INTELLIGENT WHALE: A HISTORICAL AND ARCHAEOLOGICAL
ANALYSIS OF AN AMERICAN CIVIL WAR SUBMERSIBLE

A Thesis

by

PETER WINSTON HITCHCOCK

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

May 2002

Major Subject: Anthropology
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Approved as to style and content by:

Donny L. Hamilton
(Chairman)

Kevin J. Crisman
(Member)

James C. Bradford
(Member)

David L. Carlson
(Head of Department)

May 2002

Major Subject: Anthropology
ABSTRACT

_Intelligent Whale_: A Historical and Archaeological Analysis of
an American Civil War Submersible. (May 2002)

Peter Winston Hitchcock, B.A., Texas A&M University

Chair of Advisory Committee: Dr. Donny L. Hamilton

The topic of this thesis is an American Civil War submersible known as the
_Intelligent Whale_. Construction of the vessel began in 1863, but due to several
obstacles it was not completed until 1869. Failing an open water test conducted at the
Brooklyn Navy Yard (New York Navy Yard) in 1872, the vessel was removed from the
water. It remained at the yard until 1965, when it was moved to the Washington Navy
Yard. In 1999 it moved to its current location at the National Guard Militia Museum of
New Jersey in Sea Girt. Relatively unknown by historians, the _Intelligent Whale_ is the
oldest existing submersible in the U.S. Navy.

On the rare occasions when scholars of submersible history provide information
about the _Intelligent Whale_, it is generally limited and in some cases wrong. This thesis
will clarify the historical facts and provide a detailed chronology not found in previous
histories. Furthermore, a reconstruction of the submersible on paper using
measurements taken directly from the vessel will aid the analysis of its hull design,
method of construction and configuration of its internal and external features. To date
this has not been done, resulting in a lack of knowledge concerning the operation and
collection of the submersible. New information will make it possible to discuss the
vessel's relation to other Civil War era submersibles, such as the Louisiana State
Museum Vessel and H.L. Hunley, and consequently its role in the U.S. Navy and
submersible warfare.

In February of 1996, a preliminary survey of the submersible was conducted at
the Washington Navy Yard, the objectives of which were to become acquainted with
the vessel and determine the extent of previous research. The following summer an
extensive survey documented the vessel's interior and exterior features and compiled a
photographic record. During the summer of 1998, additional information concerning
the vessel's history was obtained from the National Archives and the Naval Historical
Center in Washington, D.C. Final documentation of the hull was conducted in March
of 2002.
DEDICATION

This research is dedicated to Scovel S. Merriam, whose work is not forgotten.
ACKNOWLEDGEMENTS

Over the past few years I have had several people help with the research of the *Intelligent Whale* and I would like to extend my deepest gratitude. To Rich Wills, thank you for sparking my interest in Civil War submersibles—I probably would have never known of the *Whale* without your call from the Naval Historical Center. Also thank you for lending/leaving your extensive library which has helped provide a great deal of information and insight into my own work. While conducting my research away from home, I have had the assistance of several individuals that made the task a little easier and much more enjoyable. Thank you to Brett Phaneuf, Rich Wills, and Alan Flanigan for assisting with the recording. I would also like to thank Dr. Edward Furgol of the Naval Museum at the Washington Navy Yard for sharing what he knew of the *Whale* and for pointing me in the right direction at the National Archives. A special thanks goes to Bruce Halsted, who has provided me with a wealth of information concerning his family and whose stories have brought "Pet" back to life. During my last visit to the submersible, in New Jersey, I had the privilege of meeting Judith McCabe and the rest of the staff at the National Guard Militia Museum. For over a week they provided me with a place to stay, all the coffee I could drink, and did not seem to mind that I took over a corner of their building—my sincerest thank you.

As for the work at home, I extend my appreciation to both Stephanie Judjahn and Mrs. Phaneuf for taking the time to read over (and over) the chapters I sent them. Likewise, Taras Pevny has been invaluable for his assistance in turning the
measurements I gathered in the field into something that I could make sense of on paper. I would also like to give thanks to my committee members who have shown much patience with my work.

Last but not least, I would like to thank my family, especially my wife Molly – your patience, support, and encouragement have been the most help of all.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>iii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>vi</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>SHORT TITLE KEY TO ABBREVIATIONS</td>
<td>xvi</td>
</tr>
<tr>
<td><strong>CHAPTER</strong></td>
<td></td>
</tr>
<tr>
<td>I  INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Organization of Thesis</td>
<td>4</td>
</tr>
<tr>
<td>Methodology</td>
<td>5</td>
</tr>
<tr>
<td>II SUBMERSIBLE EFFORTS PRIOR TO 1861</td>
<td>6</td>
</tr>
<tr>
<td><em>Turtle</em> (1776)</td>
<td>6</td>
</tr>
<tr>
<td><em>Nautilus</em> (1800)</td>
<td>11</td>
</tr>
<tr>
<td>Other Submersible Efforts During the War of 1812</td>
<td>18</td>
</tr>
<tr>
<td><em>Chelsea Submarine</em> (1815)</td>
<td>19</td>
</tr>
<tr>
<td><em>Marine Cigar</em> (1851)</td>
<td>23</td>
</tr>
<tr>
<td>New York Submarine Boat (1851)</td>
<td>30</td>
</tr>
<tr>
<td>De Villeroi’s Philadelphia Submersible (1859)</td>
<td>31</td>
</tr>
<tr>
<td>Eve of the American Civil War</td>
<td>35</td>
</tr>
</tbody>
</table>
CHAPTER

III SUBMERSIBLE EFFORTS DURING THE AMERICAN CIVIL WAR

- Louisiana State Museum Vessel (1861) ......................................................... 39
- Submersible Efforts at the Tredegar Iron Works (1861) .................................. 43
- Pioneer (1861) ................................................................................................. 49
- U.S.S. Alligator (1862) .................................................................................... 53
- American Diver (1862) .................................................................................... 60
- H.L. Hunley (1863) ......................................................................................... 62
- Other Southern Efforts ..................................................................................... 69
- Northern Efforts Not Realized ....................................................................... 73

IV THE HISTORY OF INTELLIGENT WHALE FROM 1863 TO PRESENT

- Scovel S. Merriam and the American Submarine Company .......................... 83
- Oliver S. Halsted Jr. .......................................................................................... 90
- Intelligent Whale and the U.S. Navy .............................................................. 100
- Intelligent Whale on Display ......................................................................... 105

V CONSTRUCTION OF INTELLIGENT WHALE

- Documentation of the Submersible ................................................................. 111
- Hull Characteristics ......................................................................................... 113
- Hull Construction ............................................................................................ 118
- Systems Configurations .................................................................................. 143

VI CONCLUSIONS

- Comparisons to Contemporary Submersibles .............................................. 174
- Potential Design Influences ........................................................................... 179
- Historical Significance .................................................................................... 180
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An illustration of David Bushnell’s <em>Turtle</em></td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>A nineteenth century illustration of Robert Fulton’s <em>Nautilus</em></td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>Watercolor sketch by Lt. John Bowen of a submersible discovered in Long Island Sound during the War of 1812</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Sketch of Silas Halsey submersible found in Samuel Colt’s papers</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>Lodner Phillips’ second submersible as depicted in 1916 newspaper advertisement</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>A diagram of Lodner Phillips’ third submersible <em>Marine Cigar</em></td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>Phillips’ 1852 patent diagram for a rudderless submersible steered by a prop mounted on a universal joint</td>
<td>28</td>
</tr>
<tr>
<td>8</td>
<td>An illustration of Alexander Lambert’s New York Submarine Boat</td>
<td>32</td>
</tr>
<tr>
<td>9</td>
<td>De Villeroi’s submersible built to salvage the H.M.S. <em>De Braak</em></td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>The Louisiana State Museum Vessel on display at the Pontalba Building in New Orleans</td>
<td>41</td>
</tr>
<tr>
<td>11</td>
<td>A sketch by Acting Master William Cheeney of a submersible propeller for a vessel under construction at the Tredegar Iron Works, dated September 1861</td>
<td>44</td>
</tr>
<tr>
<td>12</td>
<td>An illustration from <em>Harper’s Weekly</em> depicting the submersible that attacked the U.S.S. <em>Minnesota</em> in the James River on 9 October 1861</td>
<td>47</td>
</tr>
<tr>
<td>13</td>
<td>A drawing of the submersible <em>Pioneer</em> by Assistant Engineers G.W. Baird and Alfred Colin of the United States Navy</td>
<td>52</td>
</tr>
<tr>
<td>14</td>
<td>An illustration of de Villeroi’s of the U.S.S. <em>Alligator</em></td>
<td>56</td>
</tr>
<tr>
<td>FIGURE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>15</td>
<td>A drawing of the Confederate submersible <em>American Diver</em> as described by</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>James McClintock to the British Royal Navy in 1872.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>A drawing of the Confederate submersible <em>H.L. Hunley</em> by William Alexander.</td>
<td>64</td>
</tr>
<tr>
<td>17</td>
<td>An illustration from <em>Harper's Weekly</em> depicting the submersible that was</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>captured in Mobile Bay by Federal forces in August 1864.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>The submersible design submitted by Professor Horstford to the U.S. Navy in</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>1864.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>A comparison of a design submitted to the U.S. Navy by Lodner Phillips in</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>1851 (above) to an unidentified submersible discovered in Charleston, South</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carolina in 1865.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>A maker's mark stamped on a frame inside <em>Intelligent Whale</em> that reads</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>&quot;W.P. &amp; Co. [crown] BES.&quot;.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>A patent submitted by Merriam in October 1866, indicating he resided in</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Springfield, Massachusetts.</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>A portrait of Oliver S. Halsted Jr. taken during the American Civil War.</td>
<td>91</td>
</tr>
<tr>
<td>23</td>
<td>An illustration of a diver (like Sweeny) leaving the bottom hatch of the</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td><em>Intelligent Whale</em> to attach a torpedo to a targeted ship.</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>The earliest known photograph of the <em>Intelligent Whale</em> on the &quot;Cob Dock&quot;</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>at the Brooklyn Navy Yard circa 1872.</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td><em>Intelligent Whale</em> at the Brooklyn Navy Yard on the corner of Third Street</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>and Perry Avenue. Photograph taken during the early 1900's.</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>A picture of <em>Intelligent Whale</em> without the propeller basket.</td>
<td>107</td>
</tr>
<tr>
<td>27</td>
<td>A picture of <em>Intelligent Whale</em> in front of the Disbursing Office at the</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Brooklyn Navy Yard circa 1940.</td>
<td></td>
</tr>
<tr>
<td>FIGURE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>28</td>
<td><em>Intelligent Whale</em> at the Washington Naval Yard in the late 1960's or early 1970's</td>
<td>109</td>
</tr>
<tr>
<td>29</td>
<td><em>Intelligent Whale</em> being lifted by crane in Sea Girt, New Jersey, in 1999</td>
<td>110</td>
</tr>
<tr>
<td>30</td>
<td>Two photographs comparing <em>Intelligent Whale’s stern</em> with and without the propeller basket</td>
<td>114</td>
</tr>
<tr>
<td>31</td>
<td>Lines of <em>Intelligent Whale</em> based upon documentation gathered during the 2002 recording project</td>
<td>115</td>
</tr>
<tr>
<td>32</td>
<td>External construction views of <em>Intelligent Whale</em>, depicting the starboard profile, topside, and bottom</td>
<td>119</td>
</tr>
<tr>
<td>33</td>
<td>Internal construction views of <em>Intelligent Whale</em>, depicting the centerline profile (looking towards the port side) and the bottom half from the sheer</td>
<td>120</td>
</tr>
<tr>
<td>34</td>
<td>Transverse section views at the location of the frames</td>
<td>121</td>
</tr>
<tr>
<td>35</td>
<td>A picture taken inside the hull facing the stern to illustrate the orientation of the frames and stringers</td>
<td>124</td>
</tr>
<tr>
<td>36</td>
<td>A photograph of the “T”-shaped midship frame</td>
<td>126</td>
</tr>
<tr>
<td>37</td>
<td>Detail of a stringer overlapping a frame</td>
<td>126</td>
</tr>
<tr>
<td>38</td>
<td>Detail of the bow and stern stringers, illustrating the symmetry of the fore and aft sections</td>
<td>128</td>
</tr>
<tr>
<td>39</td>
<td>Detail of Roman numerals inscribed on the stringers</td>
<td>128</td>
</tr>
<tr>
<td>40</td>
<td>A simplified diagram of the top, bottom, and starboard side showing the hull plating arrangement</td>
<td>129</td>
</tr>
<tr>
<td>41</td>
<td>Detail of the random rivet pattern on the top hull plates</td>
<td>130</td>
</tr>
<tr>
<td>42</td>
<td>Exterior (left) and interior (right) photographs of the conning tower</td>
<td>132</td>
</tr>
<tr>
<td>43</td>
<td>Detail of the conning tower port</td>
<td>132</td>
</tr>
<tr>
<td>FIGURE</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Exterior (left) and interior (right) photographs of the larger port.</td>
<td>134</td>
</tr>
<tr>
<td>45</td>
<td>Exterior (left) and interior (right) photographs of the smaller port.</td>
<td>134</td>
</tr>
<tr>
<td>46</td>
<td>Exterior view of the upper hatch facing the stern</td>
<td>136</td>
</tr>
<tr>
<td>47</td>
<td>Detail of the outboard (left) and inboard (right) surfaces of the upper hatch.</td>
<td>136</td>
</tr>
<tr>
<td>48</td>
<td>A photograph of the lower hatches and main deck area.</td>
<td>138</td>
</tr>
<tr>
<td>49</td>
<td>Detail of a dog clip on the midship frame to hold bottom hatch up.</td>
<td>138</td>
</tr>
<tr>
<td>50</td>
<td>Detail of a lock that swivels over the bottom hatch.</td>
<td>139</td>
</tr>
<tr>
<td>51</td>
<td>External (left) and internal (right) photographs of <em>Intelligent Whale</em>’s bow.</td>
<td>139</td>
</tr>
<tr>
<td>52</td>
<td>Exterior (left) and interior (right) photographs of the stern.</td>
<td>141</td>
</tr>
<tr>
<td>53</td>
<td>Detail of the remaining propeller basket straps and fastenings.</td>
<td>141</td>
</tr>
<tr>
<td>54</td>
<td>Detail of the aft rigging eye.</td>
<td>142</td>
</tr>
<tr>
<td>55</td>
<td>Detail of the aft ballast tank cover.</td>
<td>145</td>
</tr>
<tr>
<td>56</td>
<td>Detail of the forward ballast tank drain assembly.</td>
<td>146</td>
</tr>
<tr>
<td>57</td>
<td>Exterior photograph of the forward ballast tank drain cover.</td>
<td>147</td>
</tr>
<tr>
<td>58</td>
<td>Detail of a fixture (gauge) on the forward ballast tank.</td>
<td>148</td>
</tr>
<tr>
<td>59</td>
<td>Detail of the forward compressed air tank.</td>
<td>150</td>
</tr>
<tr>
<td>60</td>
<td>One of four large air pumps used to empty the ballast tank.</td>
<td>151</td>
</tr>
<tr>
<td>61</td>
<td>Earliest known photograph of <em>Intelligent Whale</em> taken during the 1870’s.</td>
<td>153</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>62</td>
<td>Detail of a fixture mounted on the upper hull that is a part of the snorkel assembly</td>
<td>153</td>
</tr>
<tr>
<td>63</td>
<td>Detail of the pump arms that join at midships</td>
<td>154</td>
</tr>
<tr>
<td>64</td>
<td>Detail of two thumb valves mounted abaft the upper hatch</td>
<td>156</td>
</tr>
<tr>
<td>65</td>
<td>Detail of the crank assembly</td>
<td>158</td>
</tr>
<tr>
<td>66</td>
<td>Detail of the pillow block that supports the crank shaft at the top of the stern ballast tank</td>
<td>159</td>
</tr>
<tr>
<td>67</td>
<td>Detail of the reduction gear from the crank shaft to the drive shaft</td>
<td>160</td>
</tr>
<tr>
<td>68</td>
<td>Exterior view of the drive shaft assembly, which includes the propeller and the boss hub</td>
<td>162</td>
</tr>
<tr>
<td>69</td>
<td>Detail of the fixed blocks used in the rudder assembly</td>
<td>163</td>
</tr>
<tr>
<td>70</td>
<td>Detail of the rudder stock</td>
<td>165</td>
</tr>
<tr>
<td>71</td>
<td>A photograph of the exterior rudder assembly, which includes the lower portion of the rudder stock, rudder plate, and skeg</td>
<td>165</td>
</tr>
<tr>
<td>72</td>
<td>Detail of the internal dive plane assembly</td>
<td>166</td>
</tr>
<tr>
<td>73</td>
<td>A photograph of the starboard dive plane and skeg</td>
<td>168</td>
</tr>
<tr>
<td>74</td>
<td>A photograph of the recessed socket at the bottom of the hull to stow one of the anchor balls</td>
<td>168</td>
</tr>
<tr>
<td>75</td>
<td>A photograph of the stern anchor windlass</td>
<td>169</td>
</tr>
<tr>
<td>76</td>
<td>A gearwheel and lever found inside the hull which were used with the windlass</td>
<td>171</td>
</tr>
<tr>
<td>77</td>
<td>Detail of the sheave above the anchor socket</td>
<td>171</td>
</tr>
<tr>
<td>78</td>
<td>A portion of the anchor ball socket viewed from inside the forward ballast tank</td>
<td>172</td>
</tr>
</tbody>
</table>
Profiles of *H.L. Hunley*, the Louisiana State Museum Vessel, and *Intelligent Whale*
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADM</td>
<td>Public Record Office, Admiralty Office Series</td>
</tr>
<tr>
<td>ANJ</td>
<td>Army and Navy Journal</td>
</tr>
<tr>
<td>LC</td>
<td>Library of Congress</td>
</tr>
<tr>
<td>NARA</td>
<td>National Archives and Records Administration</td>
</tr>
<tr>
<td>NHC</td>
<td>Naval Historical Center</td>
</tr>
<tr>
<td>ORN</td>
<td>Official Records of the Union and Confederate Navies in the War of the Rebellion</td>
</tr>
<tr>
<td>PRO</td>
<td>Public Record Office, London</td>
</tr>
<tr>
<td>RG</td>
<td>Record Group</td>
</tr>
<tr>
<td>SA</td>
<td>Scientific American</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

On 18 September 1872, a group of men gathered along Ordnance Dock at the Brooklyn Navy Yard and peered into the murky waters of the East River to witness the trial of a submersible known as Intelligent Whale. From the vessel’s conception in 1863, numerous obstacles impeded its sale to the U.S. Navy, such as insufficient funds, legal disputes, murder, and greed. The witnesses on the dock knew the risk to the crew aboard. Less than a decade before, twenty-one men died in a similar vessel called H.L. Hunley (Lake 1918:39, Ragan 1999:127,188). Although the risk was great, the potential benefits of a successful trial were greater. For the U.S. Navy, a working submersible might prove useful for the protection of American harbors. For the owners of Intelligent Whale, a successful trial meant money, paid by the government for purchase of the vessel. As the hours passed, someone noticed that the tide had pushed the small iron submersible beneath a floating derrick, making it unable to surface. Sailors quickly organized and hoisted it from the water before the situation proved fatal (New York Daily Tribune, 24 September 1872). Failing to impress a naval committee present, Intelligent Whale was hauled ashore and abandoned. Eventually the submersible slipped into obscurity, left to become another curiosity in the annals of

This thesis follows the style and format of American Antiquity.
early submarine development.

