioned well forward by the boat’s designer. Dive planes are employed to not only arrive at the desired depths more efficiently, but also to maintain that depth while under power. The designer and builder obviously intended for this vessel to vertically maneuver up and down while traveling submerged. They were likely intended to be used to alter or maintain depth in conjunction with a variable ballast system. Forward motion would have been required for the dive planes to be employed
effectively. Due to their forward placement, reverse motion with upward or downward-angled planes would likely have resulted in some degree of longitudinal instability, although this may have been mitigated by how the boat’s ballast was trimmed. The boat’s performance characteristics would have been reduced when making sternway while submerged.

The Buoyancy Control System

The dive planes would have allowed the boat to change its attitude on the vertical plane and assisted in its maintaining depth when running submerged under power. A separate system of ballast management would have been required, however, to transition between (and maintain) states of positive, negative and neutral buoyancy. For a submersible vessel to submerge, it must either increase its weight or decrease its buoyancy. Generally, a submersible vessel’s buoyancy can be regulated using three assets: fixed solid ballast, portable solid ballast, and variable water ballast. The practice of effecting variations between weight and buoyancy within a submersible vessel is termed compensating, and requires a water distribution system capable of altering and then maintaining a particular state of buoyancy. The practice of adjusting a submerged vessel’s longitudinal balance is trimming (Burcher and Rydill 1994:43). For submerging, a free flood valve is necessary to allow the entry of water into the hull, and an air vent valve is required to expel trapped air out. To surface, there must be a means of forcing water out and forcing air in.

Very little evidence remains of the means by which this boat regulated its buoyancy or trimmed itself. At minimum, a bilge pump would have been required for evacuating any water shipped in through the hatch or which leaked in during operation. Any system of regulating variable buoyancy in this boat must have included a water ballast tank located in the bottom portion of the hull. Such a reservoir may have been covered by a floor plate. It may have been a watertight tank within the hull, or more simply, the hull itself may have served as an open container, subjecting the crew to a semi-wet work environment. The shape of the boat indicates that its designer likely intended for it to be able to maintain some degree of longitudinal and transverse stability even when partly filled with water. At minimum, the water distribution system probably employed an adjustable valve to allow the controlled introduction of water, a hand-operated brass force pump to expel the water, and plumbing for both. If any ballast reservoir survives it is now hidden by the cement contained within the boat, and any pumps which might have once been present are now gone.

One item of plumbing, a single threaded brass pipe fitting, remains within the hull. It is located on the starboard side, mounted through the forward lower corner portion of plate O-4 (Figures 77 and 78). This fitting measures approximately 2 inches (5.08 centimeters) in length, 2 inches (5.08 centimeters) in outer diameter, and 1 5/8 inches (4.13 centimeters) in bore diameter. It possesses a raised ridge around its inboard end that measures 3/4 inch (1.9 centimeters) in thickness. The pipe had internal threads cut on the
Figure 77. Internal detail of the brass pipe fitting in the starboard side (photo by Greg Cook).

Figure 78. External detail of the brass pipe fitting in the starboard side (at center of picture) (photo by Greg Cook).
Figure 79. Detail of the unidentified item visible through the deteriorated bottom hull plating (photo by Greg Cook).
inboard side; these extend six threads, or 3/4 inch (1.9 centimeters), deep. It is impossible to tell whether or not the outboard side is threaded due to its being sealed with a consolidating compound. This pipe fitting was probably intended to be used for moving water.

An unidentified item is visible through the deteriorated hull plating on the vessel’s bottom starboard side, at plate G-2 just above the keel (Figure 79). This object is composed of iron and possesses a corrugated appearance, and may be a cast component. It measures approximately 8 inches (20.32 centimeters) in length over its exposed surface; its width cannot be determined under the present conditions. One possibility suggested by its close proximity to the keel is that it may represent a piece of solid internal ballast.

The Louisiana State Museum Vessel does not appear to have been capable of altering its level of buoyancy through any external means other than the introduction and expulsion of water. How much solid ballast this boat may have been intended to employ remains a question. When its weight, displacement, and buoyancy are taken into consideration, it may be concluded that it would have required at least 2 tons (2.03 metric tons) of solid internal ballast to bring it within a practically regulatable range of neutral buoyancy. There is no evidence to suggest that the boat possessed externally mounted solid ballast that could be jettisoned in an emergency, such as was the case in Mc Clintock’s vessel designs. The boat may have been longitudinally trimmed using portable solid weights, which could be moved around the interior of the vessel to adjust trim accordingly.

This boat’s designer likely intended for its buoyancy to be adjusted through the variable regulation of water ballast. The means by which water ballast was regulated is uncertain, but it can be concluded with some level of certainty that the boat employed a simple water management system consisting of a reservoir, a bilge pump, a common adjustable water inlet/expulsion valve, and associated plumbing. The air inlet through the top of the vessel (discussed fully in the following section) may have also been used under carefully controlled conditions as an air vent to permit water to enter the boat, and as a way to provide air for forcing water out. The system of buoyancy regulation possessed by this boat may thus have interacted to some degree with the air replenishment system.

The Air Replenishment System

Little evidence survives of the system this vessel used to provide a breathable atmosphere for its crew. The few features that do remain are both fragmentary and ambiguous. Only one item, the stack structure forward of the hatchway (Figures 80 and 81), can be associated with an air replenishment system. The relationship that the mounting points on either side of the stack (Figures 81 and 82) may have had with such a system is less certain. Two brackets internally mounted to the hull plates above the flywheel and
Figure 80. Detail of the external stack structure (photo by Greg Cook).
Figure 81. Internal view of the threaded collar beneath the stack structure, also showing the partially covered evidence of the unidentified features located forward and aft of the stack (photo by Greg Cook).

Figure 82. Detail of the upper deck showing the unidentified features located forward and aft of the stack structure (photo by Greg Cook).
Figure 83. Detail of the two overhead brackets possibly relating to an air replenishment system (photo by Greg Cook).
driveshaft (Figure 83) may also be related to a ventilation system. Detailed drawings of these features are provided in Figures 51 and 52.

The small stack-like assembly that projects upward from the deck (Figure 80) is positioned forward of the hatch area, located 3 inches (7.62 centimeters) aft of the internal plate edge of plate O-3. This structure is mounted near the forward edge of plate O-4, and is positioned slightly off center laterally, being oriented a little to the port side. The stack measures approximately 6 inches (15.24 centimeters) in overall height. The base mounting portion of the stack measures 8 1/2 inches (21.59 centimeters) in outside diameter and 1/4 inch (.64 centimeter) in thickness, while the upright stack portion measures 5 inches (12.7 centimeters) in internal diameter and 1/8 inch (.32 centimeter) in wall thickness. The stack's base is secured to the top plate by seven rivets around its circumference, and is reinforced with four through-bolts secured with nuts. The bolts are oriented with their heads down and their threaded ends up, and are secured with nuts measuring 1 inch (2.54 centimeters) square. The stack wall has a vertical slot, open at the top end, that faces the hatch. The stack displays evidence of damage, and is now filled with an unidentified consolidant probably applied in recent decades to waterproof the interior. This makes it difficult to examine its internal features.

The stack provides a passageway into the vessel, terminating in a complex collar assembly (Figure 81). The precise diameter of the through-hull opening could not be determined due to the presence of the consolidant, but it is probably narrower than the diameter of the stack walls. The collar beneath the stack measures 8 1/4 inches (20.96 centimeters) in outer diameter, 6 1/4 inches (15.88 centimeters) in base inner diameter, and 1 inch (2.54 centimeters) in thickness. A lip on the inner surface of the collar reduces the opening to a diameter of 5 1/8 inches (13.02 centimeters), above which the diameter returns to its previous dimension. The four previously-mentioned bolts pass through the base of the stack structure and secure the external stack and internal collar to one another. The bolt heads appear to be of a smaller size than most others employed in the boat's construction, measuring 3/4 inch (1.9 centimeters) square and in thickness. The external stack must have been riveted on the hull before the internal collar was installed, for the internal rivet heads are covered by the collar assembly.

The hull plates forward and aft sides of this stack are perforated by two sets of holes (Figures 81 and 82). Both sets of holes are now covered inside with steel mesh held in place by wire, and are sealed with plastic body filler. The two groups of holes are nearly identical to one another, each consisting of a center hole measuring 1 5/8 inches (4.13 centimeters) in diameter surrounded by a ring of slightly smaller holes measuring 1 inch (2.54 centimeters) in diameter. In both cases, the radiating holes are spaced 3 inches (7.62 centimeters) from the center perforation. The only difference between the two groupings is that the aft feature possesses eight outlying holes while the forward feature possesses only seven.

Two brackets are mounted to the overhead internal hull surface above the forward part of the drivetrain (Figure 83). The brackets are held in place by the forwardmost and aftermost bolts of the after
line attachment eye. The forward bracket is mounted above and slightly forward of the flywheel. The piece of iron stock from which this component was shaped measures approximately 15 1/8 inches (38.42 centimeters) in overall (pre-bent) length, 1 1/2 inches (3.81 centimeters) in width, and 1/4 inch (.64 centimeter) in thickness. It is bent twice at right angles to form a three-sided component possessing one leg longer than the other. It has been positioned so that the uppermost portion (2 5/8 inches, or 6.67 centimeters) of its length is oriented horizontally and longitudinally in relation to the hull. The retaining bolt passes through this portion of the bracket. The open end of this component faces aft. The center portion of the bracket extends downward for a length of 8 1/4 inches (21 centimeters), and at the base of this it is again turned aft horizontally and longitudinally for a length of 4 1/4 inches (10.8 centimeters). At the base, it has a hole made through it measuring approximately 3/4 inch (1.9 centimeters) in diameter.

The after bracket is curved for most of its shape, dropping downward and projecting aft horizontally and longitudinally for a length of approximately 2 feet (60.96 centimeters). It measures approximately 32 inches (81.28 centimeters) in (pre-bent) length, 1 3/8 inches (3.49 centimeters) in width, and 1/8 inch (.32 centimeter) in thickness. Its distal end is turned up 1 1/4 inches (3.18 centimeters) and possesses a circular cutout measuring approximately 3/4 inches (1.9 centimeters) in diameter. This cutout is open at the top to provide a mounting point for some component that was circular in cross-section and is no longer present. A similar notch in the shape of a half-circle has been taken out of the starboard side of the bracket at the point of its forward bend. These fore and aft modifications to the bracket are in close alignment with one another longitudinally. This bracket has maintained a flexibility that allows it to freely move up and down, and return to its original orientation. The bracket angles slightly to the starboard side over its length, so that is in an increasingly off center orientation. All of these characteristics suggest the possibility that a device requiring repetitive movement may have been retained within this bracket.

The stack, the overhead brackets, and possibly the handle feature on the flywheel (previously discussed in the propulsion system section) may all be part of an air replenishment system. The most logical interpretation of the stack is that it is a snorkel attachment point. The slot in the aft wall of the stack may be evidence of a means for externally adding and securing an extension tube or hose for use as a snorkel when running submerged. An overhead-mounted air pump may have been coupled to the iron stack and collar assembly. Any air forcing pump may have been used in conjunction with a chemical solution of similarly soaked cloth in order to chemically augment the oxygen levels during submergence (this was a method known to have been used in American efforts before the war). The unusual shape and flexibility of the after bracket suggests the possibility that it perhaps contained a bellows-like device intended to either draw air downward through the stack assembly, or force it through a medium that could re-purify it. Such a device may have been powered by the armature on the wheel's possible handle shaft, or perhaps by the element that resembles a rotating sleeve at the base of the shaft. If some sort of air-drawing and expelling
device was employed, it may have been capable of both wheel-driven and independent power, the latter probably by the cranksman when he was not occupied with turning the screw.

The similarity between the circular mounting points on either side of the stack indicates that they were likely related to one another in their function. The smaller, circularly arranged holes may suggest that they were intended as passageways for fasteners, perhaps to secure a retaining collar of some sort. The center holes, which measure a wider diameter, must have been intended to act as passageways for air, water, or possibly light. The features were not identical in form to the stack feature that survives between them (the stack assembly passageway was wider in diameter than the center hole present in the adjacent features). The most likely explanation for both features is that they were air inlets to refresh the boat's interior and assist in regulating the water level within the buoyancy system's ballast tank. The close proximity of these features to the stack may suggest an interrelationship between the buoyancy and air replenishment systems. A less likely alternative is that these features may comprise the remnants of two dorsally located deadlights; this possibility will be discussed in the following section.

The Crew Accommodations

There survives fairly good evidence of this vessel's crew accommodations. Two iron brackets are present beneath the hatchway opening at the point presumably occupied by a pilot's seat (Figures 84 and 85). An iron knee is present further aft on the port side, and is undoubtedly associated with the position occupied by the cranksman's bench (Figure 86). A set of holes drilled through the port side of the shaft bearing may indicate where the other end of the cranksman's bench was secured. Detailed drawings of these features are provided in Figure 52.

The two iron brackets for the pilot's seat are located directly beneath the hatch opening, one on the starboard side (Figure 84), and one on the port side (Figure 85). Both are of the same form and roughly the same dimensions. Each bracket was fashioned from a rectangular piece of wrought iron plate by cutting a strip out of it, resulting in a piece possessing an open center and side. The two flanges had their last 4 inches (10.16 centimeters) bent downward at an angle of approximately 90° in order to fasten them to the hull. The brackets measure approximately 1/2 inch (1.27 centimeters) in thickness at the base of their vertical flanges, and decrease in thickness to 3/8 inch (.95 centimeter) at the inboard edge of their lateral extent. The flange and seat support portions measure approximately 2 inches (5.08 centimeters) in width. The thwart support portions project inboard laterally from the hull for a distance of approximately 6 inches (15.24 centimeters), and the inboard edges measure approximately 10 inches (25.4 centimeters) from their forward to aft points.

The brackets are mounted approximately 3 inches (7.62 centimeters) below the internal horizontal seams joining the side strakes to plate O-5, and are secured to the hull at the vertical plate seams joining
Figure 84. Detail of the pilot’s starboard thwart bracket, looking forward (photo by Greg Cook).