From 1872 to the present day, *Intelligent Whale* has been displayed at three locations: the Brooklyn Navy Yard (presently the New York Navy Yard), the Washington Navy Yard, and the National Guard Militia Museum of New Jersey. At the turn of the twentieth century, interest in the submersible was renewed and it was exhibited as a unique relic from the American Civil War at the Brooklyn Yard. In 1968 it was transferred to the Washington Naval Yard in Washington, D.C., and was displayed with other submarine paraphernalia. As the collection at the Yard’s museum grew, a new location for the vessel was sought. In 1999 *Intelligent Whale* was transported to the National Guard Militia Museum of New Jersey in Sea Girt, where it is currently on display.

In addition to *Intelligent Whale*, two other American Civil War era submersibles exist. The oldest surviving example is a Confederate submersible known as the Louisiana State Museum Vessel. Discovered in 1878 while a portion of Lake Ponchartrain was being dredged, it had a nomadic existence as a curiosity exhibit before being acquired by the Louisiana State Museum in New Orleans in 1957. While it is presumed to be the earliest example of a submersible during the war, scholars have generally ignored the vessel, until recently. In 1999 Richard Wills completed a detailed analysis of the vessel’s construction and history in an effort to determine its identity, which has been the topic of some speculation (Wills 2000: 1). Furthermore, recent conservation has revealed previously unseen portions of the hull. The information obtained in the last two years has greatly contributed to our knowledge of this vessel’s role within submersible development and warfare.
The other surviving submersible is the Confederacy's *H.L. Hunley*, credited with being the first submersible in history to destroy an enemy warship (Schafer 1996:124; Murphy, ed. 1998:35). Lost at sea on the night of its victory, its location remained a mystery for 131 years until 1995, when the vessel was discovered and eventually raised. It is currently located in Charleston, South Carolina, where archaeologists are excavating the vessel’s interior prior to conservation. Deservedly so, *H.L. Hunley* has been the focus of much scholarly research regarding submersibles built during the American Civil War (Ragan 1995; Murphy, ed. 1998). Its recent recovery and ongoing excavation have stimulated interest concerning the entire scope of early submersible development. Within the next few years, many questions about the construction and design of *H.L. Hunley* in relation to other surviving submersibles will be answered.

Of the three remaining Civil War submersibles, *Intelligent Whale* is the only example built in the North. While all share the same purpose—the destruction of an enemy ship from an attack below the waterline—the design and construction of *Intelligent Whale* is quite different from the other two. Unlike its Confederate counterparts, the northern submersible features compressed air tanks, a pressurized ballast system, and the capability for a diver to exit the hull. In spite of these noticeable differences, scholars have ignored it as a topic of study. On the rare occasion information is provided, it is generally limited and in some cases wrong. For instance, sources claim *Intelligent Whale* carried a crew from 10 to 13 men and in the process of being tested drowned 39 (Barnes 1944:13; Burgess 1975:83; Lawliss 1991:38). While it may be conceivable for thirteen persons to wedge themselves into the hull, this number exceeds the practical limit for operating the vessel due to the small interior
space. As for the deaths, naval records indicate no known fatalities. The misinformation is largely the result of the repeating of incorrect facts published in earlier works. To date, there has yet to be a publication that reconstructs the history of the vessel using primary source material. Additionally, no publication has furnished a detailed archaeological analysis of the hull. Providing this information is the subject of this thesis. An investigation of Intelligent Whale's historical and archaeological significance is timely considering the work presently being done with the Louisiana State Museum Vessel and H.L. Hunley.

ORGANIZATION OF THESIS

This thesis has three primary objectives: to provide a detailed and accurate history of Intelligent Whale, to analyze the physical characteristics of the vessel, and to determine its role in the development of submersibles in North America. In order to compare Intelligent Whale to earlier vessels, a survey of submersible development before and during the American Civil War will be presented in Chapters II and III. Due to many inconsistencies in previous research concerning Intelligent Whale, a history will be reconstructed from primary sources and presented in Chapter IV. Since there is no previous documentation and analysis of the vessel, this will be the subject matter of Chapter V. Parallels with other contemporary submersibles will be examined and conclusions drawn and presented in Chapter VI.
METHODOLOGY

The primary source of information used to reconstruct the history of *Intelligent Whale* was obtained from documents found at the National Archives in Washington, D.C. These records allow a history of the vessel to be reconstructed from 1863 to 1877. Additional information was gathered through correspondence with persons having first hand knowledge of the vessel's history, such as the curator at the Washington Navy Yard, Dr. Edward Furgol, and a descendent of one of the submersible's owners, Mr. Bruce Halsted. Secondary source material is taken into consideration, but only as a reference to check for possible mistakes. Information concerning submersible efforts prior to and during the American Civil War was obtained from a survey of published materials relating to the topic.

Data in the form of direct measurements of the hull internally and externally were obtained by nautical archaeology students Peter Hitchcock, Brett Phaneuf, and Richard Wills in the spring of 1996. This data is supplemented with an extensive photographic record compiled in 1996 and 1998. In 2002, a final visit to the submersible by Peter Hitchcock obtained external measurements in order to prepare lines of the vessel.
CHAPTER II

SUBMERSIBLE EFFORTS PRIOR TO 1861

The concept of submersible warfare did not evolve spontaneously on the eve of the American Civil War, but developed from a collective body of knowledge through decades of experimentation in America and abroad. The submersible’s true potential as a tool for destruction was first recognized during the American Revolution and was closely tied to the development of the weapon it was meant to deliver - an underwater bomb known as the torpedo. The development and application of this unique type of watercraft prior to 1861 were motivated by military interest, but did not always meet the approval of naval authorities who considered its use to be as a non-gentlemanly way of conducting naval warfare. Some submersibles, however, were used for non-military applications such as underwater exploration, salvage operations, and business ventures. Although the submersible made its appearance during the American Revolution as a rather crude vehicle for deploying a weapon, by the eve of the American Civil War it utilized the latest technology of that time.

TURTLE (1776)

In 1775, as tension rose between the American Colonies and England, a student at Yale, David Bushnell, began experimenting with underwater explosives. His purpose
was to develop a weapon capable of destroying a British ship. The result of his effort was a waterproof cask of gunpowder with a clockwork mechanism that could be set for delayed explosion. Having perfected a weapon, he focused his attention toward designing a vehicle that would allow the explosive to be attached to the bottom of a ship. What Bushnell invented next was the first submersible in naval history to be used as a military weapon, earning him the title among historians as the “father of underwater warfare” (Low 1941:37; Roland 1978:70).

In the summer of 1775, Bushnell returned to his hometown of Saybrook, Connecticut, and began construction of a one-man submersible known as Turtle. With the help of his younger brother and local craftsmen whom he could trust, the vessel was completed in the fall. Bushnell was extremely secretive about his work almost to the point of paranoia (Roland 1977:158). No contemporary drawings or plans of Turtle have survived. However, through Bushnell’s postwar correspondence with Thomas Jefferson, a fellow scientist named Benjamin Gale, and through the personal account of Turtle’s first pilot, an accurate description of the submersible can be made (Leary 1996:20, Grant 1976:55).

Turtle, named appropriately for its peculiar shape, encapsulated the pilot between two wooden shells (figure 1). It measured 7 feet (2.13 m) long, 5 and ½ feet (1.68 m) tall, and approximately 4 feet (1.22 m) wide. The sides that formed the hull were constructed from thick oak planks joined together and reinforced with iron strapping. Internally, a horizontal plank connected both sides for reinforcement and served as a bench for the pilot. All joints between the planks were sealed with caulk and the outside of the hull was liberally coated with tar. Located at the top was a brass
Figure 1. An illustration of David Bushnell's Turtle (after Morell 1874:Plate I).
crown or conning dome that served as a hatchway into the vessel. Once the pilot entered, the hatch was closed and sealed from the inside by tightening several thumbscrews. In addition to being an entry, the conning dome had several portholes that made it possible for the pilot to sight an enemy ship while on the surface. With the hatch closed, air entered the interior though two pipes, or snorkels. While one snorkel admitted fresh air, the other snorkel ran to the bottom of the vessel to remove the “foul air,” under the assumption that it was heavier. Outside, the ends of the snorkels were fitted with self-sealing valves that closed underwater. Once Turtle submerged, the volume of air inside the vessel was enough for a pilot to work for only thirty minutes (Grant 1976:1-4).

In his letters Bushnell described the submersible as carrying 700 pounds (261.26 kg) of ballast inside the hull for stability, with an additional 200 pound (74.65 kg) lead ingot attached outside to be dropped in an emergency. The weight of the hull and ballast was close to 3,300 pounds (1231.69 kg). Buoyancy was regulated by a foot-pedal that opened a drain and allowed water into the bottom of the hull causing the vessel to submerge (Leary 1996:22-23). In order to surface, the water was evacuated from the hull by working two levers located on either side of the pilot. The drains and pump openings were covered with screens to prevent their getting clogged in the event that the submersible settled on the riverbed.

Turtle was propelled horizontally and vertically through the water by two windmill-shaped screw propellers. At the bow, a twelve-inch (30.48 cm) prop allowed the submersible to move forward or backward depending on which direction the crankshaft rotated. A smaller prop located in front of the hatch, mounted horizontally,
maintained the submersible’s trim while submerged. Bushnell is credited with being the first person to implement screw propulsion on a watercraft (Philip 1985:78).

Manually operating the propellers with one hand, the pilot manipulated a tiller with the other to control a small rudder located at the stern. Other navigational equipment included a compass and barometer illuminated with phosphorescence that enabled them to be seen in the dark. *Turtle*’s weapon system consisted of a detachable wood auger, protruding from the top of the submersible, to be drilled into the hull of the enemy ship. A rope attached to the auger to a torpedo, which was piggybacked on the outside of the submersible above the rudder. Once the explosive was released and the clockwork mechanism started, the rope drew the torpedo in close to the enemy’s hull as the submersible moved away (Roland 1978:73).

In 1776 *Turtle* participated in two clandestine night operations against British warships moored in New York Harbor. On 6 September Sergeant Ezra Lee piloted the submersible in an unsuccessful attack against a 50-gun warship off Governor’s Island. Historical records are unclear if the targeted vessel was British Admiral Richard Howe’s flagship *Eagle* or *Asia*. Lee was unable to twist the auger into the bottom of the hull and set the torpedo adrift. It exploded and caused enough of a distraction for him to return to shore unnoticed (Burgess 1975:29-30). On 5 October *Turtle* was used in another attempt to destroy the British warship *Phoenix*. This time the pilot was Phineas Pratt, the craftsman whom Bushnell had contracted to machine the clockwork for the torpedo (Roland 1978:76). The mission failed, as Pratt had trouble maintaining *Turtle*’s buoyancy and was unable to attach the explosive. Frustrated, Bushnell abandoned the submersible.
After the war ended, Bushnell spent several years living in Europe. While residing in France, he submitted a submersible design to the Minister of Marine in 1790 but it was rejected (Roland 1978:90-92). Frustrated and financially destitute, Bushnell sought the help of a fellow American in France, Abraham Baldwin, who loaned him enough money to return to the United States. With the rejection of the French government, Bushnell discontinued his work with submersibles. Another American, however, would arrive in France and succeed where his predecessor had failed.

*NAUTILUS* (1800)

Robert Fulton, an American inventor famed for his success with the steamboat, devoted much of his life to developing different methods of underwater warfare. His interest in submersibles can first be documented after his arrival in Paris during the summer of 1797. France was at war with England, and it was an opportune setting for an ardent inventor like Fulton. Historical documentation is unclear as to whether or not Fulton met Bushnell and was thus inspired; however, a connection between the two inventors can be made through a mutual friend. When Fulton arrived in Paris, he resided with another American named Joel Barlow, who became the young inventor's mentor and beneficiary. Barlow, a Yale alumnus, may have assisted Bushnell with the submission of his submersible design to the French Ministry of Marine in 1790. Furthermore, Barlow's brother-in-law was Abraham Baldwin, who had financed Bushnell's return to America (Hutcheon 1981:28, Roland 1978:90-91). It is most likely that Fulton learned the details of Bushnell's work through Barlow and adapted them
into his own submersible design. With financial assistance from Barlow, Fulton established the Nautilus Company and in 1797 approached the Ministry of Marine with his own plans.

Obtaining support from the French government to construct a submersible did not come easily to Fulton. It required two years of political maneuvering and several meetings with various government officials before the project began. On three different occasions the Ministry of Marine rejected Fulton’s designs for the submersible he called Nautilus. The rejections were largely due to the demand that he and his crew be commissioned as French naval officers. Fulton feared British capture of the submersible would result in his and his crew’s execution under the penalty of piracy, but as French officers they might be protected as prisoners of war. In addition to the commission, he wanted a large reward for sinking British warships, money that would be used to build a fleet of Nautilii (Philip 1985:75 and 85; Hutcheon 1981:30; Roland 1978:96). On 5 September 1798, a commission of scientists organized by the French government submitted a favorable report to the Ministry of Marine for the proposed Nautilus. Again the minister rejected the plans, but this report contains the most detailed description of the submersible to date. In the summer of 1799 a new minister was appointed who was willing to work with the young American inventor, and with financial assistance from Barlow, Fulton began construction of Nautilus at the Pèrier Boat Yard near Paris during that fall.

Under the direction of Fulton, the three-man submersible was completed in the late spring of 1800 and demonstrated for the public in Paris on 13 June (Philip 1985:96; Hutcheon 1981:41). Unlike Turtle, Nautilus was an elongated ellipsoid resembling a
cigar. Fulton was the first submersible designer to adopt this shape (figure 2). The vessel was constructed from sheets of copper measuring 21 feet 3 inches (6.48 m) in length, and 6 feet 4 inches (1.93 m) in width at its maximum beam (Hutcheon 1981:41; Parsons 1922:25). The bow was conical in shape and the stern tapered into a rounded end with the propeller and rudder in line with the vessel’s keel. Fulton modified his previous design submitted to the commission and included a deck on the top of the vessel that measured 20 feet (6.1 m) long by 6 feet (6.25 m) wide. The deck helped disguise the submersible as an ordinary boat and allowed the crew to leave the confined quarters of the hull while running on the surface (Philip 1985:98). A conning dome that included a hatchway and portholes for the pilot to navigate was located near the bow. The keel was a sealed iron box that served as a ballast tank to control the vessel’s buoyancy. Introduction into or removal of water from the tank by a hand-operated suction pump caused the submersible to descend or ascend respectively (Parsons 1922:26).

*Nautilus* had two methods of propulsion. On the surface the vessel used a collapsible fan-shaped sail that could be raised and rigged within minutes to handle like a sailing boat. While submerged, it moved horizontally through the water by a large 4-foot (1.22 m) screw propeller with slightly inclined blades. Two crewmen manually operated a crank attached to a reduction gear that spun the shaft connected to the prop. Fulton claimed that under optimal conditions the propeller made 240 revolutions per minute, propelling the submersible at a speed of 4 knots (7.42 km/hr), twice as fast as two men rowing a boat on the surface. After several trials in open water, Fulton added a horizontal propeller at the bow to help maintain the vessel’s trim while submerged.
Figure 2. A nineteenth century illustration of Robert Fulton's Naufragus (from Pesce 1996:183).
A snorkel brought air inside the hull when the hatch was closed or *Nautilus* was operating at a shallow depth. While submerged, oxygen neutralized with lime was periodically released from canisters to reduce the level of carbon dioxide in the vessel's atmosphere. This system allowed the crew to remain submerged for approximately 3 hours with the submersible's interior illuminated by a single candle. Eventually the system was replaced with compressed air, allowing the crew to remain submerged for 4 hours and 20 minutes. To further conserve oxygen, the candle was replaced by a large port window in front of the conning dome, which provided sufficient light for Fulton to see his instruments (Hutcheon 1981:41-48).

Fulton designed *Nautilus*' weapon system after Bushnell's *Turtle*. A detachable auger, referred to as the "horn of the *Nautilus,‘" protruded up from the conning dome and was to be drilled into the bottom of the targeted warship. The auger was slightly different in that it was a heavier bit, which could be hammered prior to being drilled. A lanyard attached to the torpedo passed through an eye at the end of the bit, and as the submersible moved away the explosive was pulled into the hull. The torpedo also varied slightly: it was a bell-shaped copper cask of gunpowder triggered by a contact fuse, which immediately detonated when compressed against the hull (Philip 1985:79).

After *Nautilus*’ public demonstration in Paris, it was moved to the port city of Le Havre for closer access to the English Channel. Fulton tested the submersible in the channel, but as a precautionary measure never dove below 25 feet (7.62 m), fearing the hull would collapse under the increased water pressure. On 12 September 1800, Fulton set out from Le Havre and followed the coast westward toward Cap de la Hague in
search of British warships. His crew consisted of another American, Nathaniel Sargent, and a Frenchman named Fleuret (Hutcheon 1981:41). Five days into the voyage Nautilus encountered a storm and had to remain submerged for six hours, taking in air through the snorkel. When the weather cleared, Fulton sailed the submersible to the small port town of Grown where it remained for a month. During this time, he launched two separate attacks on British brigs moored off Grown that were unsuccessful. Failing to destroy any British warships, Nautilus was towed back to Paris where it remained dry-docked for the winter (Philip 1985:101).

In the spring of 1801, Nautilus was transported overland to Brest where testing resumed. Fulton spent the summer on the French coast in search of British vessels, but again was unsuccessful. In September he returned to Paris where he wrote a letter to the Ministry of Marine in response to a request by Napoleon to meet with him and see Nautilus. In rather blunt language, Fulton claimed that the submersible leaked badly and was an “imperfect engine.” Consequently, he had Nautilus completely dismantled and its parts sold to recoup the money he had spent in its construction. Fulton ended the letter audaciously, excusing himself from the meeting with the reigning Consul (Hutcheon 1981:49). The tenuous relationship between Fulton and the French government was damaged by the letter and never fully recovered. Unable to make further progress in France, in 1804 he left for England lured by the prospects of a contract with the British government.

Fulton courted the British Parliament in much the same manner he had the French Ministry of Marine. He submitted a proposal for a submersible and, if approved, demanded to be commissioned into the British Navy. The British, aware of
Fulton's activities in France, had evidently lured him away from their adversary to protect their own naval supremacy from a new breed of weapon. They had no interest in manufacturing a submersible, let alone incorporating it into the way they conducted naval warfare. The design was rejected by conservative members of the navy on what they deemed moral grounds. Undaunted, Fulton continued negotiations; however, the submersible was permanently removed from consideration in favor of various plans for drifting, towed, and anchored torpedoes (Roland 1978:107-108). Fulton continued his underwater warfare experiments in England with limited success, and decided to return to the United States in 1806 after a nineteen-year absence.

Fulton was a mercenary in the truest sense and soon proposed a submersible design to the United States government. Although his ideas received more support than they had abroad, a conservative naval bureaucracy again rejected the proposed weapons. Fortunately, Fulton was able to fall back on another interest, the steamboat. As was the case with the submersible, he did not conceptually invent the steamboat, but made improvements in the design that ultimately proved to be a financial success. This venture occupied Fulton until the War of 1812. In March 1813, Congress passed the “Torpedo Act” that awarded to anyone able to sink a British warship a bounty amounting to half of the vessel’s value (Lundeberg 1974:22). Again Fulton approached the government with a variety of designs for underwater warfare, including one for a submersible that was rejected. Having the financial ability to proceed with the projects independently, Fulton concentrated on developing different methods of protecting harbors, including an armored steamship called Demologos. Before Fulton's death in February 1815 it was rumored he had designed a submersible called Mute, supposedly
under construction at the boatyard of shipwright Noah Brown. The fate of this vessel is unknown.

OTHER SUBMERSIBLE EFFORTS DURING THE WAR OF 1812

The lure of the reward offered by the Torpedo Act in 1813 inspired other inventors to construct submersibles to destroy invading British warships during the War of 1812. Contemporary historical documentation supports the evidence of at least two submersibles having been built. In August 1813, an unidentified submersible built in Connecticut attacked H.M.S. Ramilies, a British squadron flagship moored in Long Island Sound. Like Turtle thirty-seven years earlier, the pilot tried to attach a torpedo to the bottom to the hull using an auger but failed. Its fate is unknown, but in response, American prisoners of war were kept onboard the British warship to deter future attacks (Roland: 1978:121-122). A year later another submersible, or semi-submersible, was discovered washed ashore on the northeastern edge of Long Island Sound near Horton Beach. It was built of wood plated over the top with iron, measured 23 feet (7.01 m) in length, and was manually driven by a crank that propelled two side-mounted paddlewheels. Reportedly, the craft was the work of a New Yorker named Berrian who operated out of New London Harbor in 1814 (Niles’ Weekly Register, 9 July 1814:318). The frigate H.M.S. Maidstone spotted the craft on the beach surrounded by local townsmen, some of whom were carrying weapons. A party of Royal Marines under the command of Lieutenant John Bowen went ashore to destroy the vessel, but by the time they arrived the locals had stripped it of its propulsion and weapon systems (Field
1908:73-76; Roland 1978:121). Bowen recorded the vessel and ordered his men to destroy what remained. In addition to his written account, two watercolor portraits by Bowen have survived and are in the collection of the Public Record Office in London (figure 3) (PRO, Adm 1/4369, Two watercolor sketches by LT Bowen. Cited in De Kay 1990:130).

A more tenuous reference to the construction of another submersible was discovered several years after the war. Samuel Colt, who patented the repeating pistol on which his fame chiefly rests, was a proponent of underwater warfare and experimented with different methods of detonating torpedoes. While he did not work with submersibles directly, it is through his research on the topic that information pertaining to another submersible comes to light. Colt’s papers, now a part of a collection at the Connecticut Historical Society, include an illustration of a submersible. The drawing is that of a vessel attributed to Silas Halsey, which was lost in New London Harbor while attempting to destroy a British 74-gun warship in 1814. The picture depicts an elongated ellipsoid-shaped submersible with features that include an air tube, a hand-operated prop, a suction pump, a torpedo and an auger for attaching the explosive to the hull (figure 4).

CHELSEA SUBMARINE (1815)

Fulton’s experimentation with underwater warfare in England may have inspired one of his acquaintances, Thomas Johnstone, who constructed a submersible in 1815. Historical information concerning this gentleman is vague, sometimes describing him as
Figure 3. Watercolor sketch by John Bowen of a submersible discovered in Long Island Sound during the War of 1812 (PRO, Adm 1/4369; from De Kay 1990:130).
an American smuggler, a channel pilot, a privateer, a spy, as well as a retired captain of
the British Royal Navy (van der Vat 1995:13). In 1812 Johnstone completed a model of
a submersible powered by clockwork, and commissioned an engineer to build a larger
version. The resulting vessel was constructed at Chelsea Meadows in 1815. It was
porpoise-shaped with pointed ends and measured 27 feet (8.23 m) in length. The hull
was constructed from iron plates fastened to a wood frame and lined with cork. Like
Nautilus it incorporated two propulsion systems. On the surface a sail was used, but
while submerged protruding oars on each side propelled it through the water. In
addition to a snorkel that supplied surface air, compressed air in a tank was released,
allowing the three-man crew to stay submerged for several hours (Pesce 1906:240-242).
Although Johnstone successfully tested his submersible in the Thames River near
Woolwich, he was unable to negotiate a contract with the British Admiralty. The fate
of the Chelsea Submarine is unknown, but one account reports the vessel was boarded
by government agents near London Bridge and taken to Blackwall to be destroyed
(Friedman 1994:315; Harris 1997:65-66; van der Vat 1995:13-14). It was rumored
Johnstone was working on another submersible after a group of French patriots offered
him 40,000 English pounds to rescue Napoleon, exiled on St. Helena in the South
Atlantic. However, Johnstone’s submersible efforts appeared to have ended with the
death of Napoleon in 1821.
MARINE CIGAR (1851)

The next account of a submersible constructed by an American was in 1845, by a twenty-year-old shoemaker named Lodner Phillips of Michigan City, Indiana. Nothing is known of its dimensions except that it was modeled after a white fish. A relative later recounted that the submersible was manufactured of copper sheets fastened around a wooden frame and tested in Lake Michigan. The propulsion system consisted of a pole that passed through a watertight rubber gasket, allowing the vessel to be pushed along the bottom of the lake. Buoyancy was regulated by manually operating a plunger that filled or expelled water from a cylinder. For additional weight, pig iron was used as ballast. Shortly after its construction, the vessel sank in 10 feet (3.09 m) of water, and afterwards was raised and taken to the banks of Trail Creek where it lay abandoned (Gruse-Harris 1982:2-3). Although Phillips' first vessel was rather crude and did not test well, it demonstrated the intuitive instinct he had for submersible design.

Sometime between 1845 and 1850 Phillips launched his second submersible in the Chicago River. Information concerning its construction is limited, but it also used a pole for propulsion. The vessel sank in the Chicago River for reasons not mentioned, but its history did not end with the sinking. In 1890, William Nissen purchased and raised the submersible. He conducted some experiments with it but one day mysteriously disappeared. In 1916 William Deneau, a diver for the Great Lakes Dredge and Dock Company discovered Phillips' second submersible during a salvage operation. He obtained permission from the federal government to remove it from the river for exhibition purposes. After raising the vessel and opening the hatch, Deneau
reportedly found human and a canine skeleton inside, presumably the remains of Mr. Nissen and his dog. The submersible, dubbed the "Fool Killer," was placed on exhibit in Chicago (figure 5). A ten-cent ticket bought admission to a lecture by Captain Deneau on the "most intensely interesting exhibit ever shown in Chicago" and a chance to "inspect the interior at your own risk" (Gruse-Harris 1982:3-4).

In 1851 Phillips had designed and constructed a third submersible that was launched during the summer and christened Marine Cigar. There are some discrepancies among source material concerning the physical description of the vessel. One account claims the submersible was 60 feet (18.29 m) long, 7 ½ feet (2.29 m) wide, and weighed over 8 tons (5971 kg) (Gruse-Harris 1992: 10). Furthermore, it used a steam engine for propulsion and was capable of carrying twenty to thirty men. What appears to be a more accurate and reasonable description was presented in an 1875 lecture by Lt. F. M. Barber at the U.S. Torpedo Station in Rhode Island concerning submarine boats and their application to torpedo operations. He described Phillips' third submersible as cigar-shaped, 40 feet (12.19 m) long, and 4 feet (1.22 m) wide at its maximum breadth (figure 6). A conning dome, located at the top of the vessel, also served as a hatchway. In addition, several glass decklights were mounted in the top of the hull to provide interior illumination while operating at shallow depths. A lamp designed by Phillips provided additional light during deeper dives (Gruse-Harris 1982:11). To protect the hull against increased water pressure during deep dives, four external keels ran the length of the hull, located at the top, bottom, and both sides. Both ends of the vessel were conical in shape. The tip of the bow contained a universal joint for a variety of tools that could be manipulated from inside the hull. Located at the
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Figure 5. Lodner Phillips’ second submersible as depicted in 1916 newspaper advertisement (from the Chicago Daily Tribune, 23 February 1916:24; cited in Gruse Harris 1982:4).
Figure 6. A diagram of Loder's patent submarine "Marine Cigar" (from Barber 1875, Plate VII).
stern was a two-blade screw propeller with a unique feature that Phillips secured a patent for in 1852 (figure 7). The propeller, mounted on a shaft that passed through a universal joint, allowed the drive shaft to pivot and thus change the direction of the submersible. Two crewmen not only rotated the shaft but had the additional responsibility of steering it like a tiller (U.S. Patent No. 9389, 9 November 1852). Also at the stern, a dual rudder configuration was employed, with one blade above the prop and the other below. Round anchor weights, located both fore and aft at the bottom of the hull near the ends, could be raised and lowered by chains connected to a windlass inside the hull.

Several ballast tanks located along the bottom of the hull maintained Marine Cigar's stability. At the bow and stern, large tanks were filled or emptied of water to lower or raise the vessel in the water. Pipes connecting these tanks equalized the water levels within for added stability, but could also be closed by a valve to manipulate them independently. Close to the center, smaller tanks were filled or emptied for fine-tuning the angle of the submersible on a horizontal plane. Compressed air canisters mounted above each ballast tank allowed the water to be forced out on demand. Phillips was the first person to design this configuration of ballast tanks—a system used fifty years later by the "father of the modern submarine," John P. Holland (Morris 1998:8).

Marine Cigar incorporated three different methods of replenishing the air supply with the hatches closed. While the submersible operated at shallow depths a telescoping snorkel brought air in from the outside. With the vessel submerged, compressed air could be released from the canisters previously mentioned. Phillips did not intend the canisters to provide the main source of breathable air, but compressed air
Figure 7. Phillips' 1852 patent diagram for a rudderless submersible steered by a prop mounted on a universal joint (from NARA, RG 241, patent no. 9389; from Harris 1982:26).
was released into the atmosphere to pressurize the hull to allow a diver to exit through a bottom hatch. The main source of breathable air was provided by a system that purified the air already consumed by the crew. In his lecture Barber credits Phillips as having “devoted more attention to the subject of purification of the atmosphere in a submarine boat than any other inventor” (Barber 1875:22, cited in Gruse-Harris 1982:11). Despite the compliment, his description of the system still leaves many questions unanswered. According to Barber, air was forced through a series of tubes with showerhead ends submerged in a liquid. As the air passed through the liquid it cooled and generated carbonic acid. This arrangement allowed a crew of four to remain submerged for up to ten hours.

Designed for military use, the submersible was equipped with a variety of weapons, including torpedoes and an underwater gun. Barber described this gun as a “6-pounder” capable of shooting into the bottom of an enemy vessel while submerged (Barber 1875:21-22 cited in Gruse Harris 1982:11). Underwater guns were not new, having been used as early as 1813 (Harris 1997:63, Hutcheon 1981:121). It is most certain that Phillips incorporated the underwater gun into the design of his submersible in an attempt to secure a contract with the U.S. Navy. This is reflected in a letter he wrote to William H. Graham of the Navy Department three months before the completion of Marine Cigar. In the letter he stated he was building a submarine boat capable of diving to 100 feet (30.48 m), able to sustain a speed of four to five miles an hour (6.4 to 8 km/hr) while submerged, and would let the navy test and examine the craft. He further claimed that he was aware of a Frenchman in New York who built a similar vessel for the price of $9,000 and that his submersible cost only $800. Like his
predecessor Fulton, Phillips was ushered through the revolving door of the navy, and received a letter from Graham two weeks later which simply stated, "the boats used by the Navy go on and not under the water!" (NARA, RG 45, Letters to the Secretary of the Navy, Miscellaneous Letters, 1801-1884, cited in Gruse Harris 1982:24). The vessel was not sold to the Navy.

In 1853 Phillips moved the submersible by freight to Lake Erie to investigate the wreckage of the Atlantic, a steamer that had collided with the Ogdensburg in 1852 near Long Point, Ontario. In an attempt to reach the wreck in 155 feet (47.24 m) of water, Phillips discovered that his boat leaked badly at 100 feet (30.48 m) and thereupon returned to the surface. In an unmanned depth test that followed, it filled with water and sank. Efforts to raise the vessel failed when the hawser broke. Phillips lost his third submersible, but was not daunted by the loss. During the American Civil War he would continue his efforts.