Figure 85. Detail of the pilot’s port thwart bracket, looking aft (photo by Greg Cook).
Figure 86. Detail of the support member for the cranksman’s bench, in foreground (photo by Greg Cook).
plates S-2 and S-3 on each side, with one flange being fastened to each plate. They are fastened to the hull with large, roughly hammered rivets. The internal rivet heads measure 3/4 inch (1.9 centimeters) in width and are slightly deeper in thickness than the rivet heads used for plate joinery. The external heads appear abnormally large in comparison to the hull plate fasteners, displaying a visible outward bulge in most cases as opposed to the less prominent riveting seen over the rest of the hull. Generally, these brackets show inconsistency in their thickness, unevenness in their cut, and imprecision in the placement and securing of the fasteners securing them to the hull, characteristics all out of character with the higher level of craftsmanship displayed elsewhere within in the boat.

Holes are drilled through the inboard corners of each seat bracket, providing what must have been attachment points for a thwart that is now missing. These holes (four in total) are inconsistent in their dimensions, ranging between 3/8 to 3/4 inch (.95 to 1.9 centimeters) in diameter. The placement and height of the brackets suggest a thwart on which the pilot, when standing (with the hatch open), would be at waist level with the hatchway edge, and when sitting, would find the hatch at neck level. This suggests that the vessel probably employed some sort of short conning tower with a viewing capability. The horizontal surfaces of the brackets angle upward a miniscule degree as they project inward, suggesting that the thwart, which was probably a wooden plank, may have possessed a slight degree of camber.

Positioned on the hull’s port side approximately 20 inches (50.8 centimeters) abaft of the pilot’s thwart brackets is a robust iron knee (Figure 86). This knee was undoubtedly intended to provide the forward point of support for the cranksman’s bench. Its upper and lower ends were fastened through plate S-3, in the area just below the vertical seam between plates O-5 and O-6. The knee consists of two parts, a horizontal member that projects inboard laterally, and a diagonal element that rises up from the hull to support the horizontal element at its inboardmost proximity. The horizontal member is fairly level and measures 1 foot 1 3/4 inches (34.9 centimeters) in length, 2 inches (5.08 centimeters) in width, and 1/2 inch (1.27 centimeters) in thickness. Its outboard end is turned up at an angle of 90°, providing a 2 1/2 inch (6.4 centimeter) flange for mounting against the hull. It projects inboard laterally for a length of 1 foot 1 3/4 inches (34.93 centimeters). The horizontal member has two holes measuring 3/4 inches (1.9 centimeters) in diameter, one located only 5/8 inch (1.59 centimeters) from the inboard end, the other 8 inches (20.32 centimeters) from the same edge. The inboard hole also passes through the head of the diagonal supporting knee located beneath it. The diagonal piece measures approximately 1 foot 8 inches (50.8 centimeters) in length, 2 inches (5.08 centimeters) in width and 3/8 inch (.95 centimeter) in thickness. It is angled at its ends to provide a vertical flange measuring 4 1/4 inch (12.07 centimeters) at its lower extremity, and a level horizontal face at its upper extremity measuring 3 1/4 inches (9.53 centimeters). The upper flange was secured to plate S-3 by a single rivet (now missing), while the foot of the knee is fastened by two rivets.

The pair of holes drilled through the knee’s horizontal element align with the two holes in the port side of the forward drive shaft bearing (Figure 66), suggesting mounting points for a cranksman’s bench.
which extended along the port side of the hull. The longitudinal distance between the two supports measures approximately 3 feet 6 inches (1.07 meters).

The seating arrangements and placement of the steering controls suggest a minimum crew of two persons, a pilot and a cranksman. Operation of the boat by a single individual was highly unlikely, as that person would have borne the entire responsibility of maintaining propulsion, steering, adjusting depth control and buoyancy, ensuring air replenishment, and supervising the use of any weaponry. Although the cranksman’s bench would have been long enough to seat two men side by side, a crew of three in this cramped interior would likewise seem improbable in light of the space and life support limitations of the boat. The screw was probably intended to be operated by a single cranksman, who turned it upon the orders of the pilot.

If the off center feature on the wheel does represent the crank handle attachment point, it is not well placed because it would have barely provided the minimum necessary lateral cranking clearance with the bench, and would have required an uncomfortable orientation for the cranksman. The position of the crank handle furthermore suggests that it would not have allowed maximum leverage to have been exerted upon it. The bench is positioned at a level equal to that of the pilot’s thwart, which means that headroom in the area of the cranking space would have been highly limited, resulting in an uncomfortable bent-forward position by the cranksman. Furthermore, the small diameter of the wheel relative to the large diameter of the screw suggests a very inefficient arrangement if hand power was applied directly to the wheel.

The means by which illumination was provided for the crew is unknown. It has been suggested that the two sets of unidentified mounting holes located on either side of the stack structure may have held small glass deadlights (Robinson 1928:173-174). While this is unlikely considering the close proximity of the snorkel, it is feasible that brass mounting rings, perhaps for small deadlights, may have been fastened to the hull using the outer holes, into which glass pieces were set through which light was permitted to enter the small center hole. However, it is more likely that the hatch cover contained deadlights for navigation and illumination.

The Weapon System

Any explosive antiship weapon intended for use by this craft would have targeted an enemy vessel’s hull below the waterline. Three weapon systems existed for use with this type of boat: a towed torpedo, a torpedo that was outrigged forward on a spar, or a manually attached explosive device. If a towed or projected device was used, the torpedo may have been either contact detonated or remotely detonated. If a manually attached device was employed, an externally mounted charge may have been intended to be fastened remotely using an augering device mounted through the hull, such as in the system
employed by Pioneer. If a remotely detonated charge was employed, it may have been activated either through electrical impulse or with a preset clockwork-actuated fuze.

A towed explosive charge seems impractical. The boat's slow speed would not have been conducive to any sort of towing strategy. Furthermore, it is not certain whether its relatively large propeller possessed any guard or shroud to prevent potential fouling by the towline. The employment of an impact-detonated spar torpedo also seems unlikely based upon the relatively small size of vessel and its probable limited ability to make headway and sternway. Nevertheless, there is a distinct socket set into the bow end piece (Figures 57 and 58). This probably indicates an intended capability to carry some sort of forward-projecting spar assembly. Such a spar may have been intended to carry an explosive device, or it may merely have served as a forward-projecting element to assist in weight adjustment or underwater maneuvering against other objects.

To place this possibility that the boat was equipped with a spar torpedo in relative comparative context, the 40 foot (12.19 meter)-long H.L. Hunley reportedly employed an outrigger spar measuring roughly half its length. Therefore if this roughly 20 foot (6.096 meter) long vessel were equipped with such a spar, or with any sort of mounting assembly for such a device, it would be reasonable to assume that the spar may have measured at least 10 feet (3.04 meters) in length. The weight of any explosive device used in this manner would have been a significant added factor in regulating the boat's longitudinal trim, much more so than in Hunley. It is feasible that the forward external rigging eye may have offered a support point for any such outrigger feature.

An alternative possibility is that the vessel may have been intended to employ a weapon that was designed to be carried externally on the vessel and attached to an enemy bottom by manual means. The two unidentified circular features located on either side of the stack could have been used to mount such an explosive weapon, or perhaps to provide the means for attachment in the form of an augering tool mounted through the hull. If the weapon was electrically detonated, these features may also have been related to a pathway for paying out and guiding insulated electrical cable. This is strictly conjectural, however.

ANALYSIS

This vessel has yet to be identified, but a general evaluation can be made of its design, construction, seaworthiness, and performance characteristics. Such an analysis must be limited in its scope by the absence of numerous components or entire systems, as well as by the inaccessibility of evidence now covered with cement. In short, good evidence survives of the hull construction, enabling relatively accurate conclusions to be drawn in regard to its weight, displacement, buoyancy, and stability. Fairly good evidence also remains of the horizontal steering control system, vertical steering control system, and crew accommodations. Fair evidence survives of the propulsion system. Very little evidence remains to
accurately indicate or reconstruct the precise systems of buoyancy regulation, life support, and offensive weaponry used by the vessel.

The level of craftsmanship present within the vessel's construction suggests that it was fabricated in a machine shop or similar metalworking facility capable of performing basic casting, turning, forming, cutting, and drilling tasks. From the labor perspective, it seems likely that the specialized expertise of marine boilermaking would have been closely relied upon during the process of fabrication. The iron plates used in the vessel's construction were not necessarily rolled at same facility within which it was built. New plates may have been custom crafted for this boat, but it is also possible that used boilerplate may have been recycled, cut down, and remachined during the fabrication process. Plate of 1/4 inch (.64 centimeter) thickness was the most common stock of rolled wrought iron plate available at that time, and it was much easier to work with than the thicker gauges such as 3/8 inch (.95 centimeter), 1/2 inch (1.27 centimeters), or 5/8 inch (1.59 centimeters). To obtain the form desired, the plates were probably shaped on a common jig after being heated to a plastic state. Some of the internal components mounted to the hull were fabricated from various thicknesses of plate stock, suggesting opportunistic metal selection perhaps related to early wartime shortages. The gear wheel in particular may represent a recycled machinery component. In the case of the pilot's thwart brackets, a possible post-fabrication modification is suggested by an anomalous method of fastening and the obviously inferior quality of craftsmanship visible in their construction when compared to that of the rest of the vessel.

The boat is very small in size, of a simple configuration, and hydrodynamic in hull design. Reconstructed estimates for weight, displacement, attainable reserve of buoyancy, and stability all indicate that the Louisiana State Museum Vessel was thoughtfully designed and fabricated with proportionate relationships of weight and buoyancy in mind. If this craft ever reached a point of operational employment, it would have floated or submerged upon demand under the proper conditions. It likely was slow, but possessed a high level of transverse stability, and may have been easily trimmed and highly maneuverable, although possibly with unpredictable hydrodynamic characteristics in some maneuvers.

A premium appears to have been placed on underwater stability and maneuverability. The concept of a self-righting hull appears to have figured particularly high on the list of the designer's priorities. The presence of extreme lateral deadrise in the keel and garboard strakes suggests that a high center of buoyancy was intended, and may also embody an intent to minimize any resistance in the case of contact with bottom sediments. A low center of gravity was likewise intended, as indicated by the high amount of solid ballast that must have been required in the lower hull spaces. The boat's level of longitudinal stability is less certain, but any instability in its trim may have been corrected with portable ballast. The vessel likely possessed a simple system of water management for regulating its buoyancy, but may have incorporated a more complex system for life support and air regulation.
The dive planes appear to be well designed and positioned for good effect. The boat's unique dual rudder configuration comprises an extremely unorthodox system that presumably was intended to provide a high degree of maneuverability for submerged operation. The angled attitude of the bow rudder may have resulted in some degree of upward lift if used during forward travel, however. While its rate of speed is unknown, it is unlikely that it could have exceeded more than a knot or so under optimal conditions. It likely required a crew of two, although it possessed the capacity to carry three. It would have offered a less-than-desirable level of habitability for its crew, but this obviously would have been of little consideration relative to its intended tactical function.

The boat's system of offensive weaponry, and thus its effectiveness as a weapon, cannot be reliably evaluated. The vessel was certainly intended for use as an offensive tactical platform. The deep socket in the bow is possibly related to a weapon system. One objective may have been to contact the target with a torpedo rigged out forward on a bow-mounted spar. Another intention may have been to maneuver submerged beneath an enemy bottom and manually attach a remotely detonated or timer-activated explosive device. The potential for a dual weapon system may be present, raising the possibility of an intended flexibility in tactical applications.
CHAPTER VI

A COMPARISON OF THE LOUISIANA STATE MUSEUM VESSEL WITH KNOWN CONFEDERATE EFFORTS

In 1878, ten years after the auction of McClintock's derelict Pioneer, the submersible boat presently located at the Louisiana State Museum was encountered by a channel dredge in Lake Ponchartrain. For almost 100 years since, historians and writers have identified the Louisiana State Museum Vessel as the privateer Pioneer. The very close geographic proximity of both boats' locations to one another, the passage of time, and the sheer number of such presumed associations over this time have all essentially had the effect of establishing this assumption as conventional wisdom. The geography is particularly compelling. The Pioneer was last reported on the bank of the New Canal at Claiborne Street, while the Louisiana State Museum Vessel was recovered in the Lake Ponchartrain between the mouths of the New Canal and Bayou St. John. The New Canal and the Bayou St. John run closely parallel to one another and both connect New Orleans city to the lake. The New Basin is connected to the lake by the New Canal. Spanish Fort is located at the juncture of Lake Ponchartrain and Bayou St. John. There is an approximate distance of one and a half miles between the canal and the bayou at most points. Furthermore, as the Louisiana State Museum Vessel gradually made its way back into the French Quarter, it approached closer to areas possessing associations with the Pioneer, to the point where it ended up literally blocks from where McClintock's privateer was built. The map of New Orleans provided earlier (Figure 45) displays all of the various locations occupied by the Louisiana State Museum Vessel over time, as well as the known past locations of the Pioneer.

The Louisiana State Museum Vessel was probably first identified as Pioneer in a 1901 article published in the Southern Historical Society Papers (SHSP XXIX:292-295). This identification was perhaps spurred by a reference to the New Orleans-built privateer in the recently released Official Records of the Union and Confederate Navies in the War of the Rebellion (ORN 2, I:263, 399-401). Shortly thereafter, this association was repeated in editorial comments preceding reprinted newspaper articles written by surviving Confederate submariner Alexander (1902a, 1902b, 1902c, 1902d, and 1903), and in a New Orleans Daily Picayune article written when the boat was moved to the Louisiana Soldiers' Home (New Orleans Daily Picayune, 2 April 1909).