NEW YORK SUBMARINE BOAT (1851)

The Frenchman to whom Phillips referred in his letter of 1851 was most likely Alexander Lambert, who belonged to a private enterprise called the Submarine Exploring Company. In 1852 Lambert designed and constructed a submersible to retrieve pearls, coral, and sunken treasure off the coast of Panama. Prior to leaving the United States, the submersible was reported to have laid telegraph lines across the East River between Brooklyn and Manhattan. The submersible was cigar-shaped,
constructed from boiler iron, and measured 30 feet (9.14 m) long by 10 feet (3.04 m) wide (figure 8). The top did not have a conning dome but a raised hatch sealed from inside. At the bottom of the hull another hatch allowed divers to exit while submerged. Flooding two sealed ballast tanks at each end of the vessel controlled buoyancy and these could be emptied with manual pumps. Equipped with a chemical-based air purification system, the submersible allowed the crew to remain submerged up to seven hours (Pesce 1906: 101-103). Unlike previous submersibles, the New York Submarine Boat hung suspended from a surface vessel and relied on it as the main source of propulsion. Comparing it to a glorified diving bell, one source states that the submersible was eventually fitted with a manually operated screw propeller (Keatts and Farr 1991:7-9). The fate of the New York Submarine Boat is unknown.

DE VILLEROI’S PHILADELPHIA SUBMERSIBLE (1859)

In 1832 Brutus de Villeroi gained the attention of naval authorities by constructing a small three-man submersible in Nantes, France. The vessel was 10 feet (3.04 m) long, 3 ½ feet (1.07 m) wide, and able to stay submerged for 2 hours. In 1835 a demonstration given at Saint-Quen tested the vessel’s ability in front of a commission appointed by the French government. The commission reported unfavourably and de Villeroi received no further encouragement. Nothing was heard from de Villeroi until the Crimean War when he proposed a submersible design to the Ministry of Marine to attack the Russian Fleet in the Black Sea. This plan was rejected. In 1859 he left France and immigrated to the United States, eventually residing in Philadelphia.
Figure 8. An illustration of Alexander Lambert’s New York Submarine Boat (from Pessec 1906:103).
De Villeroi’s luck turned when he was commissioned by a wealthy Philadelphian to build a submersible for salvage of the H.M.S. *De Braak*, a warship that had capsized off the coast of Delaware in 1798 with an estimated $10,000,000 treasure. The submersible as described by navy officials was an iron cylinder 30 feet (9.14 m) long, 4 feet (1.22 m) wide, propelled by a 3-foot (.95 m) propeller in its stern (figure 9). One account from the *Philadelphia Inquirer* stated that, “with her gothic arched back and conical bow, she looks not unlike a big sturgeon” (SA 1862:315). The submersible was large enough for a crew of six to twelve men and could stay submerged for three hours with the help of a secret air replenishing system. At the top of the vessel a heavy iron dome 18 inches (45.72 cm) in height served as a hatch and could be sealed with several screws and hooks. Another hatch was located at the bottom of the hull where divers could exit when submerged. Also located at the top of the vessel were two rows of eighteen glass deadlights running the length of the hull to illuminate the interior. On either side of the boat near the bow were two eighteen-square-inch (116.1 sq cm) dive planes to regulate the pitch of the hull. Buoyancy was controlled by pumping water into a ballast tank and additional weight was fixed to the hull in the form of pig iron.

In 1860 de Villeroi’s submersible conducted a series of tests in the Delaware River but was never used for salvage. One reason for this may have been difficulty in regulating the boat’s depth. The vessel was tested at 20 feet (6.09 m) deep, but two buoys were used to suspend it in the water column. Although de Villeroi’s boat did not see success as a submersible, it did prove invaluable as a publicity stunt that earned him a contract with the U.S. Navy during the American Civil War.
Figure 9. De Villeroi's submersible built to salvage the H.M.S. De Braak (from Frank Leslie's Illustrated News, 25 May 1861).
EVE OF THE AMERICAN CIVIL WAR

On the eve of the American Civil War, submersible designers and builders had a collective body of knowledge obtained from 86 years of experience. Efforts by Americans, both at home and abroad, provided the foundation of information utilized by both combatants during the war. Prior to 1861 submersible development was typically motivated by military interest, such as the efforts of Bushnell, Fulton and those individuals during the War of 1812. However, this unique type of watercraft was also developed for private ventures as seen in the examples of Lambert, Phillips and de Villeroi.

During the 86 years between the American Revolution and the American Civil War, submersible construction had undergone several changes. *Turtle*, the first submersible built in North America, was small and ellipsoidal in shape. Twenty-two years later in France, American inventor Robert Fulton introduced a larger, elongated submersible. Eventually, the shape predominately used by builders resembled a cigar—a more practical design for traveling through water. Construction materials also changed from those consisting primarily of wood, to those using iron plating. The result of this change was a stronger hull able to withstand a greater amount of water pressure and therefore able to dive deeper. Fulton avoided submerging *Nautilus* below 25 feet (7.62 m) lest it be crushed, while fifty years later Phillips’ iron-plated *Marine Cigar* could dive to 100 feet (30.48 m). Although the propulsion system while submerged continued to be powered by humans prior to the Civil War, alternative methods had been suggested, as was the case of the one account claiming Lodner
Phillips' third submersible was powered by a steam engine. While this remains questionable, by the eve of the war, steam and electric motors had progressed, making the concept feasible. Air replenishing systems had also changed as technology advanced. Snorkels continued to provide fresh air while operating at shallow depths, but elaborate and often secret systems for scrubbing air had been implemented in later submersibles. The amount of time underwater had lengthened from approximately one hour to several hours, even with a larger crew.

One aspect concerning submersible warfare did not change over several decades—the attitude of the naval authority towards submersible use. Although they may have recognized the potential the submersible had for delivering an explosive to destroy an enemy ship, time and time again conservative naval bureaucracies failed to support such ventures. It would not be until the American Civil War that the true destructive nature of such a vehicle used by skilled personnel would be proven.
CHAPTER III

SUBMERSIBLE EFFORTS DURING THE AMERICAN CIVIL WAR

The American Civil War in many respects was the first modern war, utilizing new technology previously unknown to armies and navies. For the first time railroads provided rapid movement of men and munitions to battlefronts, telegraphs immediately reported events that previously took weeks to recount, and photography revealed the true battle conditions to the public. Naval warfare also changed during the course of the conflict. Ironclad warships battled one another, underwater mines were deployed for harbor and river defense, and, for the first time in naval history, a submarine delivered a devastating and lethal blow to an enemy warship.

Shortly after his election to President of the Confederacy in February 1861, Jefferson Davis appointed Stephen Mallory Secretary of the Confederate Navy. Mallory previously worked in Washington, D.C., as chairman for the Committee of Naval Affairs and had labored diligently to modernize the U.S. Navy (Luraghi 1996:12). On 12 April 1861 the war began as Confederate artillery fire fell on Fort Sumter in Charleston, South Carolina. Within a week President Abraham Lincoln imposed a blockade on southern ports in response to the Confederate Congress calling for privateers to defend southern ports. At the time of the proclamation the U.S. Navy had to few ships in service to effectively execute the order, but it was meant as a
warning; rejoin the Union or the supplies and munitions desperately needed from Europe to engage in war would be cut off.

Newly-appointed Secretary Mallory faced the monumental task of building an entire navy out of virtually nothing. Unlike the United States Navy, the Confederate States Navy had few functional navy yards and only a limited number of operational private shipyards. The situation was further complicated by the South’s lack of manpower, natural resources, and industry, which were abundant in the North. The Tredegar Iron Works in Richmond, Virginia, was the only facility capable of manufacturing materials needed to construct a modern warship—primarily iron plating. Despite these overwhelming deficiencies, Mallory quickly organized a small staff and began to build a navy from the few resources available. By incorporating the use of new technology, he hoped to gain a winning edge over his adversary. Submersible and torpedo warfare was part of this strategy. Mallory’s farsighted ability to promote experimentation with radical means of naval warfare and to implement its use ultimately defined Confederate naval efforts (Luraghi 1996:68).

Southern submersible efforts, and their ultimate success, overshadow the attempts made by the North. Between 1861 and 1865, both the Confederate Navy and the U.S. Navy engaged in submersible development and construction. While Mallory strongly supported building efforts by both the navy and privateers to defend ports, his counterpart, Secretary of the U.S. Navy Gideon Welles, took a more conservative approach since the U.S. Navy’s role in the war was primarily offensive. Consequently, more submersibles were constructed in the South than in the North. According to one historian, approximately two dozen submersible efforts took place during the war, but
documentation concerning this topic is limited and may never fully be understood (Ragan 1999:257). At the end of the war, most top-secret Confederate documents were destroyed to prevent them from falling into enemy hands, including information concerning an extensive submersible program. On the other hand, federal documentation has survived, but is often fragmentary and incomplete.

While patriotism and the lure of a reward prompted many inventors to submit submersible designs to their respective governments, only a few proposals are known to have reached the construction phase. Of those completed, even fewer were operational. The submersibles presented in the following chapter are those efforts that produced operational vessels, and they appear chronologically in the order they entered the war.

LOUISIANA STATE MUSEUM VESSEL (1861)

Evidence suggests the first submersible built during the American Civil War was the Louisiana State Museum Vessel, which is currently on display at the Louisiana State Museum in New Orleans. Discovered in 1879 during a dredging operation in Lake Ponchartrain, its identity has been the subject of intense speculation and the topic of recent research (Wills 2000). An account published after the discovery stated, “a torpedo was dredged up in July 1878, in the canal near the Spanish Fort, New Orleans. It had undoubtedly been built by the Confederates and sunk when they evacuated the city in 1862” (Scharf 1887:761). The submersible had a nomadic journey through Louisiana as a curiosity exhibit and was incorrectly identified as the Pioneer, a contemporary Confederate vessel. Recent research, however, has concluded that it was
not the *Pioneer*, but an earlier effort initiated sometime at the beginning of 1861 (Wills 2000:184). A letter written to the U.S. Navy by informant E. P. Doer supports this conclusion. He provided information pertaining to a small iron submersible spotted in the mouth of the Mississippi River during the month of June 1861. The vessel was described as having a pointed bow used to perforate the bottom of an enemy hull and explode (NARA, RG 45, Entry M124, *Letters Received by the Secretary of the Navy*, 1801-1884; cited in Ragan 1999:5). While there may be doubts as to whether or not Doer was writing of the Louisiana State Museum Vessel, his description does resemble the submersible on display at the museum. The Louisiana State Museum Vessel is a small three-man submersible made from overlapping plates of boiler iron and weighing approximately 2,014 pounds (751.71 kilograms). The boat is cigar-shaped in appearance with the bow and stern tapering to points (figure 10). It measures 19 feet 5 inches (5.92 m) in length with an additional 9 inches (22.86 cm) for the propeller shaft. The width of the vessel is 3 feet, 2 ½ inches (97.79 cm) and the distance from top to bottom is 6 feet ½-inch (1.84 m) (Wills 2000:109). A hole at the top of the vessel is where a conning tower was once attached. It is estimated the missing tower would have extended the depth of the submersible by approximately 1 or 2 feet (30.48 to 60.96 cm). Included in the tower would have been portholes from which the pilot could navigate, and these would illuminate the interior as well. The remains of hinges connected to the rim of the hole suggest the conning was lifted to provide entry into the vessel (Wills 2000:127-130). A smaller hole, located in front of the entry, is all that remains of the vessel's air replenishing system. It is likely that a stack or snorkel tube once rose from the hole, permitting fresh air to enter. The system may have included a pump to help
Figure 10. The Louisiana State Museum Vessel on display at the Poinelab Building in New Orleans (from Compton-Hall, 1983:37).
draw air from the surface, although this cannot be confirmed (Wills 2000:160-162). In addition to the holes at the top of the vessel there are two robust lifting eyes used to hoist the boat in and out of the water by crane. Near the bow two small dive planes controlled the boat’s longitudinal movement. The planes are connected to one another by a rod passing through the hull, and can be raised or lowered by a lever attached to the rod. Horizontal movement, on the other hand, was controlled by a rudder at each end of the hull (Wills 2000:143, 149). The submersible was powered by a stern-mounted screw propeller with four blades, all of which are broken off near the hub, leaving only stubs. This prop is attached to a shaft that passes through a waterproof stuffing box and is connected to the remains of a reduction gear. While portions of the drivetrain are now absent, it is presumed one or two crewmen turned a crankshaft to propel the vessel (Wills 2000:138). Although there is no weapon currently associated with the submersible, a socket set into the bow suggests that a spar with a torpedo once projected from the forward end (Wills 2000:167). As Doer described in his letter to the U.S. Navy, the submersible would have attacked an enemy ship by ramming it with the bow.

Who deployed the Louisiana State Museum Vessel during 1861 is a mystery; however, events that occurred the following year sealed the submersible’s fate. Under the command of Commodore David G. Farragut, the Federal Navy attacked New Orleans on 20 April 1862, which fell days later (Schafer 1996:111). To prevent the submersible from becoming property of the U.S. Navy, the unknown builders scuttled it in Lake Ponchartrain.
SUBMERSIBLE EFFORTS AT THE TREDEGAR IRON WORKS (1861)

Historical documentation supports the construction of two submersibles at the Tredegar Iron Works in Richmond, Virginia, between September 1861 and May 1862. At the beginning of the war, the foundry was the only location in the south capable of manufacturing iron plating for ironclad warships. It was also capable of supplying many of the same materials required for the construction of a submersible. During the summer of 1861, Acting Master William Cheeney of the Confederate States Navy was assigned to the Submarine Bureau at Richmond to oversee the construction of a “submarine boat” (Coski 1996:117). The earliest evidence suggesting a submersible program at the foundry is a sketch drawn by Cheeney on 25 September 1861 labeled “propeller for a sub-marine boat” (figure 11). The illustration depicts a two-bladed screw propeller 46 inches (116.84 cm) in length that would have fitted on a 2-inch (5.08 cm) diameter shaft. Although the illustration states it is for a submersible, whether or not it was manufactured and used for that purpose remains unknown (Ragan 1999:13). Additional records from the foundry reveal Cheeney was supplied with materials associated with the construction of a submersible. Items such as air pumps, articles for diving bells, boiler plates, bolts, pig iron, brass plumbing, and grinding glass for deadlights are listed on several invoices (Dew 1966:123; Coski 1996:117,120; Ragan 1999:13). Further evidence is provided by Cheeney’s assistant, Lieutenant John Brooke, who stated in his diary, “Cheeney will be ready to start on his submarine expedition soon. I fear that Commodore Maury [Commodore Mathew Fontaine Maury, head of the Office of Special Service] will alarm the enemy by his attempts [torpedo
Figure 11. A sketch by Acting Master William Cheeney of a submersible propeller for a vessel under construction at the Tredegar Iron Works, dated September 1861 (from Ragan 1999:37).
deployment]—which have already proved unsuccessful” (John M. Brooke Diary, 8 November 1861; cited in Coski 1996:117).

Perhaps the most conclusive evidence of a submersible program at the Tredegar Iron Works was provided by the observations of Mrs. E. H. Baker. The Director of the Federal Secret Service, Allan Pinkerton, sent Baker to Richmond to gather information concerning the foundry’s rumored activities in developing torpedoes and submersibles (Pinkerton 1888:335). Upon her arrival she befriended “Captain Atwater and his wife” who graciously accepted her into their home. Mrs. Baker was escorted to several points of interest around Richmond, including earthworks and fortifications. Eventually, she convinced the captain to let her witness a demonstration of a strange underwater vessel built at the Tredegar Iron Works. In a book published after the war, Pinkerton recounts the observations reported by Baker concerning the events seen on the banks of the James River in October 1861:

A large scow had been towed to the middle of the river, and the submarine vessel was to approach it and attach a magazine, containing nearly a half a bushel of powder, to which was attached several deadly projectiles, and this was to be fired by a peculiarly constructed fuse, connected to a long wire coiled on board the submarine vessel. At a given signal the boat was sunk in the river, about 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 (Pinkerton 1888:339).

Baker reported the submersible was a smaller version of a larger model she had seen under construction at the foundry, and that they were to be deployed against Federal warships at the mouth of the James River. While Cheeney’s invoices may suggest the construction of two vessels at the foundry, Baker’s sighting is the only direct identification of a second vessel built at the Tredegar Iron Works.

Shortly after Baker left Richmond, a submersible attacked the U.S.S. Minnesota near Hampton Roads on 12 October 1861. A correspondent with the New York Herald wrote of the account, reprinted in Harper’s Weekly on 2 November 1861 (figure 12). A portion of the article states:

On Wednesday evening last an infernal machine was sent down from Sewell’s Point for the purpose of blowing up the flag-ship. She came down to the ship without any difficulty, but she caught in the grappling always hanging from the jib-boom 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 found they were sadly mistaken, when they came near losing their lives as well as the machine. They, however, escaped, and worked themselves on shore on rebel ground, and the machine was carted back to Norfolk, to try the experiment at some future time.
Figure 12. An illustration from *Harper's Weekly* depicting the submersible that attacked the U.S.S. *Minnesota* in the James River on 9 October 1861 (from *Harper's Weekly*, 2 November 1861:701).
According to an eyewitness, the submersible was built of iron, of a sufficient capacity to accommodate two persons, and was propelled by a small screw propeller. It was guided by a rudder and ballasted with water, which could be forced out by means of a pump. A compass was used to navigate, as well as a velocimeter that indicated the distance the vessel traveled. A rubber tube floated on the surface and supplied the crew with air (New York Herald, 12 October 1861; reprinted in Harper’s Weekly, 2 November 1861:701).

As a result of the attack, a general alert was issued throughout the U.S. Navy to watch for such a vessel. Captain William Smith of the U.S.S. Congress offered a defensive tactic to be employed against a submersible. When one approached, he suggested a large A-shaped netted frame be dropped over the vessel to hold it in place. If the submersible passed under the hull without being captured, the net could be dropped on the air hose (snorkel buoy) and held underwater, cutting off the air supply of the occupants inside (ORN 1, XI:363; cited in Coski 1996:119; Ragan 1999:23).

Historical documentation cannot confirm if the attack on the U.S.S. Minnesota was conducted by the same submersible Baker witnessed in the James River. However, her observations, Cheeney’s trail of invoices at the foundry, and Brooke’s diary entry strongly support the construction of at least one operational submersible during the fall of 1861. Submersible efforts at the Tredegar Iron Works ended with Cheeney’s desertion from the Confederate States Navy in September 1862 (Coski 1996:120).
PIONEER (1861)

While the Louisiana State Museum Vessel was operating in the waters of New Orleans, two steam gauge manufacturers named James McClintock and Baxter Watson were constructing a three-man submersible of their own. Prior to its completion in March 1862, another man, Horace L. Hunley, joined the effort. Hunley was a lawyer by trade, who worked in the New Orleans Customs House as assistant deputy collector. It is most likely that while serving in this capacity he became involved with the submersible effort. To this project, as well as two more with McClintock and Watson, he devoted his energy, money, and ultimately his life. According to the register of commissions at the Custom House, the group was issued a letter of marque by the Confederate Government on 31 March 1862. This document granted the group permission to use the submersible as a privateer (Kloepel 1992:8; Ragan 1995:18; Luraghi 1996:252).

The vessel was built at the Leeds Foundry on the corner of Forcher and DeLord Streets in New Orleans. Launched in March and christened Pioneer, trial operations began in Lake Ponchartrain. The letter of marque identified Pioneer as a “submarine propeller” armed with a “magazine of powder.” Its dimensions measured 34 feet (10.36 m) in overall length, 4 feet (1.22 m) in beam, it drew 4 feet (1.22 m) of water, and weighed 4 tons (2985.92 kg). The boat was painted black and had round conical ends (ORN 1, I:556). McClintock added to the description of the boat in a letter written to Commodore Maury after the war:
At New Orleans in 1862 we built the first boat, she was made of iron ¼-inch [.64 cm] thick. The boat was of a cigar shape 30 feet [9.14 m] long and 4 feet [1.22 m] in diameter with cone ends 10 feet [3.05 m] long, with a propeller in one end, turned with a crank by two persons inside 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 or the water. (LC, Undated Letter from McClintock to Maury, 1871).

McClintock elaborated on the description during an interview with the British Admiralty in London after the war. According to the builder, the air capacity within the boat was adequate for three men to remain submerged for a period of two hours without suffering any serious inconveniences. A mercury gauge fixed opposite the pilot regulated the depth. For each ¼-inch (1.27 cm) rise in the mercury level, the submersible descended one foot (30.48 cm) in the water column. Apparently the vessel was difficult to navigate, and “on several occasions the crew continued turning the crankshaft when all the time the boat was stuck in the mud” (PRO, Adm. Series I/6236, File 39455, Report on McClintock’s Submarine Torpedo Boat).

While McClintock has provided a physical description of Pioneer, there is a limited amount of information pertaining to its use. The submersible’s effectiveness as a military weapon was demonstrated in Lake Ponchartrain, where it destroyed a barge (Kloeppe 1992:7). The vessel, however, did not have the chance to be used as intended. Like the Louisiana State Museum Vessel, Pioneer was scuttled to prevent it from falling into Federal possession after the fall of New Orleans. At some point during the occupation it was discovered by Union troops near New Basin Canal (Baird
1902:845). Two officers from the U.S.S. Pensacola, Second Assistant Engineer Alfred Colin and Third Assistant Engineer G. W. Baird, studied the vessel’s construction and submitted a report with drawings to their superiors (figure 13). After the war Baird recounted the vessel’s information and stated:

She had a little conning tower with a manhole in the top, and small, circular, glass windows in its sides. She had vanes, the function of which were those of the pectoral fins of a fish. The torpedo was of clockwork type, and was intended to be screwed into the bottom of the enemy’s ship. It was carried on top of the boat, and the screws employed were gimlet-point and tempered steel. McClintock (after the war) informed me that he had made several descents in his boat, in the lake, and succeeded in destroying a small schooner and several rafts.... (Baird 1902:845).

Pioneer lay abandoned at the bank of the canal during the course of the entire war. In the morning edition of the New Orleans Picayune on 15 February 1868, a notice was printed announcing the “a torpedo boat now lying on the banks of the New Canal is to be sold at auction today.” The evening edition followed up with, “the submersible, which cost twenty-six hundred to build, was sold for forty-three dollars” (New Orleans Picayune, 15 February 1868).
Figure 13. A drawing of the submersible *Pioneer* by Assistant Engineers G.W. Baird and Alfred Colin of the United States Navy (from Ragan 1999:91).
U.S.S. ALLIGATOR (1862)

On 16 May 1861, a mysterious vessel was spotted in the Delaware River near Philadelphia. Harbor police were notified and a pursuit ensued leading to its capture. When authorities approached the vessel, they discovered French inventor Brutus de Villeroi in the submersible he had built for the salvage of H.M.S. De Braak. News of the incident reported in the Philadelphia Evening Bulletin and the New York Herald captivated the public, including the Commandant of the Philadelphia Navy Yard, Captain Samuel F. Du Pont. A staff of naval engineers inspected the submersible and submitted a favorable report to Du Pont on 7 July 1861. The engineers concluded, “We therefore consider that the services of the distinguished French engineer would be very valuable to the Government and that the possession of his invention would be of the greatest importance” (NARA, RG 45, Navy Department Letters, September – December 1861. 7 July; cited in Ragan 1999:5). The report was forwarded to Commodore Joseph Smith of the Bureau of Yards and Docks in Washington, D.C., who in turn sent it to the Secretary of the Navy Gideon Welles. Although de Villeroi had won the support of Du Pont in Philadelphia, Smith showed mild enthusiasm. When de Villeroi did not receive an immediate reply from the Navy Department, he grew impatient and wrote a letter directly to President Lincoln on 4 September 1861. In this letter, he explained how easy it would be for a submersible to patrol the coast, land men and munitions at any location, and destroy enemy vessels without being seen. With just a few of these vessels the most formidable fleet could be annihilated in a short time (Bruce 1989:176). While the President’s response is unknown, it may have prompted
Commodore Smith to finally submit a report on 16 October 1861. Although skeptical, Smith agreed to support the construction of a submersible if certain criteria could be met, and concluded:

If the boat by the inventor can be propelled at the rate of three miles per hour [4.88 km/hr] and the persons working it can detach themselves from it and operate outside, the invention might prove useful. The inventor and his friends propose to enter into contract with the Government for a given sum to destroy the vessel in the port of Norfolk without pay in the event of failure. This would be a safe experiment for the Government . . . (NARA, RG 45, Navy Department Letters, September-December 1861, 16 October; cited in Bolander 1936:849).

On 1 November 1861, a contract was signed between the Federal government and Martin Thomas, who represented de Villeroi’s interest. The contract stipulated the submersible was to be built in forty days at a cost of no more than $14,000. A well-known and reputable shipbuilding firm, Neafie and Levy, was subcontracted, and hired de Villeroi as superintendent of the project. Although de Villeroi did not personally sign the contract with the government, he received a portion of the $10,000 paid by the government for the submersible. If the project proved successful, he would get an additional $5,000 for each enemy warship sunk thereafter (Bolander 1936:150).

Under the direction of de Villeroi, construction began in mid-November 1861. The allotted time passed and the submersible was far from finished. The government generously extended the time limit, and continued to do so for five months while the
boat was being completed. The longest delay, a dispute between de Villeroi and Thomas, concerned the installation of "certain articles the inventor considered indispensable" and "ought to have remained a secret." What these "certain articles" were remains unclear. One historian suggests the articles were part of the vessel's air renewal system (Bolander 1936:150). Eventually, the issue was resolved and the submersible was launched on 30 April 1862.

The submersible, officially unnamed and referred to as the "sub-marine propeller," was 46 feet (14.02 m) in length, 6 feet (1.83 m) in depth, and 4 feet 6 inches (1.37 m) in breadth (Welch 1959). Twenty men were needed as crew -16 to power the propulsion system and 4 to operate the vessel. In appearance it was similar to de Villeroi's previous submersible built in 1859, resembling a long iron boiler with a conical bow and a rounded stern (figure 14). A fan-shaped rudder resembling a crescent was attached to the stern, with the top and bottom points connected to the hull. The top of the hull contained a hatch, a conning dome with ports, and two rows of deadlights to illuminate the interior. At the middle of the submersible, a horizontal sheet of iron ran the length of the vessel protecting eight oars that protruded from each side of the hull. Unlike a typical oar, the end opened and closed like a book, to avoid water resistance during the backstroke (Philadelphia Inquirer, 2 May 1862, evening edition). Why de Villeroi designed the submersible with oars when he had previously built a vessel with a propeller is unknown. The oars proved inadequate and were eventually replaced with a manually operated screw propeller mounted at the stern.

One novel feature included in the construction was a watertight compartment in the bow. The room was accessed by a small door from the main interior space, and was
Figure 14. An illustration of de Villeroi's U.S.S. *Alligator* (from Pesce 1906:299).
intended to be a lockout chamber allowing a diver to exit the vessel. A list of the submersible’s equipment included a double barrel air pump with hose, which may have been used to supply the diver with air (NARA, RG 45, Entry M124, Letter Received by the Secretary of the Navy: Miscellaneous Letters, 1801-1884; cited in Ragan 1999:102). Two large ball anchors, located underneath the vessel were used to hold the vessel in place and provide stability while the torpedo was being manually deployed.

On 1 May 1862, the submersible was moved to the Philadelphia Navy Yard where it was assigned a voluntary crew under the command of Samuel Eakins. The Navy Department was eager to send it to Hampton Roads to attack the ironclad C.S.S. Virginia under repair in Norfolk. The urgency lessened on 3 May 1862 when the Union Army of the Potomac advanced onto the Virginian Peninsula and Confederate forces retreated towards Richmond. The ironclad followed the retreat but was unable to pass over the mouth of the James River and was scuttled (Sharf 1887:221). Nevertheless, the submersible was sent to Hampton Roads on June 23rd to assist the Federal fleet. Prior to it being towed south, the submersible was christened U.S.S. Alligator.

At Hampton Roads Alligator was immediately ordered to proceed to City Point, located at the confluence of the James and Appomattox Rivers. It was hoped the submersible could destroy a bridge at Petersburg and possibly move obstructions in the river near Fort Darling. The area, however, was under intense fire, and the commanding officer did not want to be liable for loss of the U.S. Navy’s first submersible. After only five days in the James River, it was sent back to the less-threatening waters of Hampton Roads. Although the vessel was safe, the commanding
officer, Flag-Officer Louis Goldsborough, was reluctant to put the vessel to use. In a
dispatch sent to the Secretary of the Navy, he urged it be towed to the Washington
Navy Yard for further testing (ORN 1, VII:526). Alligator left the military theater of
the James River, thus ending the navy’s first submersible expedition into an active war
zone.

In Washington, D.C., the voluntary crew was replaced with enlisted naval
personnel under the command of Lieutenant Thomas Selfridge. Assistant Secretary of
the Navy Gustavus Fox proposed a plan for Alligator to attack a new ironclad under
construction in Richmond, the C.S.S. Virginia II. Selfridge conducted a series of tests
in the Potomac River during the summer of 1862 in preparation for this mission, and
was not impressed with the submersible’s performance. In a report submitted to Fox,
Selfridge outlined several of the vessel’s deficiencies. During the trials, the submersible
was unable to remain suspended in the water. Interestingly enough, de Villeroi had the
same problem with his previous design. Selfridge further pointed out the vessel could
only be used in depths shallow enough for a diver to reach the bottom of a targeted ship.
In the event a diver did exit, there was not a reliable air supply. As for the atmosphere
contained in the hull, no means of purifying and replenishing air existed other than
forcing it through lime water. Although the method was effective for absorbing the
carbonic acid, it was of little practical use for a 22-man crew. Alligator’s propulsion
system, which still relied on oars, posed another problem. The slow speed of the vessel
made it incapable of stemming a tide of more than 1-½ knots (2.79 km/hr.) and difficult
to maneuver in the best conditions. Selfridge concluded by stating, “the U.S.S.
Alligator could be salvaged if its speed could be increased and steering apparatus
improved, but further trials should not be conducted until the improvements had taken place” (NARA, RG 45, Entry M148, Letters Received by the Secretary of the Navy from Officers Below the Rank of Commander, 1802-1884; cited in Ragan 1999:82-83). On that inglorious note, Fox’s plan to destroy the C.S.S. *Virginia II* with the submersible ended, as did Selfridge’s involvement with the vessel.

The U.S.S. *Alligator* was refitted with a propeller and tests resumed until March 1863, when it was ordered south to Port Royal, South Carolina. Port Royal was a supply station and relay depot for the blockading Federal fleet stationed off Charleston, South Carolina, and Savannah, Georgia. Although information pertaining to the specific role it would serve is limited, it may have been intended to remove underwater torpedoes in Charleston Harbor (Ragan 1999:101). On 1 April 1863, *Alligator* began its journey southward in tow behind the steamer *Sumpter*. The first day proved uneventful, but on the second day a heavy storm was encountered. High winds and rough seas combined with the burden of a tow proved too much for *Sumpter*. Near Cape Hatteras the situation grew worse when the submersible began to take on water. One of two hawsers connecting the vessels broke, and the submersible began to steer wildly in a heavy gale. At 5:30 p.m. on 2 April, an unanimous decision was reached by the officers to cut the remaining towrope and save the steamer. De Villeroi’s submersible was cast adrift and to this day its location remains a mystery. Although private citizens in the North would undertake other submersible efforts, such as *Intelligent Whale*, the loss of *Alligator* effectively ended the U.S. Navy’s active submersible program.
AMERICAN DIVER (1862)

The same month the U.S.S. Alligator was launched at Neafie and Levy in Philadelphia, James McClintock, Baxter Watson, and Horace Hunley arrived in Mobile, Alabama. The loss of Pioneer discouraged but did not defeat the three privateers. Having designed a second submersible, permission was granted them by Major General Dabney Maury to begin another project. It received less enthusiasm, however, from the commanding officer of Mobile’s naval forces, Admiral Franklin Buchanan. Later he wrote he “considered the whole affair impracticable from the commencement” (NARA, RG 45, [no entry], Buchanan Letter to Maury, 14 February 1863; cited in Ragan 1999:95). Regardless of Buchanan’s attitude, Maury supported the inventors and allowed them to construct the vessel at the Parks and Lyons machine shop on Water Street. In addition, they were offered the technical assistance of engineer Lieutenant William Alexander of the 21st Alabama Regiment, who had been assigned to the shop as a supervisor in charge of musket conversions (Kloeppe1 1987:21; Ragan 1999:76).

The resulting submersible, called American Diver, was launched at the end of 1862 or during the first month of 1863. Constructed from ¼-inch (.64 cm) thick boiler iron, it measured 36 feet (10.97 m) long, 3 feet (.91 m) wide, and 4 feet (1.22 m) deep (figure 15). Twelve feet (3.66 m) of both ends tapered to a flat vertical edge allowing the vessel to pass through the water easily. A rudder mounted at the stern controlled the vessel’s horizontal movement in the water. Likewise, two dive planes protruding from the sides controlled the vessel’s vertical movement. The American Diver operated with
Figure 15. A drawing of the Confederate submersible *American Diver* as described by James McClintock to the British Royal Navy in 1872 (from PRO, ADM 1/6236, file 39455).
a crew of five men, four of whom were used for the vessel’s propulsion system.

Ultimately a stern-mounted screw was employed; however, the group put much effort into experimenting with an electromagnetic engine as well as a custom-built steam engine. McClintock stated after the war that much time and money was lost in an attempt to build an engine for propelling the boat. Eventually the more reliable man-powered system was installed, but it still did not provide the desired speed to attack the blockaders moored six miles (9.65 m) offshore (PRO, Adm. Series 1/6236, File 39455, Report on Mr. McClintock’s Submarine Torpedo Boat).

In February of 1863, American Diver was fitted with a torpedo and moved to the entrance of Mobile Bay. Unfortunately, a description of the weapon system does not exist. Since the vessel lacked a bottom hatch for a diver to exit, and there was no mention of a spar, the torpedo was most likely towed. The submersible itself was towed to Fort Morgan to attack the blockading fleet, but was caught in a gale and sank. Fortunately, no lives were lost (Ragan 1999:96).