The boat was further identified as Pioneer in articles appearing in the magazine Confederate Veteran by Levy (1909) and Tomb (1914). This association with Pioneer has subsequently been perpetuated by Robinson (1928:170-172), Thomson (1941:40), Arthur (1942), Barnes (1944:12), Arthur (1947:405-410), Kelln (1953:196fn), Stern (1962:174-175, although to be fair he suggests there may be an alternative to this identification), Perry 1965:94, 211 fn6), Dorset (1967:126-130), Burton (1971:228),

Recently, a small number of historians and researchers have refuted this association, contending that certain evidence demonstrates the boat does not represent Pioneer. This group includes Genella (Genella Collection, miscellaneous undated documents), Foster (1961), Kloeppel (1989, 1992:9-19), Schell (1992), Cornelius (1996:63), Cussler (1996:183), Furman (Coski 1996:296 fn21), and Ragan (various personal communications, 1996 and 1997). The arguments of these individuals have influenced the author of this work, who initially argued in favor of an association with Pioneer (Wills 1994), to gradually change his views regarding the boat's identity as well (Wills 1997; Wills 1998:7-8; Murphy ed. 1998:24-25). Several alternative theories have been proposed.

In his book Danger Beneath the Waves James Kloeppel argues that there were two different submarines present in New Orleans during the Civil War (Kloeppel 1992:6-19). Kloeppel interprets the 1868 auction event as the Pioneer's being broken up and thus its last appearance in the historical record, and interprets the 1878 discovery near Lake Ponchartrain as constituting a second, entirely different vessel. Kloeppel supports this theory with the fact that the dimensions of the Louisiana State Museum Vessel are not consistent with the three surviving descriptions of Pioneer's dimensions. In the original letter of marque application, John K. Scott described the Pioneer as being 34 feet long, four feet in beam, four feet in depth, and weighing four tons (ORN I, IX:399-400). Following the war, James McClintock described the Pioneer as having been "cigar-shaped, 30 feet long, and 4 feet in diameter" and as having weighed "4 tons" (LC, Maury Papers, undated letter from McClintock to Matthew Fontaine Maury). Baird's recollection of the vessel's recovery sometime between 1862 and early 1864 provide it with a length of 30 feet, echoing McClintock's recollection (Baird 1902:845). Additionally, in the narrative McClintock wrote for the British Admiralty, he gave the dimensions of Pioneer as 30 feet in length, 4 feet in diameter, and "with cone ends 10 feet long" (PRO, Adm 1/6236, File 39455, Report on a Submarine Boat Invented by Mr. McClintock of Mobile, U.S. of America). When looked at collectively, the dimensions provided in the original letter of marque and in the two separate McClintock communications all reliably indicate a set of dimensions different from those of the Louisiana State Museum Vessel.
It has always been supposed that the mystery of the boat's identity could be solved if Colin and Baird's drawings of the *Pioneer* were located in archival sources and compared to the present vessel. In 1997 this finally came to pass when the long-sought after correspondence was located at the National Archives by historical researcher Mark Ragan (NARA, RG 45, Entry M148, Letters received by the Secretary of the Navy from Officers below the Rank of Commander, 1802-1884). The material uncovered by Ragan includes a drawn plan of the *Pioneer* with measurements (Figure 20). This drawing, coupled with the recently uncovered Staufer sketches (Figure 21) conclusively demonstrates that the Louisiana State Museum Vessel is not the *Pioneer*.

The *Pioneer* is not the only vessel whose history may have been clouded by the Louisiana State Museum Vessel. It also appears to have had its dimensions confused with those of *H.L. Hunley* on several occasions in the years between 1878 and the turn of the century. A sketch in the Library of Congress collections of Edward Willis, formerly a Major in the C.S. Army and Chief Quartermaster to General Beauregard's Command in Charleston, reveals a hand drawn, stylized vessel representation identified as "Hunley's Fish Fin Torpedo Boat" which he identified as being "20 feet long," "fish shaped," "3 ½ feet wide," and "5 feet deep" (Figure 87) (LC, Willis Collection, undated sketch; Ragan 1995:16). This drawing is probably postwar, and seems to have incorporated rough measurements of the recovered Louisiana State Museum Vessel. Two postwar articles referring to the operations of the *H.L. Hunley*, written by P.G.T. Beauregard and Julia Hartwell, also provide dimensions similar to those of the Louisiana State Museum Vessel. Beauregard described the *H.L. Hunley* as "shaped like a fish, made of galvanized iron, was twenty feet long, and at the middle three and a half feet wide by five feet deep" (Beauregard 1878:152). Shortly thereafter, in a lengthy newspaper article appearing in a Mobile newspaper, Julia Hartwell provided the dimensions of one of McClintock's Mobile-built boats as "20 feet long and 3 1-2 feet wide by 5 feet deep" (Hartwell 1900). Perhaps Willis was the source of these latter two sets of dimensions.

Scharf, while he did not identify the boat by name, felt that it must have been built in New Orleans (Scharf 1887:761). Sidney Schell has suggested that the Louisiana State Museum Vessel represents a second New Orleans-built vessel perhaps predating *Pioneer* (Schell 1992:167). In setting the stage for the consideration of this possibility, Schell has made an important contribution by sweeping away the common perception that there existed only a single Southern submersible development consortium. He provides a compilation of evidence demonstrating that Confederate submersible boats were constructed by parties other than the coalition formed in New Orleans around McClintock and Watson. Foster and Genella both felt that the vessel was built by the same agents who built the Confederate ironclad steam ram *Manassas* (ex-*Enoch Train*) (Genella Collection, undated miscellaneous documents; Foster 1961). Kloeppel, on the other hand, has noted some intriguing similarities between the Louisiana State Museum Vessel and the *Harper's Weekly* drawing of 2 November 1861 (Kloeppel 1992:17). Researcher Francis Chandler Furman believes that it may be one of the vessels reportedly built at the Tredegar Iron Works, which mysteriously
Hunley's Fish Fin Torpedo Boat.

Made of galvanised iron worked by a hand crank.

Figure 87. Edward Willis' sketch of "Hunley's Fish Fin Torpedo Boat" giving the dimensions of the Louisiana State Museum Vessel (from LC, Willis Collection; courtesy of Mark Ragan).
dropped from the historical records about the same time of the loss of New Orleans to Farragut and Butler (Coski 1996:296 fn21).

At the most fundamental level, a few basic conclusions regarding the Louisiana State Museum Vessel may be drawn with a reliable level of probability. The boat likely represents a Confederate submersible construction effort. It was likely built in the early years of the war, or immediately beforehand. It was probably lost in the evacuation of New Orleans during the fall of that city to Federal forces in late April 1862. Loss of the boat in the evacuation and seizure of the city seems likely due to the location of the discovery, and would be consistent with the circumstances of that event. It is known that much material of military value was either destroyed or sunk in surrounding waters during the city’s evacuation in order to prevent resources from falling into the hands of the enemy. Another submersible, the Pioneer, is known to have been abandoned at a point close by during the city’s loss.

There are two basic possibilities as to where this boat came from. It was either built locally in New Orleans, or it was imported from elsewhere. If built locally, there are several theories concerning its origin: it may be a fourth, unknown effort of McClintock or members of his associates; it may have been built privately by others, possibly with municipal sponsorship; or it may have been fabricated as part of a C.S. Navy effort, perhaps as an extension of the program underway at Tredegar. If built elsewhere and imported, it may have been brought from either Mobile or Richmond before the occupation, or from the Trans-Mississippi by Federal forces during the occupation.

Several considerations must be kept in mind. Because a number of designs were available for use at the time, the source of the design does not necessarily have to have originated from the same agency that fabricated the boat. Also, a number of influences may have been exerted upon its design and construction, so it should not be assumed that it was the product of a singular influence. And the vessel does not necessarily have to represent a known effort, it could be the product of a hitherto unknown attempt now completely lost to history. In other words, it may be utterly unidentifiable.

The only conclusions that can be made with certainty are in regard to what this boat is not. It does not comprise any of the Confederate vessels whose fates have been accounted for. Specifically, it is not one of McClintock’s three acknowledged efforts. Also, it cannot be the boat upon which Albert Pierce served, as that vessel was differently configured and damaged due to a boiler explosion. Furthermore, its design and configuration do not match the characteristics of Halligan’s St. Patrick, which in addition to being larger possessed a steam plant. And finally, it is probably not the vessel attributed to Anstilt, as that vessel likely never existed.

Could the boat represent an earlier, fourth effort by McClintock, Watson, and their coalition of supporters? This is a slight possibility, although it seems unlikely. The closeness of where both the Pioneer and the Louisiana State Museum Vessel were lost and the fact that McClintock put Pioneer through trials on Lake Ponchartrain may be significant, and could be seen as supportive of such a theory. On the
other hand, McClintock made no mention of any vessels in addition to the three he claimed in his postwar writings. McClintock was openly frank in acknowledging the shortcomings within his designs, especially in the case of Pioneer. If he were willing to acknowledge the design inadequacies in Pioneer, why would he hide an earlier attempt? Furthermore, McClintock’s three vessel designs all follow a basic configuration very different from the Louisiana State Museum Vessel, which in comparison appears smaller, simpler, and much differently shaped.

Could it represent the product of other local efforts? Perhaps it reflects an effort contemporaneous with, but unrelated to, McClintock’s early work. The possibility has been raised that it may comprise a local, private, underfunded effort, based upon the simplicity of its design and construction materials. Genella has suggested that it may represent an effort by John A. Stevensen, builder of the Manassas. The Manassas (Figure 88) was the result of a group of speculators formed for the purpose of outfitting a privateer. They purchased the Boston-built icebreaker Enoch Train, converted it into an ironclad ram, and ultimately ended up selling it to the Navy Department (Merrill 1962:87). Genella’s theory is based upon two pieces of evidence: the similarity in appearance between the Manassas and the Louisiana State Museum Vessel above the waterline, and the receipt by the U.S. Secretary of the Navy Welles of a letter dated 25 June 1861 which warned of “an infernal submarine vessel” under construction in New Orleans. The letter, from a concerned New York citizen named E.P. Dorr, states “from her description, she is to be used as a projectile with a sharp iron or steel pointed prow to perforate the bottom of the vessel and then explode” (ORN 1, XXII:288). According to his letter, Dorr received this rumor secondhand. It seems probable that the rumor relates not to a submarine, but to the Manassas. The conversion of the Enoch Train at New Orleans’ Algiers Shipyard was common knowledge, and as it progressed it became the subject of several sensationalistic and alarmist reports in Northern newspapers in July 1861 (Dufour 1990:72-73, 110). As far as the above-the-waterline similarities between the Louisiana State Museum Vessel and the Manassas go, this may merely be coincidence. Nevertheless, it should not exclude the theory from consideration. The motives, funds, and resources were available to support a New Orleans construction effort. Stevensen had the innovational mindset (perhaps too innovational, it could be argued) necessary to have permitted such an idea to reach fruition. Stevensen was certainly embracing unusual new vessel designs, and had the financial means at his disposal in the backing of New Orleans’ Public Safety Committee, which played an active role in preparing the city for the war effort. No matter who is responsible for the boat’s construction, if it was built in New Orleans, it seems likely that the Public Safety Committee would have been involved in some way. From a practical standpoint, however, one would think that Stevensen had his hands full enough with the projects we know he was involved with.

There is also the possibility that the vessel was contracted for locally with C.S. Navy funds, perhaps in relation with the project being undertaken at Tredegar. As head of the Confederate Navy’s Ordnance Department in New Orleans, Lieutenant Beverly Kennon had the financial means and probably
Figure 88. Drawing of the ironclad steam ram CSS *Manassas* (ex-*Enoch Train*), which appears similar to the Louisiana State Museum Vessel in its construction above the waterline (from NARA; reproduced in Dufour 1990).
the connections to either contract with parties for its construction locally, or to have it transported to New Orleans (SHSP XXII:92). He is known to have liberally expended $50,000.00 in C.S.N. funds on various ordnance-related contracts, an effort that exceeded his authority and landed him in disfavor with the Navy Department (Still 1987:43). It is also a matter of record that he was sending torpedoes from his Ordnance Department to Memphis, Tennessee and Columbus, Kentucky at the time (Luraghi 1996:239). Thus, theoretically, Kennon had the funds, the mindset, and the lines of connection with both New Orleans weapons contractors and those in outside regions, such as Tennessee, Kentucky, and elsewhere. However, it seems that it would have been less trouble to ship an existing boat rather than to go through the effort of building another. In addition to the fact that resources were limited, it is unlikely that the Navy Department would have approved of two vessels being constructed in two different places at the same time when the design was probably yet untested.

Could the vessel have been brought in from Mobile? It was certainly closer than Richmond, and rail communication was definitely available. Perhaps it represents the early, sabotaged “submarine apparatus” that Schell has tentatively associated with Smith (Schell 1992:165fn).

Then there is the theory recently proposed by researcher Francis Chandler Furman, which suggests that the Louisiana State Museum Vessel may in fact be one of the submersibles constructed at the Tredegar Iron Works (Coski 1996:292fn). Of the four sources of information available regarding the Tredegar building project, each reveals some facts that are consistent with the characteristics of the Louisiana State Museum Vessel. The surviving Tredegar and C.S. Navy Department records can be interpreted to represent two vessels, the first begun around early August 1861 and probably completed in October or November of that year, and the second begun in early December and possibly completed in May 1862. The first incorporated rather ordinary materials such as boilerplate, iron castings, bolts, brass castings, cloth, and paint. The second required a larger amount of materials and a great deal more specialized labor, incorporated a lot of brass plumbing, and had installed “false bows.” Baker also uncovered information that there were two vessels actually being constructed as part of the Navy program, one a smaller operational prototype, and the other a larger boat still under construction (Pinkerton 1888:400). The miniscule size of the Louisiana State Museum Vessel is consistent with the idea of a smaller builder’s working prototype. Therefore, if the Louisiana State Museum Vessel constitutes either of these vessels, it is the first.

The length Bradford provided in 1882 for the Tredegar vessel (he evidently only knew of one) is the same as that of the Louisiana State Museum Vessel. The archival descriptions of the first Tredegar vessel reveal that it required the purchase of 7,143 pounds of boilerplate, 2 tons of pig iron, and seven castings in its construction, among other needs. These amounts of material all compare favorably with the Louisiana State Museum Vessel, which is estimated to contain roughly 2,500 pounds of 1/4 inch thick boilerplate, contains at least five castings, and would have required at least 2 tons of pig iron ballast to approach a near-neutrally buoyant state.
Other characteristics Baker observed in the Tredegar design included a rubber air hose supported on the surface by a float, and a crew of two to three persons that possibly included at least one suited diver who manually attached the charge. Basically, the most important fact Baker observed was that it may have comprised a maneuverable vehicle housing a sort of air manifold capable of supporting suited divers, as opposed to a fully self-contained submersible (Perry 1965:93). These few construction characteristics described by the Pinkerton agent could be seen as consistent or potentially consistent with the features and overall configuration of the Louisiana State Museum Vessel, specifically its stack structure and the unidentified adjacent mounting features. In agreement with Baker’s observation, the Harper’s Weekly account (as well as the commanding officer of the Congress) describes a rubber air hose supported on the surface by a float. Additionally, the vessel described displays the following features: a two person crew, a four-bladed propeller, a low floor with the ballast compartment underneath, a simple plumbing configuration mounted through the floor plate, a very low hatch feature, a “grapple” assembly by which the vessel could veer and maneuver itself against objects such as anchor chains, and a hull form and size very similar to that of the Louisiana State Museum Vessel. Furthermore, the vessel seemed dependent on blind navigation using course bearings and a “velocimeter,” and employed an unusual method of manually attaching the explosive weapon through using rubber water dams mounted around the hatch area.

All of these characteristics are potentially consistent with the New Orleans boat. A small working prototype certainly may have been more desirable to ship from Richmond to New Orleans for a number of reasons, including portability, the presence of an optimal operating environment in Lake Ponchartrain, and the possibility that it was intended to be used as a template for the production of one or more larger boats in New Orleans. The C.S. Navy was desperate for any available support in the face of the overwhelming naval opposition coming down on them. Military resources in New Orleans were limited, and materials were needed badly enough that they were being shipped in from elsewhere, and from as far away as Richmond. A lake such as the Ponchartrain may have been seen as the best body of water in which to operate a vessel of such limitations. New Orleans was certainly under a threat of an invasion by enemy naval forces, and Lake Ponchartrain in particular contained a U.S. Navy presence (in the form of the steamships USS New London and USS Calhoun) which needed to be countered. The personnel required to theoretically coordinate such a shipment were also in place. The C.S. Navy had a presence in both Richmond (in Acting Master Cheeney) and New Orleans (in Naval Constructor Pierce and Lieutenant Kennon). Tredegar also had an agent in New Orleans (in Edward M. Ivens) working with the C.S. Navy and in potential communication with the Public Safety Committee (ORN 2, I:533). The boat may have been sent to New Orleans through Ivens for either tactical application or to be used as a model in the construction of larger such vessels to be built at Confederate Navy Department facilities there and elsewhere. The temporal aspects of such an undertaking are also in theoretical agreement. Two vessels are known to have been built at Tredegar, both of which disappeared from the historical record around the same time as the conquest of
New Orleans. Shipments of machinery, including one large specially-configured railroad car carrying the center shaft to the ironclad Mississippi, were transported by rail from Tredegar to Ivens and Pierce in New Orleans in mid-April, only a week or so prior to the city's loss (CSA 1864:112; ORN 1, VI:626-627; ORN 1, IX:411-412; ORN 1, XXII:103-105; Still 1969:32; Coski 1996:291 fn21). This shipment was made under the direct authorization of Secretary of the Navy Stephen Mallory. Earlier shipments from Richmond to New Orleans included 220 heavy guns (SHSP XXII:92). A later similar rail shipment of a submersible from one theater to another is known to have occurred in the case of the H.L. Hunley's transport from Mobile to Charleston, so such an idea was certainly feasible. Even if the boat was a failed effort shipped for no other reason than to be recycled as scrap iron, such a possibility still merits consideration, as New Orleans was in need of iron. If so, Tredegar may have been the source. Iron scrap and boiler plate were in high demand by the ordnance works, shipyards, and machine shops within the Confederacy.

Another possibility is that the Louisiana State Museum Vessel may constitute a Williams-designed vessel, either predating the loss of the New Orleans or constituting a later Triton Company effort that somehow ended up in Lake Ponchartrain either during the occupation or at the end of the war. Although Williams was not granted any patents until 1864, he was apparently active earlier. In November 1863, when documents and plans relating to submersible construction were captured during transport across the Mississippi River into Texas, Federal intelligence sources reported that similar such designs had been sent to Houston and Shreveport (Perry 1965:94). The 1863 drawing may represent the same design that he later patented, which is now lost. It bears some similarity to the design of the Louisiana State Museum Vessel, particularly in terms of overall proportions, the keel and lower hull configuration, the presence of a floating air tube system for air replenishment, and the possible capability to carry mines externally. It also bears a likeness to the surviving descriptions of the second Tredegar vessel. The fact that the Williams designs were being circulated in the Houston, Galveston, and Shreveport areas may be indicative of an earlier presence or interest in the Western Gulf areas, and in Louisiana in particular.

It has been suggested that the Louisiana State Museum Vessel may represent a war trophy brought to New Orleans by Federal forces during the occupation (Kloeppe 1989:17). It could be a Triton Company boat captured or otherwise acquired by Federal forces at the end of the war and brought to New Orleans for inspection or some other purpose. The Trans-Mississippi Department forces under General Edmund Kirby Smith, CSA, in Texas, Arkansas, Western Louisiana, and Indian Territory were the last ground forces to surrender in the war, after having been cut off and isolated from all other departments, and after having lost control of most of the waterways to the U.S. Navy. The theory that it is an end-of-war find seems feasible in light of the references to the possible presence of iron torpedo boats in the Shreveport, Galveston, and Houston areas toward the end of the war.
If it cannot be determined where the vessel was built, is it possible to at least identify the source of its design? Based on comparison with other known Confederate efforts, designs that can be ruled out include those of McClintock, Halligan, Anstilt, Winans, and Pierce. Leavitt’s initial design also can be dismissed because it entailed a 50 ton vessel employing steam propulsion, a chemical air repurification system, and a bow-mounted cannon. Designs that may be relevant include those of Smith, Cheeney’s Tredegar efforts, Williams’ Triton Company boats. The influence of lesser-known individuals like Patton remain an unknown quantity. An intriguing possibility is that the designs employed by the Tredegar project (or at least that of the second effort) and the Triton Company may have been one and the same. They possessed many similar characteristics. A connection may exist between the two efforts in the person of James Jones (Perry 1965:94). Also interesting is the fact that the possible Confederate patent model in the collections of the U.S. Naval Academy museum possesses a double-ended design that includes dual rudders. If this model is attributable to Williams, as Robinson believed, it may indicate a connection with the design source for the Louisiana State Museum Vessel.

What of the possibility of a non-American, prewar influence? When foreign designs from the prewar period are studied, there is one that emerges as particularly similar. This design, by Englishman William E. Newton, bears very close study and comparison to the Louisiana State Museum Vessel. Newton designed an unusual submersible working vessel during the years between 1838 and 1858. For various aspects of his design Newton was granted three English patents (numbers 7695, dated June 1838; 726, dated 26 March 1856; and 2268, dated October 1858), as well as one French patent (number 28410, dated 8 July 1856) (Pesce 1906:48 fn3).

Newton’s proposed salvage vessel (there is no evidence it was actually built) was a small, lemon-shaped affair of iron construction (Figure 89). It incorporated internal iron frames intended to act as reinforcing members. A simple hatch was located at the top rear of the vessel to permit entrance and egress of the crew. The little vessel incorporated externally-mounted benches on its sides for divers to sit upon, presumably for transporting them to and from a work site. It was powered by a single hand-cranked screw at the stern, and possessed what appears to be a rudder (translated from the French as “vertical rudder”) at the lower stern end. Most interestingly, it possessed what is referred to as a rudder at the bow (translated from the French as “oar-rudder”) as well (Pesce 1906:49).

The buoyancy of Newton’s boat could be regulated using both fixed and portable solid ballast, and by the introduction and expulsion of water ballast. The portable solid ballast consisted of small weights capable of being moved around the boat’s interior, and if necessary, being jettisoned in order to assist in ascent (although it is not indicated precisely how they would be jettisoned). A simple floor lay over the water ballast chamber. The boat also possessed two snorkel-like fixtures which passed through the deck forward of the hatch and acted as passageways for air intake and exhaust. The vessel’s air supply could be replenished in one of two ways. Upon ascending to a point near the surface, two lengths of tubing (attached
Figure 89. W.E. Newton's design (an interior profile view) for a submersible salvage vessel, which he developed between the years 1838 and 1858 (from Pesce 1906:49).
Figure 90. A representation of Newton's vessel being used in a working environment (from Pesce 1906:49).
to what seem to be retractable sliding snorkels with threaded screw-valves) would permit the entrance of fresh air upon demand. Alternatively, the boat could remain in communication with a surface ship through the use of hoses connected to an air pump. Additionally, the craft could be used in conjunction with an air reservoir capable of channeling air from topside and simultaneously serving several divers. According to the French translation, the boat was "rather destined to be towed than to sail," suggesting it constituted more of a tethered maneuverable work platform than an autonomous craft capable of independent navigation (Pesce 1906:48-50).

A published illustration shows Newton's proposed vessel being employed in a working environment (Figure 90). It appears to be maneuvering independently, but nevertheless is tethered to a support ship stationed topside by a working line running to a tiedown eye on the submersible's topside. A suited diver is riding on the outside of the boat, with his air hose apparently running into the boat through an aperture in the side. An additional air hose may extend between the submersible and the surface ship (Pesce 1906:49).

There are five notable similarities between the surviving design features of the Louisiana State Museum Vessel and the unique concepts proposed by Newton. First, although not a definitive piece of evidence by any means, its size, shape, and general configuration is uncannily similar to that of the Louisiana State Museum Vessel. Second, both vessels mount rudders at the bow and the stern. Third, Newton's vessel employed a system to manage air replenishment in which air was conveyed down to the vessel from the surface using external hoses, pumps, and manifolds. The Louisiana State Museum Vessel possesses features that may represent a similar air-drawing intention, although in this design it was probably an internally contained system intended for autonomous operation. Fourth, Newton's vessel possessed the ability to be used in conjunction with divers working outside of the hull, possibly receiving their air through the vessel itself. In the Louisiana State Museum Vessel, the hatchway entrance is at the top of the vessel as opposed to the bottom, where it would be expected if intended for use as a passageway for divers to exit and enter the boat. However, although Newton's vessel acted as a sort of maneuverable submersible work platform and diver air source, the hatch for crew access and egress was also placed in the top of the boat's hull, whereas on a traditional diving bell-type design, it would be in the bottom. A feature possibly representing a capability to provide air to divers is present in the Louisiana State Museum Vessel (in the two unidentified features adjacent the air stack), and externally operating divers are historically indicated as having been used with some Confederate boats.

Whatever the Louisiana State Museum Vessel's identity and source of design influence, Richmond constitutes a likely point of its physical origin, as that city was a center of Confederate submersible development activity. In addition to the people involved in the Tredegar and Triton projects, other individuals at work in the Richmond area included Leavitt, Patton, and possibly Smith. The role these
lesser-known individuals may have had in either the Tredegar or Triton projects, or else independently, is unknown.

Smith in particular is a wild card, as his designs could have provided some level of influence to anyone involved in the construction of such boats from 1861 on. Ragan has noted that the dimensions given by McClintock are the same as those provided in the Smith letter, raising the possibility that Watson and McClintock may have built their first submarine based upon Smith’s plans, or may have been otherwise inspired or in some way influenced by Smith’s design (Ragan 1995:18; Schell 1992:165fn). Although only a limited written description is available, Smith’s design nevertheless possesses some similarities with the Louisiana State Museum Vessel, and emerges as a possible source of influence. The Smith design incorporated a 30 foot overall vessel length, a propeller drive, a top which “folds back” in order to allow effective surface operation, an “air pump,” an “inhalation tube,” “a “harpoon point” capable of separation from the bow, and the ability to carry sail. It seems possible that the Louisiana State Museum Vessel could have been built or at least partially based upon the Smith design, as indicated by its retaining potential evidence for many of these characteristics. In particular, the boat’s bow spar socket may represent the receptacle for such a detachable harpoon point, and its stack-like feature may have provided a capability for not only air replenishment or explosive attachment, but also as a socket into which a short mast may have been stepped. The possible extent of Franklin G. Smith’s influence may be answered if a copy of his circulated pamphlet of designs can be located and examined. A copy was last known to reside in a private manuscript collection in Tennessee in the early years of this century (Schell 1992:165fn).

In summary, the Louisiana State Museum Vessel remains unidentified. A number of theories have been proposed regarding its origin, some more plausible than others. Its configuration is simple in comparison with other known efforts, indicating an early place in the evolutionary lineage of Confederate submersibles. Based upon its design and the location of its loss, it was probably intended for use in relatively calm bodies of water such as lakes or rivers. It may have been built in New Orleans, perhaps representing an unknown effort overshadowed by the nearby operations of James McClintock and his coalition of supporters. Or it may have been built elsewhere in the Confederacy and subsequently imported to that city. If imported from elsewhere, it may perhaps be one of the vessels built at the Tredegar Iron Works in Richmond, Virginia as part of the C.S. Navy Department’s official building program. It also may have been the product of the Triton Company, perhaps representing a design intended for use in the Trans-Mississippi theatre. Its design and construction may have been influenced by prewar foreign designs or early concepts published and circulated by submarine warfare advocates elsewhere in the Confederacy. In summary, the only conclusions that can be made with some level of probability are that it was built within the Confederacy during the Civil War, and that it was likely lost before or during the evacuation of New Orleans in late April 1862.
CHAPTER VII

CONCLUSIONS

PHYSICAL CHARACTERISTICS OF THE LOUISIANA STATE MUSEUM VESSEL

The Louisiana State Museum Vessel was not overweighted, poorly designed, or unseaworthy as is traditionally assumed. On the contrary, it was competently and thoughtfully designed, crafted of well-selected materials joined with careful workmanship, adequately proportioned and weighted, and capable of attaining a full range of buoyancy characteristics. The boat's designer and builder possessed a clear idea of where the centers of buoyancy and gravity should be located on a submersible, and left plenty of room for ballasting adjustment in the design. This boat reflects a design that was intended to be self-righting and fairly well balanced. It is small in size, narrow and sharp in longitudinal profile, and reflects the intent for some level of double-ended maneuverability in all three planes through the use of well-configured dive planes and a highly unusual dual rudder system. Stealth, stability, simplicity, and maneuverability were valued over size, complexity, and speed.