H.L. HUNLEY (1863)

Shortly after the loss of American Diver, the three inventors from New Orleans joined an organization of engineers in Mobile known as the Singer Submarine Corporation. The group, led by a Texan named Edgar Singer, manufactured underwater contact torpedoes and entered into a contract with the Confederate Navy to mine Mobile Bay. Singer was keenly interested in the group’s proposal for another submersible.

Horace Hunley, who had been the sole financier of American Diver, chose to sell shares
in the next vessel to raise the necessary capital for construction. Retaining one-third ownership, Hunley sold the remaining interest to four members of the Singer Submarine Corporation. Singer bought a $5,000 share, R. W. Dunn purchased a $2,000 share, and B. A. Whitney and J. D. Breaman together bought a $3,000 share (Duncan 1965:64). With a $15,000 budget, construction of the group’s third and final submersible began in the spring of 1863 at the Park and Lyons machine shop under the direction of McClintock and Alexander.

In July of 1863, the submersible was named after of Horace L. Hunley and launched into Mobile’s harbor from the Theater Street Dock. H.L. Hunley was not a rebuilt version of Pioneer or American Diver, but designed and constructed from previous experiences of knowing what worked and what did not. In 1902 Alexander provided a sketch (figure 16) of the submersible as well as the most detailed description of its construction which reads:

We decided to build another boat, and for this purpose took a cylinder boiler which we had on hand, 48 inches [116.84 cm] in diameter and 25 feet [7.62 m] long (all dimensions are from memory). We cut this boiler in two, longitudinally, and inserted two 12-inch [30.48 cm] 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 [9.14 m] long, 4 feet [1.22 m] wide, and 5 feet [1.52 m] deep. A longitudinal strip 12 inches [30.48 cm] wide was riveted the full length on top. At each 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
Figure 16. A drawing of the Confederate submersible *H.L. Hunley* by William Alexander (from Pesce 1906:305).
ballasted by flat castings, made to fit the outside bottom of the hull and fastened thereto by ‘Tee’ headed bolts passing through stuffing boxes inside the boat, the inside end 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 the water from the tanks in 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 1 ¼-inch [3.17 cm] shaft passed through stuffing boxes on each side of the boat, just forward of the end of the propeller shaft. On each end of this shaft, outside of the boat, castings, or lateral fins, 5 feet [1.52 m] long and 8 inches [20.32 cm] wide, were secured. This shaft was operated by a lever amidships, and by raising or lowering the ends 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 by 12 inches [40.64 by 30.48 cm], with a conning 8 inches [20.32 cm] high. These hatches had hinged covers with rubber gaskets, 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 [30.48 by 45.72 by 10.16 cm], made to carry a hollow shaft. This shaft passed through stuffing boxes. On each end was an elbow with a 4-foot [1.22 m] length of 1 ½-inch [3.81 cm] pipe, and keyed to the hollow shaft; on the inside was a lever with a stop-cock to admit air (Alexander 1902a:86).

At some point during the submersible’s construction, Lt. George Dixon of the 21st Alabama Regiment joined the effort. Injured during the battle of Shiloh on 6 April 1862, he arrived in Mobile after being deemed unfit for field service. The circumstances leading to his arrival in Mobile are unclear, but he may have been sent to assist his fellow regiment officer, Alexander, at the Parks and Lyons machine shop (Ragan 1995:28). Eventually Dixon took command of H.L. Hunley after the loss of several men while testing the vessel. The first accident occurred on 29 August 1863 in Mobile. While there are conflicting reports concerning the events leading to the accident, the vessel sank without warning while the hatches remained open. Of the seven men onboard, five drowned (Lake 1918:38). The submersible was raised, refitted and transported to Charleston, South Carolina, to assist the efforts against the Union blockade. A new crew, under the command of Hunley, continued training in
preparation for an eventual attack. The second accident occurred on the morning of 15 October 1863, taking the lives of Hunley and seven other crewmen. The exact cause of the catastrophe also remains a mystery. When a salvage team discovered the submersible a week later, the bow was securely imbedded in the mud at a 35 degree angle (Kloeppel 1992:46). After it was raised, the seacock allowing water to flow into the forward ballast tank was found open. After the war, Alexander provided a possible scenario that led to the accident. He believed Hunley opened the seacock to add weight to the forward ballast tank to help submerge the vessel. This, in conjunction with the dive planes in a downward position, caused the submersible to nose dive. The crew attempted to release the emergency ballast but failed. In the confusion of the rising water, Hunley forgot or was unable to close the sea cock and the crew drowned (Alexander 1902b:166). Again H.L. Hunley was raised, overhauled, and a crew assigned under the under the command of the vessel’s final commander, Dixon.

H.L. Hunley was taken to a new mooring site on Sullivan’s Island at the mouth of Charleston Harbor. Here, Dixon continued to test the submersible and condition the crew in preparation for a nocturnal attack on the Union warships moored off the coast. Unpredictable currents greatly affected control of the torpedo, which trailed the submersible by a long rope. After a near disaster in which H.L. Hunley’s support vessel came uncomfortably close to the torpedo, the explosive was positioned at the end of a long spar protruding from the bow. The submersible now had to ram the side of the enemy ship and detonate the torpedo by lanyard as it moved away. This configuration was standard on a class of semi-submersibles used by the Confederacy known as “Davids’” (Perry 1965:81).
On the night of 17 February 1864, *H.L. Hunley* attacked the U.S.S. *Housatonic*, a 13-gun sloop moored outside the harbor to guard the waterway against outgoing and incoming blockade runners. Just before 9:00 p.m., the submersible was spotted approaching the warship’s starboard quarterdeck. Several men aboard fired their muskets at the unusual vessel but it was too late. The torpedo had struck the side of the ship and the submersible had begun to pull back. A massive explosion shook *Housatonic* back and forth as timbers flew through the air. Moments later the ship lurched forward then rolled toward port and sank (Schafer 1996:124; Luraghi 1996:258). For the first time in naval history a submersible caused the destruction of an enemy vessel.

Although the mission to destroy the Federal ship was a success, *H.L. Hunley* never made it back to shore. Several speculations concerning the submersible’s fate have been presented over the years. Some believed the vessel drifted out to sea, while others thought it had gotten entangled in the sinking ship. While the events on board the submersible immediately after the explosion will always remain a mystery, a recent discovery may help determine what happened. The location of *H.L. Hunley* was discovered 1,000 feet away from the wreckage of the *Housatonic* by a team directed by Clive Cussler (Murphy, ed. 1998:94). In the year 2000 it was raised, brought to Charleston, and the hull is currently being excavated and conserved.
OTHER SOUTHERN EFFORTS

The work of McClintock’s group and the ultimate success of *H.L. Hunley* have been the primary focus of historians concerning submersible use during the American Civil War. However, efforts continued by both sides until the end of the war. Following the destruction of the U.S.S. *Housatonic*, several designs were submitted to both the Federal and Confederate navies. The U.S. Navy Department poured over designs but failed to build another submersible, while efforts within the Confederacy aggressively continued. At least two submersibles were constructed and used at Mobile, Alabama. In addition, it was rumored at the end of the war that four more were at Shreveport, Louisiana, and another at Houston, Texas.

In April 1864 a Confederate submersible was nearing completion in Mobile, Alabama. The identity of the designer is unknown. General Stephen Hurlbut, U.S. Army, learned details of the submersible through informants, and provided a description of the vessel in a letter to Secretary of the Navy Gideon Welles:

I am informed, and believe credibly, that a submerged torpedo boat is in course of preparation for attack upon the fleet at Mobile. The craft, as described to me, is a propeller about 30 feet [9.14 m] long, with an engine of great power for her size, and a boiler so constructed as to raise steam with great rapidity. She shows above the surface only a small smoke outlet and a pilothouse, both of which can be lowered and covered. The plan is to drop down within a short distance of the ship, put out the fires, cover the smoke stack pipe and pilothouse, and sink the craft to the proper depth; then work the propeller by hand, drop
beneath the ship, ascertaining her position by a magnet suspended in the propeller, rise against her bottom, fasten the torpedo by screws, drop their boat away, pass off a sufficient distance, rise to the surface, light her fires and work off (Hurlbut 1864; Cited in Ragan 206).

The General’s letter stated that the submersible carried a torpedo containing 40 pounds (14.93 kg) of gunpowder that was detonated by a clockwork mechanism. While the fate of the vessel is unknown, Union forces captured a submersible shortly after Admiral Farragut attacked Mobile on 5 August 1864. A sketch of this submersible appeared in a September edition of Harper’s Weekly (figure 17).

While the Union fleet off of Mobile was watching for a possible attack by the submersible described to Hurlbut, another was under construction at the Selma Iron Works in Selma, Alabama. In June 1864 a submersible designed by Second Lieutenant John Halligan was nearly finished. It also was propelled on the surface by a compact steam engine and relied on manpower underwater. During a preliminary sea trial conducted late in the summer, the submersible was able to achieve a speed of 7 knots (12.96 km/hr) (ORN XXI:748). Construction was completed by October, and it was christened Saint Patrick. While operating in the waters of the Alabama River, Federal informant Edward La Croix wrote the Washington Navy Yard and described what he saw. His letter stated that the torpedo boat had a length of about 30 feet (9.14 m), and that watertight compartments were used to ballasted the vessel. Although it employed an engine for propulsion, it had enough room inside the hull for a crew of five men. He further stated, “the boat proves to be a good sailor on the river and has gone to Mobile
Figure 17. An illustration from *Harper's Weekly* depicting the submersible that was captured in Mobile Bay by Federal forces in August 1864 (from *Harper's Weekly*, 24 September 1864:609).
to make last preparations for trying its efficiency on the Federal vessels" (ORN XXI:748).

*Saint Patrick* was transported to Mobile and on 27 January 1865 was involved in an unsuccessful attack on the 10-gun paddlewheel steamer U.S.S. *Octorara* (*Harper's Weekly*, 25 February 1865). During the last months of the war, it ferried munitions from the port of Mobile to the Spanish Fort, a Confederate stronghold under siege across the bay. The vessel's internal ballast in the form of lead ingots and pig iron was replaced with cases of shot and shells or other weighty items (Perry 1965:183; Ragan 1999:250). The ultimate fate of *Saint Patrick* is unknown.

More tenuous evidence supports the construction of five more submersibles – four in Louisiana and one in Texas. Historical evidence alludes to these vessels as being the work of James Jones, a partner in the Singer Submarine Corporation located in Texas (Duncan 1965: 61). Knowledge of his activity was discovered when a Confederate dispatch was intercepted, describing detailed information pertaining to Jones' involvement with torpedo deployment in the Red River and the possible construction of a submersible. This information was forwarded to Lieutenant Colonel C.T. Christenson, U.S. Army, in a letter written by Major A.M. Jackson on 13 March 1865. Jackson wrote:

The following is a description of the torpedo boats, one of which is at Houston and four at Shreveport: The boat is 40 feet [12.92 m] long, 48 inches [121.92 cm] deep, and 40 inches [101.6 cm] wide, built entirely of iron, and shaped similar to a steam boiler. The ends are sharp pointed. On the sides are two iron flanges, for the purpose of raising or lowering the
boat in the water. The boat is propelled at the rate of 4 miles an hour [6.44 km/hr] by means of a crank, worked by two men. The wheel is on the propeller principle. The boat is usually worked 7 feet [2.13 m] 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 20 feet [6.1 m] long; one at the stern, fastened on a plank 10 or 12 feet [3.05 or 3.66 m] 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 men idle two or three hours. The torpedoes are made of sheet iron three-sixteenths of an inch [.48 cm] thick, and contain 40 pounds [14.93 kg] of powder. The shape is something after the pattern of a wooden churn, and about 28 inches [71.12 cm] 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).

The fate of these submersibles is unknown. It is conceivable that they were scuttled at the end of the war to avoid capture by Federal troops.

NORTHERN EFFORTS NOT REALIZED

While there is no definitive historical evidence suggesting the Federal government operated another submersible after the loss of the U.S.S. Alligator in 1863, there is proof it remained interested in the possibility. After news of H.L. Hunley’s success in Charleston reached the North, the Navy Department was inundated with
submersible designs. A committee known as the Permanent Commission labored through submissions separating the plausible from the ludicrous. Most proposals were rejected. However, from 1863 to 1865 the department considered the submersible designs of at least four inventors worthy of further investigation.

In April 1863 Professor Horstford of Massachusetts submitted a submersible design to the Navy Department. In many respects it was similar to the vessel built by de Villerol, but also included features found on a modern submarine. The vessel included a retractable periscope, consisting of a tube with reflectors that passed through the top of the hull. Unlike previous submersibles, the pilot of this vessel would be able to take sightings of an enemy ship while remaining safely submerged. While periscopes had previously appeared on ironclad warships, Horstford was the first person to suggest their use on submersible watercraft (Lawliss 1991:39, Ragan 1999:110). The proposed vessel was 55 feet (16.76 m) long and capable of carrying 26 men (figure 18). At the bow, a small lockout chamber allowed a diver to exit the hull for torpedo deployment. Immediately behind the chamber in the main compartment were levers to control the angle of two small dive planes, which projected from each side of the vessel near the bow. Large ballast tanks situated at each end of the submersible were designed to manage the boat’s buoyancy. Additional smaller tanks running the length of the hull were designed to fine-tune the vessel’s trim. As the number of crewmen suggests, the propulsion system relied on human power. Twenty-four men, 12 positioned on either side of a long crankshaft, manually turned a stern-mounted screw propeller. A reduction gear connected to the driveshaft rotated the prop faster than the crankshaft. The design did not include evidence of a snorkel to draw
Figure 18. The submersible design submitted by Professor Horstford to the U.S. Navy in 1864 (from Ragan 1999:168).
fresh air from the surface, but relied on an ingenious method of replenishing atmosphere within the hull. A large blower was to keep the air circulating over woolen cloth dipped in lime water, to remove carbonic acid in the atmosphere and release small amounts of oxygen. Additional compressed oxygen gas was to be released from a tank. Horstford claimed the system would keep the air quality close to normal purity, allowing the crew to remain submerged for several hours (Baird 1902:848).

On 27 July 1863, Rear Admiral Charles Davis of the Permanent Commission wrote Horstford informing him the committee accepted his proposal and the government would pay half the cost of construction (NARA, RG 45, Letters of the Permanent Commission, Charles Davis Letter to Professor Horstford, 1863; cited in Ragan 1999:113). Unfortunately, there is no further evidence as to how the government financially assisted the project. Likewise, there is no documentation indicating if the professor built the submersible.

While the efforts of Horstford remain a mystery, there is proof a submersible was completed and tested at the Brooklyn Navy Yard in New York. In the fall of 1863, Edward Hunt, a major in the Army Corps of Engineers, met with an unfortunate accident when experimenting with his small one-man submersible. On 2 October a shell misfired near Hunt's boat, killing the major and ending the project. An article in the New York Times confirms the construction of the vessel and the death of the Major. A portion of the article reads:

The death of Maj. E.B. Hunt, which occurred yesterday at the Brooklyn Navy Yard, will cause profound regrets among a large and devoted circle
of friends, both in the army and private life. Maj. Hunt had, it is well known, been engaged for many months in the construction of a new submarine battery of his own invention, which promised to give the most important results. Yesterday, it is stated, that in making experiments on the vessel a shell burst, and the gas evoked so affected him that he fell down into the hold, producing concussion of the brain. He was carried to the Naval Hospital and died during the day (New York Times, 3 October 1863).

Two months later a government pension of $25 dollars per month was issued to his widow and eight-year-old son (NARA, RG 45, Case #4345, Pension File of Major Hunt, 1863). Hunt’s death is the first recorded fatality in a submersible operated by the U.S. military.

In June of the following year, the Navy Department received plans from Lodner Phillips and Fredrick Peck, who proposed three different submersible designs. Phillips, the inventor from Michigan who constructed Marine Cigar in 1851, had approached the Navy with a design before the war and was harshly rejected. The experience may be one reason he did not submit another design until the summer of 1864. While both men’s names were on the proposal, Phillips probably designed the vessels. His previous efforts show he had a vast understanding of submersible technology and its potential as a military weapon. Peck, a successful lawyer from New York City, had the financial wherewithal to cover the cost of construction. The proposed boats were far more advanced than any previously reviewed by the Permanent Commission, and featured underwater cannons, shell rockets and possibly a periscope (Gruse-Harris 1982:44; Ragan 1999:209). On 28 June 1864, Admiral Davis advised Secretary Welles
to adopt at least one of the designs. In his report to Welles he included a detailed description of the vessels that reads:

The vessel described is of a cigar-shape, forty feet [12.19 m] in length and furnished with tubes filled with compressed air sufficient not only to supply breathing air for five men for twenty hours, but also to be used for the purpose of expelling the water from tanks communicating with the sea, whereby the vessel may be made to rise towards the surface, while it is made to sink by letting the air escape from the tanks into the cabin and readmitting the water, by which the specific gravity of the vessel is increased.

By an ingenious contrivance, and the mere loading of a valve to correspond with the required pressure of the water, a given depth below the surface of the sea may be automatically preserved. This vessel, which is to be propelled by means of manpower, is to be rendered serviceable in attaching torpedoes to the side, or exploding them beneath the bottom of vessels, and to be available in sawing, undermining and otherwise removing obstructions through the agency of compressed air as a motive of power. The other vessels proposed are of much larger size, to be propelled by steam, and to be armed with shell rockets to be effective at the surface of the water, and with guns worked on or beneath the surface as occasion may require (NARA, Record Group 45, Letters of the Permanent Commission, Admiral Davis Report, 28 June 1864; cited in Ragan 1999:210).

Although the designs won the support of the commission, no further government documents indicate the vessels were built. However, more tenuous forms of evidence
suggest otherwise. According to Lodner’s granddaughter, England sent a representative to negotiate the sale of a submersible constructed during the war. An offer to purchase the vessel for $50,000 was made, but Phillips considered the sale of a warship to a foreign power an act of treason and refused. Furthermore, after the submersible supposedly sank, Peck offered to fully finance the construction of another. Phillips agreed and moved to New York. Unfortunately he died unexpectedly when the submersible was almost finished (Gruse-Harris 1982:37-39). While his death certificate indicates he was in New York, there is no proof to support the other facts in the family’s oral history. Another piece of evidence comes in the form of an old photograph dated to 1865. Historian and author Mark Ragan has pointed out the strong resemblance of a submersible discovered in Charleston, South Carolina, and a design submitted by Phillips (figure 19) (Ragan 1999:261). The identity of the vessel has never been determined, leaving several unanswered questions.

The same month Admiral Davis endorsed Phillips’ submersible to the Secretary of the Navy, the Permanent Commission received a proposal from Julius Kroehl, the chief engineer for the Pacific Pearl Company. Chief Naval Engineer W.W. Wood reviewed the plans and after an unfavorable report the Navy Department chose not to get involved with the project. Kroehl, however, continued at his own expense and completed the submersible in New York City. The resulting vessel was christened Explorer and contained large tanks of compressed air for breathing, buoyancy control and pressurizing the hull. At the bottom of the vessel were large hatches that could be opened underwater to permit divers to exit the main compartment and explore the seabed. Since Kroehl was unable to interest the navy, Explorer was towed to the Pearl
Figure 19. A comparison of a design submitted to the U.S. Navy by Lodner Phillips in 1851 (above) to an unidentified submersible discovered in Charleston, South Carolina, in 1865 (from Ragan 1999:261-262).
Islands near Panama in 1864 and used in oyster harvesting. The fate of the submersible remains a mystery.
CHAPTER IV

THE HISTORY OF INTELLIGENT WHALE

FROM 1863 TO PRESENT

The third year of the American Civil war saw many submersible efforts employed by both the North and South. In Mobile, James McClintock and his associates had lost one vessel at the beginning of the year, then proceeded to construct and test another. In Washington, D.C., Brutus de Villeroi's Alligator was refitted with a new propulsion system but sank en route to the Union fleet in South Carolina. The U.S. Navy Department's Permanent Commission received Professor Horstford's submersible design and offered to partially finance its construction. At some point during this same year, another inventor in the North, Scovel S. Merriam, designed a submersible that would eventually become known as the Intelligent Whale. In spite of the vessel being started in 1863, numerous obstacles such as disputes, greed and even murder prevented its use by the U.S. Navy until after the war. Consequently, the problems associated with the vessel affected the Navy's post-war attitude regarding submersible warfare. While scholars of submersible history have provided some information about the vessel, although not always correct, its complex beginnings are often overlooked.
SCOVEL S. MERRIAM AND THE AMERICAN SUBMARINE COMPANY

Information pertaining to *Intelligent Whale’s* origins and history from 1863 to 1865 is limited to a single document—a legal brief submitted in a court case on 25 September 1865 (NARA, AY, Box 132, piece 2). According to this record, in 1863 Scovel S. Merriam designed a submersible for use against the Confederacy. Like many inventors during the war, he had a relatively good idea but lacked the financial wherewithal to proceed independently. Therefore, on 2 November 1863 he signed a contract with Cornelius Bushnell and Augustus Rice to build his submersible within three months at a cost of $15,000. This partnership appeared to be a smart move on behalf of Merriam, as Bushnell had previously designed and built the U.S.S. *Galena* and was instrumental (and a partner) in the construction of inventor John Ericsson’s U.S.S. *Monitor* (Anderson 1962:68-69). The contract stipulated that Merriam would retain half ownership, receive a salary of $150 per month, and be paid $624 for his work designing the vessel. Bushnell and Rice would equally share the rights to the other half and have the option to sell the submersible at a public auction if proved a failure. While Bushnell and Rice provided the capital investment for the project, they did not handle the disbursement of funds, which was left to New York banker Woodruff L. Barnes. Upon signing the contract, Merriam received $7,000 to begin construction as soon as possible. The remaining amount, $8,000, was disbursed as the project progressed and the investors were satisfied with Merriam’s results.

While the legal brief provides information concerning the contract, it fails to mention where the construction took place. Evidence suggests two possible locations,
New York or Massachusetts. The metal used to manufacture the hull was from the West Point Foundry in New York—indicated by a maker’s mark located inside the hull (figure 20). Furthermore, the submersible first appears in the historical record in 1865 at the Morgan Iron Works in New York City. The Morgan facility, suitable for building such a craft, incurred a debt against Merriam’s "Submarine Apparatus" for "labor and materials furbished" (NARA, AY, Box 132, piece 2). While a strong argument could be made that the construction occurred in New York, there is evidence to suggest that it took place in Massachusetts. According to a patent submitted by Merriam in 1866 for another submersible, he resided and worked out of Springfield, Massachusetts (U.S. Patent, No. 58611, 9 October 1866) (figure 21). This information alone does not support a strong case that the vessel was built in Massachusetts. However, additional evidence in regard to the correspondence between Woodruff Barnes and the Navy Department suggests otherwise.

While Merriam was building the submersible, Bushnell, Rice and Barnes, as well as two investors named Henry Gray and Edward Livermore, started a company called the American Submarine Company. The group incorporated on 24 February 1864, five months after Merriam signed the contract to build the submersible. The purpose of the company, as indicated on their letter of intent submitted to the State of New York, was to "manufacture, sell and use submarines" (NARA, AY Box132, piece 2). Barnes' position within the company was Secretary. The day after the group incorporated he wrote two letters to the Navy Department. The first letter to Secretary of the Navy Gideon Welles opened by addressing the recent attack in Charleston Harbor
Figure 20. A maker's mark stamped on a frame inside Intelligent Whale that reads "W.P. & Co. [crown] BES." The "W.P." signifies the metal was from the West Point Foundry of New York, whereas "BES" indicates the metal was forged using the Henry Bessemer patented process for manufacturing steel (photograph taken by author, 1998).
Figure 21. A patent submitted by Merriam in October 1866, indicating he resided in Springfield, Massachusetts. (from NARA, RG 241, patent no. 58661).
(H.L. Hunley) and a discussion of submersible use in general. He continued, "the success of underwater submarine operations rest on a well planned vessel. I am confident of substantial success and if the Department will sustain us, we will undertake operating in a very short time in Charleston Harbor, and we believe we can destroy their floating batteries and torpedoes without serious difficulty" (NARA, RG 45, Entry M124, Letters Received by the Secretary of the Navy: Miscellaneous Letters, 1801-1884; cited in Ragan 1999:202). The second letter Barnes wrote was to Welles’ immediate subordinate, Assistant Secretary Gustavus Fox. In this letter he stated:

I addressed the Secretary of the Navy recently and again today in regard to proposed operations in Charleston Harbor in removing obstructions and blowing up gunboats. The vessel is nearly completed –the plan of it you have seen. We are confident of substantial success and will undertake the job if the Department desires it. We would glad to confer with the Secretary or you in regard to it. Our vessel has been quality built and the public knows nothing of it. We can be ready in about two or three weeks (NARA, RG 45, Entry M124, Letters Received by the Secretary of the Navy: Miscellaneous Letters, 1801-1884; cited in Ragan 1999:202).

Although the name of the vessel under construction is not mentioned in the two letters, they indicate Barnes was closely involved with building of a submersible, which is known to be true with his involvement with Merriam's "Submarine Apparatus" and the American Submarine Company. On 2 March, Welles telegraphed Barnes and replied, "when your boat is completed the Department will order its examination at your request." There was no communication between Barnes and the Navy Department over
the next several weeks, but on 23 April he wrote a letter to inform them the submersible was almost finished and an engineer officer was needed to examine it. "In view of the probability that the government, or rather you as secretary may want to control the direction of the vessel after she is completed," explained Barnes, "I would like to have you detail Chief Engineer Stimers to accompany me to Springfield to inspect the vessel and report upon her to you. I will advise with him as to the method of getting the vessel to New York." Three days later Welles sent a short response simply reading, "The Department can not comply with your request to detail Chief Engineer Stimers to accompany you to Springfield and examine the report on the submarine now building at that place" (NARA, RG 45, Entry M124, Letters Received by the Secretary of the Navy: Miscellaneous Letters, 1801-1884; cited in Ragan 1999:202). When one looks at the dates that Barnes communicated the activities of the American Submarine Company to the Navy, the time frame of the project as indicated in the contract, and that a submersible was under construction in Merriam's hometown, it becomes too coincidental. A strong argument can be made that the submersible eventually known as Intelligent Whale was built initially in Springfield, Massachusetts, and later transported to New York City.

Merriam's work on the vessel continued through the spring of 1864. During the process he made certain "improvements" with its design and planned to have these ideas patented. However, on 3 May Merriam sold the rights to these improvements and his half of the incomplete vessel to Barnes for $5,000, which was transferred to the American Submarine Company the following day. The historical record indicates that at this time Merriam's direct involvement with the construction of the submersible and
the company ended. For reasons not specified, on 10 May Edward Livermore also
chose to get out of the project and sold his interests in the vessel amounting to $9,166
(NARA, AY Box132, piece 2). Over the next two months information pertaining to the
company and the submersible are not provided in the historical record. Perhaps the
trustees were dealing directly with the engineer (not Stimers) sent to evaluate the vessel
rather than communicating with the Navy Department. By the end of July the Navy
Department reached a decision about the submersible and found it unacceptable (Ragan
1999:203). On 5 August Barnes wrote a letter to the navy requesting a copy of the
report concerning the evaluation but his request was denied. Five days later, the
Secretary of the Navy officially ended the Department’s interest in the vessel with a curt
letter to Barnes that read, “You are informed that the Department does not consider it
proper to furnish a copy of the report of the board which examined your submarine
boat” (NARA, RG 45, Entry M124, Letters Received by the Secretary of the Navy:

Again the historical record provides little information concerning the company
or the submersible from end of the summer in 1864 to May 1865. At some point during
this time the company underwent a dramatic organizational change. All of the
company’s original trustees, including Barnes, no longer held stock in the company or
had an interest in the submersible by June 1865. While the events leading to the change
remain a mystery, at some point prior to June the submersible caught the attention of
Oliver S. Halsted Jr.
OLIVER S. HALSTED JR.

The Halsteds were a wealthy family from New Jersey, whose members included both local politicians and military leaders. Oliver S. Halsted Jr., known as “Pet” to his friends and family, was a lawyer by trade and exemplified the characteristics of Halsted men—well educated, a member of high social circles in New England and very self-confident (figure 22). During the American Civil War he resided in Washington, D.C., and served as a lobbyist for a variety of interests that included the weapons industry. “Conspicuous among them was his engineering of a great wrought iron gun contract for the Ames Brothers. Halsted’s lectures on the proposed practice of gunnery were informative and entertaining. His schemes and speculations commanded serious attention during the time when all the inventive talent of the nation was fixed on the work of bringing out new instruments and discoveries in offensive warfare” (New York Daily Tribune, 3 July 1871). As an outspoken member of the Republican Party, Halsted also had close ties to President Lincoln, serving as Mary Lincoln’s legal and financial advisor (New York Tribune, 3 July 1871; Bruce Halsted, personal communication 1998).

At what point Halsted became associated with Merriam’s submersible is unclear, but by June 1865 he was the primary trustee of the American Submarine Company and represented its interests (NARA, AY Box 132, piece 2). On 9 June the submersible was located at the Morgan Iron Works in New York City, scheduled to be auctioned the following day. The company was unable or unwilling to pay a debt of
Figure 22. A portrait of Oliver S. Halsted Jr. taken during the American Civil War (courtesy of Mr. Bruce Halsted, 1998).
$2,468 incurred at the works for the "labor and materials furnished" (NARA, AY Box 132, piece 2). On that day Halsted signed a contract with Thomas M. Tyng, arranging that he (T intrig would buy the vessel for the company with funds provided by Halsted, as long as it did not exceed $3,000. Once purchased, the title would then be transferred back to the company and Tyng would receive $750 for his effort. At the auction the submersible was sold to Tyng for the amount owed to the Morgan Iron Works. A second contract was signed immediately after the sale, stipulating that Tyng had 30 days to transfer the title to the American Submarine Company, or 60 days to reorganize it so that he and Halsted equally owned the submersible (NARA, AY Box 132, piece 2).

A month passed and Tyng neither transferred nor attempted to reorganize the company in spite of Halsted's persistence. Unbeknownst to Halsted, on 20 July Tyng formed a partnership with Merriam and a Colonel Edward M. Serrell to manufacture, sell, and operate submersible craft. Clearly, he did not intend to return the vessel to Halsted or the American Submarine Company. On 24 July Merriam's "Submarine Apparatus" was moved from the Morgan Iron Works to Hunters Point, on the Long Island side of the East River. Halsted and his younger brother Abel went to Tyng's Wall Street office in New York City and confronted him about the situation. Tyng offered to sell the vessel back to Halsted for $6,874.67, the amount he claimed it had cost since the auction. An inspection of the receipts revealed several superfluous charges, which included $450 to Merriam for his services. Halsted refused the offer, but counter-offered with $5,000 in cash and no more. As neither party was willing to
back down, the submersible remained in Tyng's possession (NARA, AY Box 132, piece 2).

By the mid-September 1865, Halsted took matters into his own hands. On the evening of 22 September, he arranged for a tug to meet at Hunters Point on Long Island. He and his brother Abel Halsted attached the submersible to the tug by towrope and proceeded to haul it up the Passaic River towards New Jersey. Tyng, however, managed to hear of the clandestine operation and immediately left for New Jersey to intercept the only conceivable suspect. While en route the submersible was spotted moored beneath a bridge near Newark. Tyng and his men approached the Halsted brothers and a brawl quickly ensued. Local law enforcement eventually arrived and placed both parties into custody until the next morning. The submersible was also held until the rightful owner could be determined (NARA, AY Box 132, piece 2).

On 23 September a judge named Elias Kirkpatrick arranged for the vessel to be signed over to two trustees representing both parties. The trustees were General Nathaniel Norris Halsted and Colonel Edward Serrell, representing Halsted and Tyng respectively (NARA, AY Box 132, piece 3). Two days later a trial was held in the court of Judge Elias Kirkpatrick, to hear a case brought forth by Tyng against Halsted for grand larceny (NARA, AY Box 132, piece 2). During the trial, the legal brief mentioned earlier was submitted. Halsted, a noted attorney in New Jersey, represented himself and won the case after presenting to the judge all contracts and an account of Tyng's actions. Shortly thereafter, the vessel was moved to Hewes & Phillips Machine Shop on Ogden Street in Newark, New Jersey (NARA, AY Box 132, piece 14, 1865). At this new location, work on the vessel continued over the next several years.
On 22 December 1865, Tyng wrote a letter to the City of New York officially transferring the title and all equipment still located at Hunters Point to Norris Halsted for $1,000 (NARA, AY Box 132, piece 6). The money paid for the following articles associated with the submersible:

1 propeller crank
1 steersman’s stool
1 steering hawser
1 double barrel air pump
1 pressure gage
1 pressure hose 50 feet long
1 float hose 50 feet long
1 copper float
1 lot of red and white paint
1 torpedo bar and couplings
1 eight inch shell
1 torpedo grapnel

1 telegraph and instruments
2 coils of copper wire for telegraph
1 extra gasket for upper door
1 socket wrench for upper door
12 c-clamps for upper door
1 lot of bolts for upper door
2 anchor balls
2 new drums
2 new drum cases and cranks
2 boxes of tools
2 handles to tank valves

Although the letter transferred the title to Nathaniel Norris Halsted, evidence suggests it was later transferred to Oliver Halsted shortly thereafter (NARA, AY Box 132, pieces 10, 11, and 30).