To place the Louisiana State Museum Vessel in context with other known Confederate submersibles, it was the same length as the first Tredegar vessel and constructed from the same materials (this assumes it is not that vessel itself, of course). It was slightly smaller and lighter than the Pioneer, which weighed approximately 4 tons (4.064 metric tons) at the time it received its letter of marque (ORN 1, IX, 399-400). It was not nearly as large as St. Patrick, the largest of all known Confederate submersibles, or as heavy as American Diver or H.L. Hunley, the latter of which measured twice its length, possessed three times its surface area, and weighed approximately 14 tons (14.224 metric tons) (Cussler 1981:31, Murphy ed. 1998:106-107). The Hunley’s keel alone reportedly weighed approximately 4,000 pounds (1.8 metric tons), according to George W. Gift (Turner 1995, 5-8), and this was likely a gross underestimate (Murphy ed. 1998:106).

POTENTIAL SOURCES OF DESIGN INFLUENCE

The origin of the Louisiana State Museum Vessel’s design poses a perplexing question. Many ideas for submersible boats existed prior to and at the start of the Civil War. This collective body of knowledge included designs originating from both domestic and foreign quarters. Any of these concepts may have served as a source of influence, either by itself or in combination with other concepts. Furthermore, any potential design influence did not necessarily represent a successful design. When all the possible avenues by which ideas were conveyed are considered, it is difficult to state with any degree of
certainty which designs may have circulated to where, and to whom. The ideas published by Franklin G. Smith may have served as an influence, as perhaps did other information known to have circulated within the Confederate States at the outset of the war. A detailed comparison between the Louisiana State Museum Vessel and all known Confederate designs has not yielded enough definitive data to enable an identification, although a number of potential candidates emerge. What is apparent is that the boat resembles none of the known antebellum American designs discussed earlier.

Among the numerous ideas available from sources outside the United States during the early and mid-19th century, the previously discussed one attributed to William E. Newton emerges far above the rest as an unusually distinct candidate. When compared with the features of Newton’s design, the unusual combination of traits in the Louisiana State Museum Vessel suggests that it may have embodied these concepts, and that there is a connection between the two designs. Particular features within the vessel which may represent commonalities between the designs include the hull’s overall form and configuration, the combination of bow and stern rudders, the propulsion configuration, the presence of the stack-like structure and adjacent unidentified features mounted through the topside, and the placement and size of the hatch. It certainly appears that Newton’s concept of a “forward oar-rudder” is present within the Louisiana State Museum Vessel’s design. Especially intriguing is the designer’s evident intent, in both designs, to provide a high center of buoyancy and lateral stability.

It cannot be ascertained whether Newton ever succeeded in building his boat. Nevertheless, the possibility exists that his design may have circulated and influenced later individuals interested in designing, building, and employing submersible boats. An influential design would not necessarily have had to be a successful one to exert an influence on subsequent designs, and it would have been open to modification at the discretion of the appropriating agent. The Louisiana State Museum Vessel may represent such an appropriated and modified preexisting design. Perhaps it was not a submersible in the sense that we perceive such vessels today. It is perhaps a hybrid design, intended both and autonomous and semi-autonomous submersible platform and maneuverable air source that could receive surface support from an overhead platform when desired during operations, and may have possessed the capability to operate in conjunction with helmeted divers.

IDENTITY AND SIGNIFICANCE OF THE LOUISIANA STATE MUSEUM VESSEL

The Louisiana State Museum Vessel cannot be positively identified using the available data. Its history and provenience can be traced back no further than 1878. No evidence has been uncovered which can definitively associate it with any of the projects known to have been undertaken with the Confederacy during the Civil War. Although the vessel was discovered in the vicinity of New Orleans, it cannot be
stated with any certainty where it was constructed. Nevertheless, some basic presumptions can be made, and several likely theories deserve consideration.

At the most fundamental level, three conclusions may be drawn with a reliable level of probability: (1) the vessel was likely a Confederate effort, (2) it was likely built either during the war or immediately beforehand, and (3) it was probably lost before or during the occupation of New Orleans by Federal forces in April 1862. Loss of the boat in the evacuation and seizure of the city seems likely due to the location of its discovery, and would be consistent with the known circumstances of that event. It is known that much material of military value was either destroyed or sunk in surrounding waters during the city’s evacuation in order to prevent valuable resources from falling into the hands of the enemy. Another submersible, the Pioneer, is even known to have been abandoned at a point close by during the city’s loss.

If the Louisiana State Museum Vessel was built in New Orleans, three possible theories of origin deserve consideration: (1) it constitutes a previously unknown McClintock vessel, (2) it was built by other private parties, perhaps with the assistance of the Public Safety Committee, or (3) it was a locally built C.S. Navy project.

If the boat was built elsewhere in the Confederacy and brought to New Orleans, four possible theories of origin emerge: (1) it represents one of the C.S. Navy vessels constructed at the Tredegar Iron Works under Cheeney’s supervision, (2) it represents the efforts of Williams and the Triton Company or their predecessors, (3) it was brought from Mobile, where at least one effort is known to have been made early in the war, to New Orleans prior to the evacuation, or (4) it represents a hitherto unknown effort from elsewhere within the Confederacy.

Of all the possibilities, the theory possessing the most supporting evidence is the one introduced by Francis Chandler Furman, who suggests that it may comprise one of the vessels known to have been built at the Tredegar Iron Works. The few characteristics that are known are not easily disputable. Baker described two vessels, a smaller working prototype and a larger one. The length for a Tredegar vessel as provided by Bradford must be that of the prototype, and it matches that of the Louisiana State Museum Vessel. The only potential conflict lies in Bradford’s statement that it “was to be used as a diving bell, from which a torpedo was to be attached to the bottom of a vessel” (Bradford 1882:7). A diving bell, however, possesses its opening at the bottom of the vehicle, not the top. Could it be possible that the described vehicle was actually a small, crude boat that was intended to be operated by a crew of one or two while at the same time supporting a helmeted diver outside the boat? It is feasible that the unidentified mounting points on either side of the Louisiana State Museum Vessel’s stack may represent the attachment points for some sort of brass air manifolds. Baker’s report conveyed that the crew was composed of “two or three men” wearing “submarine diving armor, which enables them to work under water and attach the magazine to the ship intended to be blown up” (Pinkerton 1888:401). Perhaps Bradford likened it to a diving bell based more
upon its ability to be deployed and hoisted from a larger boat and its ability to channel air to accompanying divers, rather than its overall configuration.

Whatever the boat’s actual air replenishment air configuration, the drawing and description of the James River submersible that appeared in Harper’s Weekly following the attempted engagement with the USS Minnesota bears an uncanny resemblance to the boat in New Orleans. The surviving Tredegar records indicate that over $9,500.00 in C.S. Navy funds were expended during the latter half of 1861 on resources such as boilerplate, bolts, iron castings, brass castings, paint, cloth, and skilled labor. The smaller prototype submersible was probably the focus of this effort. In addition to the agreement in the physical evidence, all of the conditions theoretically necessary for the vessel to be have been conveyed from Richmond to New Orleans were present: the motive, the means of transport, the personnel to manage such a transfer, the presence in New Orleans of a favorable operating environment, a specific intended objective within that operating environment, and agreement in the temporal circumstances of the Tredegar vessel’s disappearance with the loss of New Orleans.

Another theory that stands out from the rest is the possibility that it may represent a Williams design, perhaps a product of the Triton Company or its predecessors. This possibility is based upon the similarities between certain structural characteristics of the Louisiana State Museum Vessel and the surviving drawing of a Williams design captured by Federal forces in 1863. The Williams design is more complex than that of the Louisiana State Museum Vessel, however, and may not have been a very practical one. Geographic lines of connection exist in the fact that later efforts connected with Williams and the Triton Company were undertaken in the Trans-Mississippi Department, although the temporal aspects are cloudy. The early operations of Williams and his colleagues remain an unknown quantity. However, it is feasible that such a vessel may have been brought to New Orleans from Shreveport or the Houston/Galveston area at the end of the war, which is when Jones and his colleagues were undertaking their activities in the west.

A significant unknown quantity is the extent to which the known building efforts may have interacted with one another. It may be that the Louisiana State Museum Vessel possesses lines of connection with more than any one single effort. There seems to be a relationship between the second described Tredegar vessel and Williams’ later drawing, as these designs appear to have in common many of the same general characteristics. It is feasible that the vessel design employed by the Triton Company was the same one used in the second, larger Tredegar boat, based upon the fact that both employed a diver lock-out chamber. Both the Triton Company and the Tredegar Iron Works were based in Richmond, and both programs probably contained at least one participant in common. Another unknown quantity is the extent of now-obscured activities undertaken by individuals such as Smith, Patton, Leavitt, and possibly others. Information is lacking on their associations and the influences they may have had upon other efforts. What is plainly evident is the close resemblance between the Louisiana State Museum Vessel and four separate
surviving historical vessel designs: the boat proposed by Smith, the Tredegar prototype vessel, the James River submersible which appeared in *Harper's Weekly*, and the Triton Company design by Williams. Additionally, both the Louisiana State Museum Vessel and the possible Confederate Patent Office model in the U.S. Naval Academy Museum have in common a unique double-ended rudder configuration. There may exist a common factor linking some or all of these vessel designs.

Despite the unanswered question of identity, the Louisiana State Museum Vessel nevertheless may comprise the oldest extant example of an important and distinct tradition of American watercraft construction, and possibly the second oldest such vessel in the world. It is likely representative of a transitional design stage between antebellum American (and perhaps British, considering the possible influence of Newton) submersible vessel designs, and later configurations such as *H.L. Hunley*. The vessel's small size and simplistic configuration suggest an early place in the evolutionary lineage of Confederate submersible vessel design. Its optimal working environment was probably calm bodies of water such as lakes and sheltered harbors. Perhaps it was not an accident that the boat came to be lost in Lake Ponchartrain; rather, perhaps that was the intended operating area. If it was intended to operate in Lake Ponchartrain, it was presumably intended to counter the U.S. Navy threat known to be present on the lake. Even if the boat proved ineffective in practical terms, its presence may have been intended as a deterrent, and this may even have been part of the plan for its employment. The value of such propaganda was certainly demonstrated by the *Harper's Weekly* articles describing the James River vessel and Anstilt's improbable *American Ram*.

THE LARGER CONTEXT OF CONFEDERATE SUBMERSIBLE VESSEL DEVELOPMENT

In opposition to the commonly held assumption that only a few submersible vessels were constructed by a single group within the South, it is now evident that there existed within the Confederacy a much broader array of submersible vessel development efforts, some part of a military building program, and some independent of one another, but all the product of a materially stressed yet highly innovative wartime economy. Lacking in technological resources and conventional weapons platforms, citizens of the Confederacy were inspired through necessity to develop innovational yet economical modes of warfare. These efforts were the result of influences originating from as far north as St. Louis and Baltimore, and embraced waters ranging from the southern Atlantic seaboard to the Gulf Coast as far west as Galveston. The efforts were motivated by a number of factors. They were inspired by feelings of Confederate nationalism, profit motive and entrepreneurial opportunism, individual quests for personal distinction, general inventiveness and competitive creativity, and the recognition of a need for a practical, effective system to defend waterways and circumvent the Federal blockade.
The efforts to build submersible vessels must be viewed in the context of the Confederacy's larger underwater warfare program. This program was an element of the South's general military strategy of defense by attrition. Although primarily defensive in nature, the Confederacy's underwater warfare program ultimately emerged as one of the most effective and economical means of combating the U.S. Navy in American waters. By the end of the war, more U.S. military vessels were destroyed (29) or damaged (14) by Confederate torpedoes than by any other cause (Scharf 1887:757, Perry 1965:199-201). The submersible vessel merely constituted one of the torpedo delivery vehicles that figured into this strategy.

The Louisiana State Museum Vessel is representative of this larger picture of Confederate underwater warfare and submersible watercraft development. These Southern efforts drew upon an established American tradition of innovation and experimentation in the construction of submersible torpedo vessels for underwater warfare purposes. The work of Bushnell, Fulton, Phillips, de Villeroi, and others served collectively to form a tradition of submersible vessel development that possessed the potential to serve as a basis for the Confederate efforts. Although it has been asserted that submariners like McClintock, for instance, arrived at their designs completely independently (Williams Collection, undated documents), it seems more likely that the ideas of Confederate mechanical engineering visionaries such as McClintock, Cheeney, Halligan, Williams, and others did not evolve within a total vacuum. This information was perhaps conveyed by word of mouth, or discussed in magazines or trade journals such as Scientific American, The Engineer, or even the daily newspapers. Or it was perhaps shared through military, civil government, or other channels. It has been reasonably demonstrated that Bushnell, Fulton, and Colt all took pains to educate themselves regarding the extant body of knowledge as it existed during their respective years of interest in the subject, and that some of this knowledge was obtained from sources outside of the United States. It seems likely that some of the Confederates embarking on development efforts would also have made attempts to verse themselves in the history of such efforts, and thus the potential appropriation of William Newton's design may not have been out of the question. There can be seen a direct line of influence in the development of the weapons to be used in conjunction with the vessels, beginning with Bushnell, extending to Fulton, further extending to Colt, and running directly to Maury and others in the Confederate underwater warfare community. This is significant because the efforts of the underwater weapons providers were intertwined with many of the vessel development projects. Such was the case with Commander Maury being involved with the C.S. Navy program at the Tredegar Iron Works, the Singer Submarine Corps being involved with McClintock's later boats, and members of the Singer group also being involved with both the Tredegar efforts and the Triton Company.

It seems likely that lines of connection existed between some of the submersible projects. Franklin Smith was a potential common link among some efforts, if not for his particular design, then at least for his early circulation of ideas and encouragement. Williams, Patton, and possibly Smith successfully patented their vessel designs, which were made public knowledge in the annual reports of the Patent Office, and
possibly also through the display of models there. Cheeney and Halligan both built boats as part of a C.S. Navy program. Four of McClintock's later supporters were members of the Singer Submarine Corp., the same group whose members were involved in the efforts of the Triton Company. A member of either the Singer Submarine Corp. or the Triton Company appears to likewise have been connected to the Navy's earlier efforts at Tredegar. whereas Leavitt and McClintock received support from the C.S. Army. The Triton Company additionally benefited from the sponsorship of C.S. Senator A.J. Marshall of Virginia, who may have enjoyed unusual access to restricted knowledge regarding the larger picture of such efforts.

An active relationship existed between the C.S. government and the submersible development enterprises. Did this widespread support in its various forms constitute a coordinated military-industrial relationship to encourage submersible production? Essentially, there existed a semi-coordinated program of government and quasi-official sponsorship. Military support of these efforts was more extensive than has traditionally been assumed. The C.S. Navy Department initiated its own building program, centered first at the Tredegar Iron Works in Richmond, Virginia and later at Selma, Alabama. These efforts, which resulted in three boats, may reflect a premeditated plan on the part of the Navy Department leadership. Some form of Army support was received by projects that resulted in at least two vessels. This support manifested itself in the form of personnel, expertise, funds, facilities, and resources. However, this cooperation may later have caused unforeseen ramifications for the initial sponsors when some boats, such as the H.L. Hunley, were subjected to complete military seizure as a result of the military's disenchantment and impatience with their civilian operators.

Quasi-official government support was also received in various forms. At least one senior elected official had direct involvement in some efforts, as in the case of Senator Marshall and the Triton Company. Local sponsorship was also available in the form of support from the various municipal public safety committees. In a tradition reaching back to the War for Independence and the War of 1812, such organizations came to exist in Richmond, New Orleans, Mobile, and elsewhere. They constituted potential sources of encouragement, financial and material support, and networks for the dissemination of information. The potential importance of these committees has probably been underestimated, and may bear further looking into.

Apart from the Navy Department program, the private Confederate initiatives were undoubtedly spurred in part by motives of profit. Corporate groups were formed specifically to promote, and possibly to profit from, underwater warfare; these included the Singer Submarine Corporation in Mobile, the Triton Company in Richmond, the Southern Torpedo Company in Charleston, and McClintock's New Orleans-based coalition of sponsors. Motivational reasons present to induce the undertaking of private efforts included the legal sanction of privateering, the placing of bounties on enemy vessels by commercial interest groups, and perhaps the presence of large amounts of government and municipally-gathered funds available for disbursement under the right circumstances. The fading but still remembered tradition of government-
sanctioned privateering was revitalized through congressional legislation providing for the issuance of letters of marque by the Confederate government. One of the approximately 50 Confederate privateers ultimately authorized by the government was McClintock and Watson’s *Pioneer*. This feeling was further encouraged on 21 April 1862, when the Confederate Congress authorized a provision by which the inventor of a device by which an enemy vessel would be destroyed would be entitled to half the value of the destroyed vessel (Scharf 1887:753). Also influential were the actions of Southern corporations such as John Fraser & Company, which placed individual and blanket bounties on the warships of the U.S. Navy blockading squadrons that were gradually gaining an ever-tightening stranglehold on Confederate maritime commerce.

It should not be presumed that any coordination between these efforts was the result of a deliberate management strategy. The government was probably conscious of them and the connections that linked them, but did not actively seek to coordinate them as one centralized program. Rather, it appears that the variety seen in the efforts reflected the larger lack of coordination evident in the Confederate military’s overall operational and strategic planning. Just as the Confederate service arms and departmental theatres suffered from a lack of coordination with each other, so did the submersible projects. Knowledge concerning such programs was widely spread among many federal agencies, including the Departments of Navy, War, and State, both houses of congress, numerous theatre and fleet commanders of flag rank and their staffs, and other federal institutions such as the Patent Office.

The Confederate submersible vessel development efforts that were undertaken saw varying levels of result, ranging from outright disaster to pyrrhic tactical victory. In retrospect, these submersible operations had several significant effects on U.S. naval operations. They acted as a powerful psychological warfare tool, causing fear among the squadrons, particularly the North Atlantic Blockading Squadron vessels at Hampton Roads in late 1861, and within the South Atlantic Blockading Squadron following *H.L. Hunley’s* engagement with *Housatonic*. They caused expensive and logistically intensive modifications to Federal blockading strategies in some squadrons through necessitating heightened security in the vessels on station, requiring them to be kept ready to get underway at all times, and forcing them to be redeployed further offshore at night, which in the case of Charleston perhaps allowed a greater possibility for blockade runners to get through to that besieged port. Finally, they may have provided the impetus for accelerated Federal attempts to gather intelligence on such craft, conduct their own research, and develop similar weapons.

Beginning with the experimental vessels of 1861, the movement to develop submersible watercraft capable of sinking enemy naval vessels reached its zenith with the *H.L. Hunley’s* attack on the *Housatonic*. This action defined to the U.S. Navy in human lives the danger posed by submersible torpedo craft in Southern waters, and demonstrated to the world the potential value of the submersible vessel in future naval strategy and operation. But even in victory it was made evident that an inherent risk was present in such
enterprises. This cost was paid in the loss of financial investments, time, energy, and for many, their very lives.

THE CONFEDERATE AND FEDERAL DEVELOPMENT EFFORTS IN PERSPECTIVE

In looking at the overall effect of Civil War submersible development efforts, the Confederate submersible torpedo vessel development programs represent only half of the story. To fully understand the place of these vessels in the larger scope of their evolution, they must be viewed in context with the parallel developmental efforts that were being undertaken in the North during this time, and in terms of the effect both had on postwar naval development.

At the outset of the Civil War, the U.S. Navy and the Confederacy both embarked on paths of submersible craft development which, while they may have differed in the manner in which they were executed, in retrospect comprised parallel attempts to produce a successful offensive submersible weapon. As the dominant naval force, the U.S. Navy did not need to rely on unconventional weapons of underwater warfare. Nevertheless, it came to be directly involved with at least two projects, first Brutus de Villeroi’s Alligator, and later Scovel S. Merriam’s Intelligent Whale. A third effort about which not much is known, E.B. Hunt’s What Is It?, may have been a joint effort between the Navy and the Army. In addition to offering his official endorsement of Alligator, President Abraham Lincoln took a personal interest in two other proposed submersible designs, those of Pascal Plant and Oliver B. Pierce, both of whom he referred to the Navy Department (Bruce 1956:177-178). One other effort, cryptically referred to only as “a submarine,” is known to have been sponsored by General Benjamin F. Butler, who was known for his endorsement of cutting-edge military technology (Bruce 1956:73).

The project that resulted in the Alligator came about due to the publicity generated following the seizure of de Villeroi’s salvage submersible by the Philadelphia Harbor Police in 1861 (publicity perhaps taken advantage of by de Villeroi, whose original sponsor had died). This led to an assessment of the vessel by the Commandant of the Philadelphia Navy Yard, following which the French designer proposed a new design in a direct letter to President Lincoln. The result was Alligator, seen by some as a potential tool with which to respond to the Confederate ironclad program. One of the original operational roles outlined for Alligator was for it to be transported to Hampton Roads in order to face the ironclad CSS Virginia (ex-USS Merrimack), and if not for logistical problems that hampered this operation, the history of the Hampton Roads engagement may have played out very differently (Bruce 1956:177). Plagued by contractor problems centering around propulsion and air generation inefficiencies, Alligator underwent a number of significant alterations during its short operational career. The overhauls did not increase the crew’s confidence level. In April 1863 it was lost off Cape Hatteras in a storm while under tow to a new station further south (NHC, Ships’ History Branch, Alligator File; Bolander 1938; DANFS 1:208).
The *Intelligent Whale* was designed by Scovel S. Merriam, and the contract for its production was drawn up in November of 1863. Initial financial support for the project was provided by Cornelius Bushnell and Augustus Price, who were shortly replaced by the newly-formed American Submarine Company. The boat was not completed until April 1866, and interrupted trials were conducted during the years between 1866 and 1870. The process was marred by litigation and ownership disputes, and further complicated by the untimely murder of one of the boat’s primary supporters. Final acceptance trials in 1872 resulted in a near-fatal accident, and as a result the boat was rejected by the Navy and classed as a failure (NHC, Ships’ History Branch, *Intelligent Whale* file; NHC, Navy Museum, Edward Furgol, *Intelligent Whale*; *DANFS* 2:444). By this time the Navy’s interest had turned more toward self-propelling torpedoes and surface torpedo craft.

A third effort is known to have been under development by the fall of 1863. Evidently a joint Army-Navy project, it was conducted at the Brooklyn Navy Yard under the supervision of Major E.B. Hunt of the Army Corps of Engineers. Little is known regarding Hunt’s project, except that it was “a new submarine battery of his own invention” which, for the lack of a better description, was referred to in contemporary newspapers as the *What Is It?* (*New York Times*, 2 October 1863:2). Because the exact nature of this project is still open to question, it cannot be definitely concluded that it involved a submersible vessel. What is known is that on 2 October 1863 Hunt died as the result of an accident aboard the vessel on the previous day involving an unidentified form of ordnance that produced poisonous fumes (“Accident on “What Is It?,” *New York Times*, 2 October 1863:1; “Death of Maj. Hunt,” *New York Times*, 2 October 1863:2). This had the effect of ending the project. References suggest that his project involved developing a platform that mounted underwater ordnance capable of firing some form of projectiles.

Another reported effort, evidence of which was discovered just as this thesis was being finalized for submittal, may have involved U.S. Army Major General Benjamin F. Butler. In his book *Lincoln and the Tools of War*, Robert V. Bruce makes a single passing reference to the fact that Butler sponsored a “submarine project” at some point during his service in the war (Bruce 1956:73). Butler earned a reputation for being very open-minded when it came to innovational military technology, and is known to have sponsored many unusual projects within his command, such as efforts in lighter-than-air reconnaissance aviation, for example (Nash 1954:44-45). The mention of his being involved in such an underwater warfare project is of interest not only because Butler commanded the U.S. Army forces which helped take and garrison New Orleans, but also because from April through December 1862 he was commander of Federal occupation forces in New Orleans (Capers 1965). Bruce has not left us with any documentation as to where his information regarding this effort came from. The questions of when any such effort took place, where it took place, and who else was involved in it are unanswered, and this topic comprises a line of further inquiry. It is a possibility that he was referring to one of the known Federal efforts previously discussed. (Although one intriguing possibility, albeit a most remote one, may be that the
Louisiana State Museum Vessel does not represent a Confederate boat at all, rather, perhaps it comprises a non-Confederate boat introduced to the city by Federal forces during the occupation. Needless to say, it would be ironic if the vessel celebrated as a New Orleans Confederate monument to the Lost Cause for so many years was someday determined to actually constitute a Federal effort, especially if that effort was connected with the man demonized by the Confederate government as “Beast” Butler.

A number of unsolicited proposals were also received by the Navy Department, the majority of which were rejected by the Permanent Commission (a board consisting of four respected scientists set up to screen the many proposals for weapons submitted to the Navy Department). One of these was a plan received in 1862 from Lodner Phillips that outlined a vessel capable of destroying the CSS Virginia; however, this plan was “left in abeyance” (Zalinski 1887:475, cited in Gruse Harris 1982:30). It would be another submersible proposal, de Villorio’s Alligator, on which the Navy would place its below-the-waterline hope for countering the threat of the Virginia (although this ship would ultimately be neutralized by another unconventional new U.S. Navy vessel, the USS Monitor). In 1864 Phillips, now living in New York City and with the backing of New York City lawyer Frederick Peck, submitted another proposal to the Navy. This proposal outlined the construction of three vessels. The first design was for a cigar-shaped vessel measuring 40 feet in length, employing compressed air, capable of sustaining five men for a minimum of 24 hours, and capable of attaching torpedoes to an enemy bottom. The second design was a vessel intended for coast and harbor defense and was armed with shell rockets possessing a three mile surface range, and guns that fired above or below the surface. The third design was similar to the second but measured 200 feet in length in order to allow the carrying of larger ordnance and to sustain heavier seas. In an unusual instance, the Permanent Commission endorsed elements of Phillips’ proposal, noting the lack of success seen in previous submersible vessels and citing the “simplicity and apparent feasibility of the plans proposed by Messrs. Phillips and Peck.” The commission recommended “an appropriation sufficient for the construction of one of the smaller vessels, be made for this purpose” (NARA, RG 45, Entry 363, Vol. 3, p. 94). It may be significant that the Assistant Secretary of War and the man who ran the Ordnance Department during Lincoln’s first administration was Peter H. Watson, who has been described as one of the nation’s foremost patent lawyers and as having possessed extensive knowledge relating to weapons patents (Bruce 1951:169). Perhaps this is the same person referred to in Phillips’ earlier 1852 letter as his patent lawyer at “Messrs Watson and Renwick, Washington City” (Gruse Harris 1982:23-24). No records have yet come to light indicating whether or not funds were actually dedicated to this effort, or what further action was made upon it, if any (Gruse Harris 1982:30-31).

Certain similarities and differences can be noted when comparing the Northern and Southern development programs. Similarities are evident in the receptiveness both governments expressed toward new ideas. Differences can be seen in what resources they allocated and how they allocated it, the rapidity with which support was provided, the extent to which the efforts were allowed to interact with private
enterprise, and the degree of control exerted by the military over them. Both the Confederate and Federal efforts captured a substantial degree of official naval interest in terms of funding, research, and development. Whereas the Federal development efforts were measured and burdened with the traditional administrative entropy of its bureaus, the Confederate efforts were able to benefit from a quick application of private initiative, which was in turn met with swift support from a government unburdened with the traditional bureaucracy of the type extant in the North. The U.S. Navy possessed a single point of contact for such ideas in the Permanent Commission, and exercised tight control over the application, funding, and undertaking of such projects. In the later case of the *Intelligent Whale*, there were strict legal and financial guidelines, and firm trial criteria had to be met. Within the Confederacy, both the Army and the Navy were involved in supporting development efforts. There may have been a similar picture of joint sponsorship in the North, if Major Hunt’s project is taken into consideration. Perhaps the greatest difference lay not in the vessels, but in the crews. The Confederates’ submariners may have proven superior in the levels of training, resolve, and sources of motivation they possessed. In particular, the Confederates’ crews may have had the benefit of better preparation. With the authorization of their superiors, Dixon and Alexander established what essentially amounted to the first organized training program for submarine crews.

Disaster was not limited to one side or the other, but descended down upon both indiscriminately. The U.S. Navy’s plan to deploy the *Alligator* to Hampton Roads to engage the CSS *Virginia* ended in failure, and the later mission to transport the vessel to Southern waters ended prematurely with the loss of the boat. Hunt’s underwater warfare experiments concluded with fatal results. Initiated during the latter half of the war, the *Intelligent Whale* would be the subject of a very slow gestation process. It was not completed and subjected to trials until after the war had ended, and even then it would be classed as a failure. Within the Confederacy, nearly all of the efforts that were undertaken failed in one manner or another. Only one effort is known to have proven successful in execution, and it was lost with its entire crew in the process, probably due to the combination of inadequacies in its design and operation, and perhaps natural forces beyond its control.

The Northern vessels were in some ways more complex in their design and construction. In contrast, the Southern boats seem to have possessed a directed simplicity. While the *Alligator* and *Intelligent Whale* may have suffered from over-engineering and the idiosyncrasies of their designers, vessels such as those built by McClenstock embodied a balanced application of both high and low-end technologies. For example, although better designs were available, McClenstock employed in the *H.L. Hunley* a simple surface-replenishing air supply system, and an open ballast tank configuration. While he experimented with advanced technologies, such as electromagnetic propulsion in the case of *American Diver*, he demonstrated that he knew when to cut his losses and revert to a simpler, recognized means of motive power. This philosophy was enough to get the vessel to an operational status. Halligan’s vessel
may have been the most superior vessel of all, as it seems he was able to successfully adapt a small steam plant into its design. This is something the Federals never achieved.

A picture of government intelligence gathering activities during the war also emerges, and it is illuminating. The data collection process went mostly in a one-way flow to the North, which possessed superior intelligence gathering resources. The Southern agents were generally more concerned with counter-intelligence operations and the acquisition of scarce material resources through interior lines and from overseas. The active and passive intelligence gathering activities undertaken by the North and the counter-espionage activities made by the South support the idea of a competitive parallel development in which Northern military agencies made a concerted effort to keep abreast of the projects being undertaken in the Confederate States.

The United States military benefited from many avenues of information, including firsthand analysis of captured vessels (as in the case of Pioneer), interrogation of prisoners (such as Pierce), covert intelligence gathering by undercover operatives (such as Secret Service agent Baker's activities at Tredegar, as well as others who had infiltrated the Confederate Torpedo Bureau [Stuart 1982 339 fn]), debriefing of defectors (military deserters such as Cheeney, as well as a number of enlisted men familiar with projects and vessels in Mobile, Charleston, and Galveston), interception of message traffic (such as in the case of Williams' vessel design), receipt of unsolicited letters from voluntary informers (such as E.P. Dorr's early warning to the Navy regarding projects in New Orleans, and later reports to the Navy regarding Halligan's efforts in Selma), Confederate government documents published for circulation (such as the annual patent office reports), and through simply reading newspapers and weekly magazines (in which appeared Smith's published design, several detailed stories in Harper's Weekly, and veiled references to efforts in various newspapers). More active measures were also taken through arrest (as in the case of the jailing of Ross Winans for secessionist sympathies), and possibly even outright sabotage (as may have been the case of the unidentified boat scuttled in Mobile). The Federals, and particularly the U.S. Navy Department, were possibly aware of even more information that what is discussed here. If the Navy's leadership was able to effectively evaluate and manage this influx of data, it had the capability to form a fairly complete common tactical picture in regard to Confederate submersible vessel development and operations. This loss of secrecy suffered by the Confederacy can be seen as nothing less than a hemorrhaging of sensitive information that compromised the fundamental integrity of its underwater warfare program.

A clandestine network existed within the Confederacy as well. The Southern efforts assumed more of a defensive posture, with most activities tending toward counter-espionage and the illicit acquisition of scarce materials through the lines. It is not known to what extent the submersible projects were affected by the South's counter-intelligence activities. However, it may be significant that several of the persons associated with one project possessed ties to clandestine organizations. In addition to being one of McClintock's principal backers, Henry J. Leovy was a prominent judicial official in the Confederate justice
system. It has also been suggested that Leovy was a highly-placed member of a secret service counter-
espionage operation (Genella Collection, undated documents). Leovy was certainly highly regarded enough
to have been the recipient of important state papers from President Jefferson Davis during the last days of
the Confederate Cabinet, and to have acted as an escort in assisting Secretary of State Judah P. Benjamin in
his undercover flight to Europe (Hanna 1938:68, 117, 195, 207). Horace Hunley has also been associated
with the South’s clandestine services (Duncan 1965:63, fn84). Furthermore, the Confederate Secret Service
agent Henry Dillingham was known to have been associated with the operations of the *H.L. Hunley* in
Charleston (Ragan 1995:66, 126). Apart from these facts, there may also have existed an underground
pipeline of valuable materials (such as telegraph cable) and technology extending to the Torpedo Bureau
from the Northern states and overseas (Perry 1965:13, 17).

Such intelligence gathering activities may not have been limited to American agents. A picture of
British Admiralty intrigue is evident in North America shortly after the end of the war. These activities
centered around the illicit inspection and evaluation of *Intelligent Whale* at the Brooklyn Navy Yard by a
senior Royal Navy officer in March 1872 (PRO, Adm 1/6236, Report on *Intelligent Whale*), the covert
acquisition of information from McClintock at Nova Scotia regarding his wartime activities and postwar
design proposals for the Royal Navy in October 1872 (PRO, Adm 1/6236, Report on Mr. McClintock’s
Submarine Torpedo Boat), and the maintaining of surveillance upon John P. Holland’s submersible *Fenian
Ram* at Paterson, New Jersey in 1878, due to the fact that the *Ram*’s construction had been funded by the
Irish Revolutionary Brotherhood’s American faction, Clan-na-Gael (O’Brien and Ryan 1953:46 fn). It
seems possible that if such efforts were being conducted by British agents shortly after the war, they may
have also been undertaken by them during the war.

THE POSTWAR LEGACY OF THE CIVIL WAR SUBMERSIBLES

The Louisiana State Museum Vessel represents a transitional period in American naval watercraft
design and construction that laid the groundwork for a U.S. Navy interest in submersible vessels. The U.S.
Navy’s experience with submarines did not begin in 1888 with the Bureau of Construction and Repair’s
solicitation for competing submersible designs, as is sometimes commonly asserted (Weir 1991:6). Rather,
it dated back to the programs undertaken by the armed services, quasi-official organizations, private
corporations, and enterprising citizens on both sides of the Civil War. The Civil War acted as a catalyst that
considerably advanced underwater warfare technology, and submersible vessel development in particular.
More efforts to build underwater boats were seen in America between the years 1861 and 1865 than had
been undertaken in the U.S. in all the previous years combined. The Civil War’s submersible development
operations, specifically manifested in the final operation of the *H.L. Hunley*, demonstrated to the U.S. Navy
and foreign navies that the submersible watercraft possessed the capability to be employed as a viable offensive torpedo delivery platform.

While the Southern efforts dissolved with the Confederacy, the U.S. Navy may have entered the Reconstruction era with a disenchantment regarding its failed wartime submersible development experiences. At the same time, the naturally conservative naval bureaucracy was entering a postwar era of downsizing operations. Nevertheless, within the Navy there was left an institutional memory of contracted submersible construction projects that never fulfilled their promised potential, a gathered knowledge regarding a variety of Confederate efforts, and the bitter operational lessons learned at the receiving end of those efforts. In 1869 the Navy institutionalized underwater warfare when it founded its torpedo development facility at Newport, Rhode Island, and indicated its intended short-term direction by turning its attention toward surface torpedo craft and self-propelled torpedoes. But although the Navy appeared fickle at times and political climates tended to change with presidential administrations and tenures of the service secretaries, during the early postwar years the idea of a Navy submersible vessel development project never really disappeared. The Navy still continued to entertain private submersible solicitations, and advocates in the ranks were cultivated in the form of a few foresighted young officers who had forged relationships with some of the private postwar innovators.

The Civil War underwater warfare experience, and specifically the effect of the South’s submersible development efforts, not only encouraged the U.S. Navy to confront such technology and engage in a contracting process for its own development in such efforts, but also prepared it for the postwar designers who would emerge to petition the Navy with their ideas. The record of American Civil War submersibles on both sides inspired the next generation of American submarine visionaries, namely George F. Baker, Josiah L. Tuck, Marcus Ruthenberg, Edmund L. Zalinski, Simon Lake, and John P. Holland. In 1888 the Navy’s Bureau of Construction & Repair (BuC&R) held an open design competition for submarine proposals. Holland’s design prevailed. In 1893 construction of a boat was authorized by congress, funds were appropriated, and Holland’s company was contracted to build a vessel. Not to be deterred, Simon Lake continued to build his own brand of innovative submersible vessels, with which he would garner later contracts from BuC&R (Figure 91). In 1900, after a turbulent gestation period, the Navy commissioned its first practical operational submersible, the USS Holland (SS-1) (Figure 92).

By the turn of the century, a competitive naval-industrial complex for building submarines was in the offing, and two corporations, the Holland Torpedo Boat Company (later Electric Boat Company) and the Lake Submarine Boat Company, were designing and delivering operational prototype submarines or submarine designs to the U.S. Navy and foreign navies, including those of Great Britain, Japan, Germany, Austria, and Russia. In the early years of the century, the U.S. Navy began to recognize the submersible vessel for its true potential as an undersea weapon and provided it with a limited operational role within its strategic organization. The submarine has subsequently emerged as one of the premiere weapons of
Figure 91. Simon Lake's *Argonaut* under construction at the Columbia Iron Works and Dry Dock Company in Baltimore, Maryland, shortly before its launching in August 1897 (from The Mariners' Museum, PN 3722).
Figure 92. USS *Holland* (SS-1) in drydock, circa 1900 (from Polmar 1983:14).
military combat and deterrence, being used with great strategic and tactical effect in the Great War, the Second World War, and the Cold War, as well as in the India-Pakistan War, the Falklands War, the Gulf War, and continuing post-Cold War encounters.
REFERENCES CITED

Manuscript Collections

Connecticut Historical Society (CHS), Hartford, Connecticut


Emory University, Atlanta, Georgia

Eustace Williams Collection, R.W. Woodruff Library Special Collections.

Transcript of a talk given by William A. Alexander to the Iberville Historical Society, Mobile, Alabama, 15 December 1903.

Miscellaneous undated documents.

Library of Congress (LC), Manuscript Division, Washington, D.C.


Edward Willis Papers, Box 3, unnumbered items. Undated sketch labeled “Hunley’s Fish Fin Torpedo Boat.”

Louisiana State Museum (LSM), New Orleans, Louisiana

Louisiana State Museum Vessel Files

Mobile City Museum, Mobile, Alabama


National Archives and Records Administration (NARA), Washington, D.C.

Record Group 45, Naval Records Collection of the Office of Naval Records and Library, 1691-1945

Letters Received by the Secretary of the Navy from Commanding Officers of Squadrons, 1841-1886 (M-89), Area 7, Roll 81.
Letter from Flag Officer Louis M. Goldsborough, USN, Commanding Officer, Atlantic Blockading Squadron to SecNav Gideon Welles, 17 October 1861.

Letter from Flag Officer Louis M. Goldsborough, USN, Commanding Officer, North Atlantic Blockading Squadron to SecNav Gideon Welles, 20 October 1861.

Letters Received by the Secretary of the Navy from Commissioned Officers Below the Rank of Commander and from Warrant Officers, 1802-1884 (M-149).


Letters Received by the Secretary of the Navy from the President and Executive Agencies, 1837-1886 (M-517), Captured Confederate Correspondence, Box 23, Item 312.

Letter from Brigadier General Edward R.C. Canby, USA, Assistant Adjutant-General to SecNav Gideon Welles, 18 January 1864. Contains as Enclosure Letter from Brigadier General Charles P. Stone, USA, Chief of Staff, Headquarters Department of the Gulf, to Adjutant-General of the Army, 27 November 1863. Drawing of submarine boat enclosed.

Subject File of the Confederate States Navy, 1861-1865 (M-1091), Subject File BM, Box 128, Roll 11.

Tredegar Journals, entries for October 1861

Pay Roll of Workmen on Submarine Batteries for 11 December 1861.

Invoices of Anderson & Co., 27 February 1862 and 13 May 1862.

Proceedings of the Naval Court of Inquiry, 26 February 1864 (Case #4345), Commission of Inquiry on the Sinking of the Housatonic.

Record Group 109, War Department Collection of Confederate Records

Letters Received by the Confederate Secretary of War, 1861-1865 (Entry M-437).


Register of Letters Received, Confederate Engineers, Vol. 7.


Record Group 241, U.S. Patent Office and Center for Cartographic and Architectural Archives, Science and Technological Archives Division


Naval Historical Center (NHC), Washington Navy Yard, Washington, D.C.

Historical Reference (Z) Files, Ships (ZC), Operational Archives (AR) Branch.


H.L. Hunley files, Department of Navy Watercraft Files, Underwater Archaeology (UA) Branch.

Public Records Office (PRO), London, Great Britain


Report on Mr. McClintock’s Submarine Torpedo Boat by Captain F. Nicholson, RN and Chief Engineer J.H. Ellis, RN, with enclosures, 21 October 1872.

Tulane University, New Orleans, Louisiana

Louis J. Genella Collection (CSS Hunley Papers), M-64, Manuscripts Department, Tulane University Library, 1958.

Letter, Chief, Tides & Currents, U.S. Coast Geodetic Survey, Department of Commerce to Louis J. Genella, 13 March 1958, and other miscellaneous documents.

Miscellaneous undated documents.

U.S. Naval Academy Museum (USNA Museum), Annapolis, Maryland

Curator’s Office Files, Accession and Catalog Records, File of Documents Relating to Accession 25.1 (7 March 1925).

Inventory of Ordnance Relics, Enclosure C in Second Endorsement 4217/4(R) of Commandant, Naval Gun Factory, 13 June 1924 (this document is referred to in subsequent memoranda, but has not been located).

Memorandum from Superintendent U.S. Naval Academy to Secretary of the Navy via Commandant and Superintendent, Naval Gun Factory, and Bureau of Ordnance, 18 February 1925 (2 pages).

Store Invoice No. 5076 (copy), of Ordnance Relics Shipped 6 March 1925 from Supply Officer, U.S. Navy Yard, Washington, D.C. to Superintendent, U.S. Naval Academy, Annapolis, Maryland (one page only, second page appears to be missing).

Virginia Historical Society (VHS), Richmond, Virginia

Virginia State Library (VSL), Archives Division, Richmond, Virginia

Tredgar Iron Works Papers 1836-1900


Tredgar Order Book, 1861-1862, entries for September, October, and November, 1861, pages 1166, 1192, and 1212.

Private Collections


Published Sources

Abbot, Henry L.

Alexander, William Anthony
1902a The True Stories of the Confederate Submarine Boats. In the New Orleans Picayune, 29 June.


Arthur, Stanley C.

Baird, G.W.
1902 Submarine Torpedo Boats. *Journal of the American Society of Naval Engineers*

Barber, Francis Morgan
1875 *Lecture on Submarine Boats and Their Application in Torpedo Operations.* U.S. Torpedo Station, Newport, Rhode Island.

Barnes, Robert Hatfield

Beauregard, P.G.T.

Bergeron, Arthur W., Jr.
1991 *Confederate Mobile.* University Press of Mississippi, Jackson, Mississippi.

Bolander, Louis H.

Bradford, LCDR Royal Bird, USN
1882 *Notes on the Spar Torpedo.* U.S. Torpedo Station, Newport, Rhode Island.

Bruce, Robert V.

Burcher, Roy, and Louis Rydill

Burgess, Robert F.

Burgoyne, Alan H.

Burton, E. Milby

[Bushnell, David]

Capers, Gerald M.
Chapelle, Howard I.  

*Chicago Daily Tribune*  

Clark, William Bell (editor)  
1964 *Naval Documents of the American Revolution*, vol. 1. Department of the Navy, Naval Historical Center, Washington, D.C.

1966 *Naval Documents of the American Revolution*, vol. 2. Department of the Navy, Naval Historical Center, Washington, D.C.

1967 *Naval Documents of the American Revolution*, vol. 3. Department of the Navy, Naval Historical Center, Washington, D.C.

Clemmer, Gregg S.  

*Cleveland Herald*  
1853 18 October. Sub-Marine Propeller.

*The Columbia Herald [Tennessee]*  
1861 10 June. Submarine Warfare.

Confederate States of America  

1864 *Proceedings of the Court of Inquiry Relative to the Fall of New Orleans, Published by Order of Congress*. R.M. Smith, Public Printer, Richmond.

1865 *Annual Report of the Commissioner of Patents to the Speaker of the House of Representatives, Richmond, January, 1865. Ordered to be printed by the House of Representatives, January 26, 1865.*

*Confederate Veteran Magazine*  

Cornelius, CDR George, USN (Ret.)  

Coski, John M.  


Compton-Hall, Richard  
Cussler, Clive

Cussler, Clive, and Craig Dirgo

The Daily Journal (Cumberland County, New Jersey)

De Kay, James Tertius

Delpuch, Lieutenant de vaisseau Maurice Yves

Desmond, C.

Dew, Charles B.

Dorset, P.F.

Dudley, William S.

Dudley, William S. (editor)

Dufour, Charles L.

Duncan, Ruth H.

The Engineer [London]


1859 8 July:37. The Cigar-Shaped Steamer.
1859 19 August:139. The Cigar Steamer.
1860 11 May:309. Abstracts of Specifications: Class 9—Electricity. “Apparatus for applying or using mechanism or electro-magnetism as a motive power.”

Field, Cyril

Flexner, James Thomas

Fort, W.B.

Foster, J.
1961 Is the Submarine in the Arcade of the Presbytere Really the Pioneer? In the *New Orleans Times Picayune*, May 14, Dixie Roto section.

*Frank Leslie’s Illustrated Newspaper*

Friedman, Norman

Furber, Holden

Gaget, Maurice
Gale, Benjamin

Gillmer, Thomas C., and Bruce Johnson

Grant, Marion Hepburn

Gruse Harris, Patricia A.

Guernsey, R.S.
1889 New York City and Vicinity During the War of 1812. Charles L. Woodward, New York.

Guthrie, John

Hagerman, CAPT George, USN (Ret.)

Hanna, Alfred Jackson

Harper's Weekly
1864 30 January:77-78. Rebel Submarine Battery.
1864 24 September:609. The Rebel Torpedo Boat.
1865 25 February:124. Incident on Board the “Octorara.”

Hart, W.O.

Hartmann, Gregory K.

Hartwell, Julia

Hearn, Chester G.

Hill, Horace N.
The Houston Chronicle

Hutchison, Wallace S., Jr.

Irvine, Dallas D.
1939 The Fate of Confederate Archives. American Historical Review 44.7:823-841.

Johnston, Henry P.
1893 Sergeant Lee's Experience with Bushnell's Submarine Torpedo in 1776. Magazine of American History with Notes and Queries 29 (March):262-266.

Katts, Henry C., and George C. Farr

Kellin, ENS Albert L., USN

Kloepel, James


Krafft, Herman F., A.B., LL.B.

Lake, Simon

Lawliss, Chuck

Levy, Gordon S.
1909 Torpedo Boat at Louisiana Soldiers' Home. Confederate Veteran 17.9 (September):459.

Lundeberg, Philip K.

Luraghi, Raimondo
Maryland Historical Trust

Merrill, James M.

*Mobile Advertiser and Register*

Moebs, Thomas Truxtun

Morgan, William J. (editor)
1972 *Naval Documents of the American Revolution*, vol. 6. Department of the Navy, Naval History Division, Washington, D.C.

Murphy, Larry E. (editor)
1998 *H.L. Hunley Site Assessment*. National Park Service, Submerged Cultural Resources Unit, Intermountain Region, Santa Fe, New Mexico.

Nash, Howard P., Jr.

*New Orleans Daily Crescent*

*New Orleans Daily Delta*

*New Orleans Daily Picayune*
1874 10 March. Died... Scott... Cited in Ragan 1995.
1909 2 April. First Torpedo Boat, Now in Place on Soldiers' Home Grounds. Copy in LSM files.

*The New Orleans Times-Democrat*
1907 19 June. Copy in LSM files.

*The New York Herald*

*The New York Times*
1863 2 October:1. Accident on “What Is It?”
1863 2 October:4. The Death of Major Hunt.
1879 15 October:5. An Inventor Killed, A Fatal Explosion in Experimenting With a New Compound.
1879 17 October:2. The Record of Accidents.

*Niles' Weekly Register*
1813 IV (3 July):293.
1813 IV (17 July):326-327.
1814 VI (9 July):318.

O'Brien, William, and Desmond Ryan (editors)

Parsons, William Barclay

Perry, Milton F.

Pesce, G.L.

Peterson, Curtiss E.

*The Philadelphia Ledger*
1859 23 August.

Philip, Cynthia Owen

Phillips-Birt, D.

Pinkerton, Allan
1888 *The Spy of the Rebellion: Being a True History of the Spy System of the United States Army During the Late Rebellion...* G.W. Dillingham, Publisher, New York.

Polmar, Norman
1983 *The American Submarine.* The Nautical & Aviation Company of America, Annapolis, Maryland.

Ragan, Mark

Robinson, William M., Jr.

Roland, Alex


Rowbotham, W.B.

Rye, Scott

Schafer, Louis S.

Scharf, J. Thomas

von Scheliha, Victor Ernest K. Rudolph
1868 *A Treatise of Coast Defence Based on the Experience Gained by Officers of the Corps of Engineers of the Army of the Confederate States, and Compiled from Official Reports of Officers of the Navy of the United States, Made during the Late North American War from 1861 to 1865.* E. & F.N. Spon, London, Great Britain.

Schell, Sidney H.

Solomon, Robert S.

*Southern Historical Society Papers*

Stanton, C.L.
1914 Submarines and Torpedo Boats. *Confederate Veteran* 22.4 (April):398-399. Typewritten transcript on file at The Mariner’s Museum Research Library, Newport News, Virginia, dated 1966. (Although cited in other sources, this file was not able to located by the author or the museum’s library staff.)

Steffy, J. Richard
1994 *Wooden Ship Building and the Interpretation of Shipwrecks.* Texas A&M University Press, College Station, Texas.

Stern, Philip Van Doren

Still, William N., Jr.
Stuart, Meriwether  

Taggart, Robert (editor)  

Thomson, David Whittet  

Tomb, James H.  

Turner, Maxine  

United Confederate Veterans  
1892 *Minutes of the Third Annual Meeting and Reunion of the United Confederate Veterans, Held in the City of New Orleans, La., April 8th and 9th, 1892.* Hopkins’ Printing Office, New Orleans, Louisiana.

U.S. Congress  

U.S. Department of the Navy, Office of Naval War Records  


U.S. Department of the Navy, Naval History Division  


U.S. War Department  

van der Vat, Dan  
[de Villeroi, Brutus]


Villon, A.M.


Walker, Jennie M.


Walthall, Ernest Taylor


Weir, Gary E.


Welch, James P.


White, John H., Jr.


Wills, Richard K.


Zalinski, Edmund L.

25 May 2000

Richard Wills
P.O. Box 1670
St. Louis, MO 63188

Dear Rich:

The Institute of Nautical Archaeology grants permission for you to reproduce any material from your article (Richard K. Wills, author) entitled "The Confederate Privateer Pioneer and the Development of Confederate Submerisible Watercraft," that appeared in Volume 21, No. 1/2 of the Institute of Nautical Archaeology Quarterly, pages 12-19, for your Master's thesis at Texas A&M University.

Sincerely,

[Signature]

Jerome Lynn Hall
President
VITA

Name: Richard Keith Wills
Date and Place of Birth: 14 October 1969, in Millville, New Jersey
Permanent Address: 300 Harrison Avenue, Millville, New Jersey 08332
Special Interests: Physical Anthropology, Forensic Nautical and Aeronautical Archaeology

Educational Background:
Atlantic Community College (Atlantic City, NJ), 1986-1987, fine arts (transferred)
Evangel College (Springfield, MO), 1987-1989, B.A. History and Political Science
American Studies Program (Washington, DC), 1989, Certificate of Completion
Texas A&M University (College Station, TX), 1991-2000, Department of Anthropology,
   Master's Program in Nautical Archaeology

Employment Background:
1988-1989 Assistant Archivist, Evangel College Archives (Springfield, MO)
1989-1990 Program Assistant, Stephen Decatur/Judah P. Benjamin House Museum, National Trust
   for Historic Preservation (Washington, DC)
1990 Watercraft Plans Collection Manager (Internship), Department of Maritime History,
   Division of Transportation, National Museum of American History, Smithsonian
   Institution (Washington, DC)
1991-1995 Monte Cristi Shipwreck Project (Monte Cristi Bay, Dominican Republic), Pan-American
   Institute of Maritime Archaeology (San Francisco, CA) and Earthwatch (Watertown,
   MA). Archaeological Staff (1992 campaign), Assistant Director (1993 campaign), Field
   Director (1994 and 1995 campaigns)
1995-1996 Archaeologist, Institute of Nautical Archaeology (INA) (College Station, TX)
1995-1997 Assistant Underwater Archaeologist, Office of the Underwater Archaeologist, Naval
   Historical Center (NHC-UA), Department of the Navy (Washington, DC)
1996-1997 Archaeologist, National Council of State Historic Preservation Officers (NCSHPO)
   (Washington, DC)
1997-present Archaeologist/Recovery Leader, U.S. Army Corps of Engineers (CEMVS-ED-Z, St.
   Louis, MO); U.S. Army Central Identification Laboratory-Hawaii (USACIL-HI, Hickam
   AFB, HI); and U.S. Navy Commander-in-Chief Pacific Command (CINCPACOM)'s
   Joint Task Force-Full Accounting (JTF-FA, Camp H.M. Smith, HI)

Archaeological Projects Participated In:
- As Archaeological Staff: Reader's Point Vessel (INA/Jamaica Heritage National Trust, St.
  Ann's Bay, Jamaica); Intelligent Whale (U.S. Navy Museum, Washington, DC); H.L. Hurley
  (NHC-UA/NPS-SCRU/SCIAA, Charleston, SC); Normandy Coastline Survey: Omaha, Utah
  (NHC-UA/INA, France).
- As Principal Investigator/Director: Louisiana State Museum Vessel Documentation Project (LSM,
  New Orleans, LA); Lake Michigan Recovered Naval Aircraft Wreck Documentation Project
  (NHC-UA/INA/National Museum of Naval Aviation, NAS Pensacola, FL); U.S. Navy TBD-2 BuNo
  2106 Documentation Project (NHC-UA/INA/NMNA, NAS Pensacola, Florida); U.S. Navy PBM-5
  BuNo 59172 (NHC-UA/NMNA, Lake Washington, WA); Puerto Rico Underwater Military Aircraft
  Wreck Site Survey (NHC-UA/INA/Consejo de Arqueología Subacuática de Puerto Rico, San Juan, PR).
- As Recovery Leader/Archaeologist during USACIL-HI/JTF-FA Joint Field Activities (JFAs) of
  unresolved Missing-in-Action (MIA) and Killed In Action/Body Not Recovered (KIA/BNR)
  personnel cases in Vietnam and Laos: 48th JFA (Recovery of 1912B); JFA 98-2L (Recovery of
  1618 and 1831); JFA 98-3L (Recovery of 1831); JFA 98-4L (Recovery of 1831 and 3004); 52nd
  JFA (Recovery of 1167, Recon Survey of 1168); JFA 99-2L (Recovery of 1084 and 1403, Recon
  Survey of 1339); JFA 99-3L (Recovery of 1403 and 1339, Recon Survey of 3037, 1340/1341,
  and 0980, Investigation of 0553, 1703A, 1703B, and AIR 993L-009); 55th JFA (Underwater
  Recovery of 0952); JFA 99-5L (Recovery of 1495 and 0553).