During the spring of 1866, the submersible underwent an unofficial trial as indicated in a letter dated 18 April to the Secretary of the Navy by General Thomas W. Sweeney. The test was witnessed by Colonels John Michal and T.R. Tresilian and Major R.C. Bocking (NARA, AY Box 132, pieces 9 and 10). Sweeney, with two other men on board, submerged the vessel to 16 feet (4.88 m) and anchored it. He then left the craft
in a diving suit and attached a torpedo to the bottom of a scow (figure 23). After Sweeny returned to the submersible, the crew detonated the torpedo by a lanyard and friction primer as the submersible moved away from the target. Sweeny and the other officers were impressed with the results and sent a favorable report to the Secretary of the Navy (Holland 1897:553; Lake 1918:156). Although Sweeny’s letter stated the trial occurred in April, an examination of his military record indicates he was then involved with the Fenian Raid on Canada. Furthermore, he was not officially serving in the US Army between December 1865 and 8 November 1866 (NHC, Furgol paper, 7 October 1994). While the exact date of the trial remains unclear, it is conceivable that Sweeny performed the test in a non-military capacity as a favor to Halsted as the navy considered it an unofficial trial.

Halsted family history, passed down through the generations, also provides interesting and entertaining stories about the submersible’s use during the spring and summer of 1866. On 21 March 1957, Oliver Halsted’s grandson, Arthur Halsted, wrote his granddaughter a letter in response to her inquiries concerning the family’s colorful history. According to Arthur’s father, on several occasions the Halsted family would picnic in the submersible. “My (Arthur’s) father and his sisters Carry and Adela, went down in the submarine and picked up shells from the bottom of the Hackensack River through a door in the bottom” (Halsted 1957). During these excursions, a son named Oliver M. Halsted must have assisted his father with operating the vessel, as he was one of the few people who would later know how to operate it (NARA, AY Box 132, piece 36).
Figure 23. An illustration of a diver (like Sweeny) leaving the bottom hatch of the *Intelligent Whale* to attach a torpedo to a targeted ship (after Pesce 1906:314).
On 3 October 1866, the submersible was hoisted onto the dock of the Hewes & Phillips Machine shop, where it remained out of the water until 17 January 1870 (NARA, AY Box 132, piece 9, 1865). Although stored on land, work continued on the vessel. A survey of a detailed invoice from Hewes & Phillips revealed 1,218 man-hours were put into the vessel from the time it first arrived on 25 September 1865, to the time it left on 17 January 1870. The total amount of labor charge for work associated with the boat was $637.95—averaging just over 52 cents per hour. This labor included boiler work, forge work, and machining. The total cost of materials incurred at Hewes & Phillips over the four-year period amounted to $186.86. The most expensive service provided by the machine shop was storage of the vessel from October 1866 to January 1870, costing Halsted $2,336 (NARA, AY Box 132, piece 14).

During October 1869, Commodores Melancton Smith and Augustus Chase, and Chief of the Torpedo Bureau Edmond Matthews inspected the submersible and filed a favorable report with Secretary of the Navy George Robeson (NARA, AY Box 132, piece 10; Lake 1918:156). On 29 October Halsted and Robeson signed a contract to sell Intelligent Whale to the Navy for $50,000. According to the contract, Halsted would receive $12,500 for endorsing the agreement. A second payment of $12,500 would be issued when the boat was brought to the Brooklyn Navy Yard and a successful trial was completed by 1 January 1870. To receive the final payment of $25,000, Halsted had to reveal in writing the “inventions, secrets and contrivances necessary to enable any competent person or persons to operate the boat and purifying the air” (NARA, AY Box 132, piece 10). The following day, Chief of the Bureau A.L. Case paid Halsted $10,000 in accordance with the first clause of the contract, while
retaining the difference to pay the outstanding debt at Hewes & Phillips (NARA, AY Box 132, pieces 18 and 22)

While the contract outlined the terms of sale between Halsted and the Navy Department, it also has some historical significance in regard to the vessel's name. This document is first to refer to the submersible as the Intelligent Whale. When and where the name originated is unknown. However, later documentation suggests the name did not come from Halsted but rather from the Navy or media who are known to have called it "Intelligent Elephant" and "Halsted's Folly" (NARA, AY, Box 132, piece 44: ANJ, 14 September 1872).

For reasons not specified, Halsted did not get the submersible to the Brooklyn Navy Yard by 1 January 1870. The delay may have been the result of several unpaid invoices, including one from Hewes & Phillips. On 2 May 1870, Halsted asked Secretary of the Navy Robeson to pay the machine shop $2,050, of which $50 was for transporting the Intelligent Whale to the Navy Yard (NARA, AY, Box 132, pieces 18, 23, and 46). Unfortunately it does indicate the exact date of the submersible's arrival. According to Hewes & Phillips, the submersible left the facility on 17 January 1870, and presumably it arrived at the yard shortly thereafter (NARA, AY, Box 132, piece 14). The first document to confirm the vessel's location at the Brooklyn Navy Yard is a letter dated 25 January 1872, but alludes to it having been there for quite some time (NARA, AY, Box 132, piece 26).

Although the career of the Intelligent Whale from January 1870 to January 1872 is not clear, one event involving Halsted's personal life during this time is well known. Unwittingly, two individuals, Mary Wilson and George Botts, would profoundly affect
the fate of the submersible. According to the New York Daily Tribune and the Newark Daily Advertiser, Wilson’s husband joined the Union army in 1861 and left her alone in Newark. Over the next several years, Wilson gained a reputation as a lady of ill repute, boarding with women who were known prostitutes. When her husband returned from the war, he discovered her living with George Botts and filed for divorce, which was readily granted. Botts, an unsavory character who had deserted his regiment during the war, peddled charcoal in Newark. Although illiterate, he gained a reputation as a shrewd entrepreneur and soon had a successful business. He also had a reputation for being an abusive drunk and quite possessive of Wilson. Wilson met Halsted in 1866, and she became smitten with his charm, charisma and wealth. Despite being married for 26 years and the father of six, Halsted began an affair with Wilson. He provided his mistress with clothing, luxurious gifts, and an apartment. All the while Botts pined for his lost love, and after several public threats towards Halsted, he finally acted on his words. On the morning of 2 July 1871, Botts broke into Wilson’s apartment in a desperate attempt to regain her affections. When he found the two in bed together he grew enraged, drew a pistol, and fatally shot Halsted. Botts fled the crime scene, but was quickly apprehended and taken into custody (New York Daily Tribune 3 July 1871; Newark Daily Advertiser 3 July 1871). Given Halsted’s intimate knowledge of Intelligent Whale and its operations, his loss dramatically lessened the chance of a successful demonstration of it for the U.S. Navy at Brooklyn.
INTELLIGENT WHALE AND THE U.S. NAVY

The untimely death of Halsted created two crucial questions concerning the pending sale of Intelligent Whale—who would perform the test for the navy and who would receive the final two payments. For several months following his death, no attempts were made to organize a trial at the Brooklyn Navy Yard. The entire Halsted family was in mourning and the navy did not pursue the issue of a test. Finally on 20 January 1872, George B. Halsted and Abel Halsted, Oliver’s brothers, visited the submersible and reported its condition to the Secretary of the Navy. In spite of the vessel being unused for nearly two years, it appeared from the outside to be in excellent condition. However, when they opened the hatch and climbed inside, they found most of the internal machinery rusted and in need of much attention. They proposed to the Secretary to return with a skilled mechanic and make the necessary repairs as soon as the weather was warmer (NARA, AY, Box 132, piece 26).

While George and Abel Halsted were planning to refurbish the submersible, the Royal Navy became intrigued with the Intelligent Whale. On 4 March 1872, Rear Admiral Edward A. Inglefield, the British naval attaché in Washington D.C., visited the Brooklyn Navy Yard specifically to view the submersible. He was unable to get authorization to inspect the vessel, but he waited until lunch when the Ordnance Dock was empty of workers and snuck down to where it was moored. In his report to the Admiralty, Inglefield wrote, “I made ample notes and a sketch on my return to the hotel but these would hardly convey the whole of the information I acquired. I therefore retain them for future service should it be desired” (PRO, Adm. Series 1/6236, File

By late May 1872, Abel Halsted wrote the Secretary of the Navy to inform him the submersible was “in perfect order and hereby reports herself, ready for duty” (NARA, AY, Box 132, piece 28). He also stated that Norris Halsted had succeeded in getting all papers concerning the vessel from Halsted’s records, including a copy of the navy contract. Abel inquired if it was possible that his brother, George, also be provided with these documents. The request is the first indication of a postmortem rift that had occurred in the Halsted family. Norris Halsted represented Oliver S. Halsted’s wife Martha A. and son Oliver M., while Abel and George Halsted pursued their own interests and intended to get the final two payments. By July the situation had deteriorated to a point where legal counsel had to be sought. Martha A. Halsted, heir to her late husband’s property, officially made Norris Halsted trustee of *Intelligent Whale* again (NARA, AY, Box 132, piece 30).

For reason not made clear, Secretary of the Navy Robeson favored the efforts of George and Abel Halsted to test the vessel. The trial was finally scheduled to take place on 18 September 1872; however, the actual test was delayed by two days. On 14 September an officer at the Navy Yard wrote of the upcoming event, which is the earliest detailed description of the vessel. The unknown author wrote:

> It is known at the yard as the “*Intelligent Elephant.*” It certainly does not derive the name from its size in comparison with the other vessels, it measuring about 30 feet [9.14 m] long and 9 feet [2.74 m] deep, though it
is bulky in appearance and is built of iron, with air and water-tight compartments for its regulation and control. At the bottom of the boat amidships, is a flat gate, the upper part and the ends being round and tapering. The water being kept from entering the vessel when it is open by compressed air. Out of this gate someone is expected to pass and place a torpedo under a vessel, an electric wire being attached and connected with a battery in the boat and thus fired. It is estimated that the air compartments will contain compressed air enough to last ten hours in use under the water. The water compartments are filled for sinking the boat by opening a valve, and can be ejected by pumps or forced out by the compressed air being let in, there being a connection between both compartments. The boat will hold thirteen persons and has been tried in the Passaic River with that number on board. Six men are sufficient for working it, its motive power being produced by part of them through the agency of a crank. Its speed would be about four knots an hour [7.41 km/hr], or according to the amount of labor used. The lookout is an iron cupola on top, somewhat larger than a man’s head. When underwater the boat is without other ventilation except the compressed air in her. When the air becomes foul it can let out by opening thumb valves. Nothing more definite can be learned until she is tested next Wednesday (NHC, 14 September 1872:69).

Norris Halsted’s efforts to stop George and Abel’s experimentation and eventual test continued throughout the week. On 16 September he wrote a letter to Robeson specifically stating that he had the deed of trust for the submersible and was the person who could legally represent the interests of Halsted’s estate. He further explained that Abel Halsted was completely ignorant when it came to operating the vessel and feared
he might do great harm to the boat (NARA, AY, Box 132, piece 32). Norris Halsted’s efforts were in vain and the demonstration proceeded as planned.

On 20 September a naval committee gathered on the Ordnance dock at the yard to witness the long overdue trial of Intelligent Whale. The officers present were: Vice Admiral Stephen C. Rowan [commandant Brooklyn Navy Yard], Commodore Edward T. Nichols, Captains William D. Whiting and Somerville Nicholson, Commanders Weld N. Allen and David B. Harmony, and Lieutenant Commander C.M. Schoomaker (Furgol 1994). Abel and a workman entered the submersible and prepared to demonstrate the vessel’s ability to remain safely underwater and navigate with ease. The test did not go as planned. “After sinking the boat it was found the opening on top was leaking through defective packing,” one witness exclaimed (ANJ, 21 September 1872:86). However, the pumping apparatus (manual and compressed air) worked well and the submersible was able to stay submerged for nearly four hours. Unfortunately the tide drove the iron craft under a derrick at about the time it was desired to resurface, and further efforts to expel the water inside soon depleted the compressed. The witnesses on the dock, fearing some serious mishap had taken place on board, organized a group of sailors to hoist the vessel out from under the derrick and bring it ashore.

When the hatch was open the naval officers discovered half the interior filled with water and a considerably frightened crew (ANJ, 21 September 1872:86; New York Daily Tribune 23 and 24 September 1872). Not having a successful trial, Intelligent Whale sat on the Ordnance Dock where it had been pulled from the water.

Over the next several months and eventually years, Norris Halsted wrote members of the Navy Department asking for a retrial. Interestingly, the letterhead
indicates the letters were written from the office of Colonel Edward Serrell, co-trustee once representing Tyng's claim to the vessel. While the title was eventually transferred to Oliver Halsted and the submersible's contract with the navy was brought forth by his efforts, Tyng and Serrell apparently retained some shares in the boat. Perhaps the once-conflicting parties put aside their differences to join forces in an attempt to persuade the navy to allow another test. While the content of Norris Halsted's letters primarily dealt with the legality of another test, some additional information about Intelligent Whale was revealed. In a letter dated 12 February 1874, he described the submersible's weapon as a "torpedo of twenty-five pounds of powder" to be placed under or against a ship. Furthermore, "certain improvements" were devised to attach a succession of 12 torpedoes to the outside hull, allowing the boat to remain submerged while another charge was put in place under a targeted vessel. Norris Halsted also claimed the submersible could stay submerged for 12 to 14 hours, by employing an "apparatus now belonging to the boat and frequently tested, which tows a object on the water about the size and shape of a wild duck, floating over it a little astern" (NARA, AY, Box 132, piece 42).

The Navy showed little interest in Intelligent Whale after the September 1872 test at the Brooklyn Navy Yard and concluded, "as a practical instrument of warfare it is utterly useless." One naval officer speaking in regard to the pilot's ability to control the vessel underwater, likened it to a "blindfolded man in a balloon trying to navigate" (NARA, AY, Box 132, piece 44). Perhaps one reason the Navy Department did not expend much energy towards the submersible was due to their interest in another weapon under development that same summer. In Schenectady, New York, John Lay
tested a self-propelled, remotely-controlled torpedo that impressed the Bureau of Ordnance (The American Neptune, Vol. 53, No. 1, 1993:7-10). Likewise in England, an inventor named Robert Whitehead was experimenting with his version of a surface supplied torpedo, which was adopted by most navies during the 1870's (van der Vat 1994:20-21). The attitude of the Navy Department towards Intelligent Whale was indifference, and can best be summarized by the closing sentence of a letter written on 3 March 1877, by the Bureau Chief of Ordnance who stated, “The boat not having been a successful, the Hon. Sec. of the Navy refused to pay any more money, since which time the whole matter has been abandoned” (NARA, AY, Box 132, piece 46).

INTELLIGENT WHALE ON DISPLAY

For several decades following the trial, Intelligent Whale lay abandoned on the Ordnance or “Cob Dock” at the Brooklyn Navy Yard (figure 24). Near the turn of the nineteenth century interest in the vessel was renewed and it was relocated in the yard to the southeast corner of Third Street and Perry Avenue (figure 25). A historian writing in 1908 stated, “…the Intelligent Whale has become a “lion” in the Brooklyn Navy Yard, where it is preserved as a relic for the delectation of sightseers” (Field 1908:121). Ten years later, noted submariner Simon Lake wrote that the submersible was exhibited on the “Green,” which presumably described the park-like atmosphere at the corner of Third and Perry (Lake 1918:135). Pictures at this location reveal that at some point while at this site the propeller basket was removed (figure 26). Also at this location a
Figure 24. Earliest known photograph of the *Intelligent Whale* on the “Cob Dock” at the Brooklyn Navy Yard circa 1872. Note the propeller basket at the stern and the snorkel pipe rising from the top of the hull (from Middleton 1976:28).

Figure 25. *Intelligent Whale* at the Brooklyn Navy Yard on the corner of Third Street and Perry Avenue. Photograph taken during the early 1900’s. (from Lake 1919:153).
Figure 26. A picture of an intelligent whale without the propeller basket (from Barnes 1944:13).
plaque was mounted on the side of the hull indicating the vessel's date of construction, builder and a list of persons associated with the vessel. At some point prior to 1966, the plaque was removed and replaced with a more detailed one (NHC, Smith letter, 22 August 1966). Currently, there are no plaques on the vessel and it is not known what became of the original or its replacement. During the 1940's Intelligent Whale was again relocated within the yard, this time placed near Building 121, the Disbursing Office (figure 27) (DON, unknown author, "A Short History of the New York Navy Yard," 23 February 1941). In 1965 after the closing of the navy yard was announced, an effort was undertaken to relocate many of the historical materials in its possession. A new location was sought for Intelligent Whale, where it could be predominately displayed as "part of our nation's rich naval and maritime heritage" (NHC, letter to Thomas Armitage, 12 February 1965).

In the end Intelligent Whale was transported to the Washington Navy Yard in Washington, D.C., and displayed in the parking lot of the Naval Historical Center's museum (figure 28). It remained an outside attraction for several years but was eventually moved into Building Annex 21, and incorporated into a larger exhibit of submarine technology and paraphernalia. The display of the vessel changed dramatically, as it was placed on a 5-½ foot [1.68 m] tall steel platform. One of the bottom hatch covers was raised allowing museum patrons to view the interior of the vessel from below. At this time several pieces of angle iron were tack welded across the hatch to prevent the public from climbing into the submersible. As the museum's
Figure 27. A picture of *Intelligent Whale* in front of the Disbursing Office at the Brooklyn Navy Yard circa 1940 (from Polmar 1983:6-7).

Figure 28. *Intelligent Whale* at the Washington Navy Yard in the late 1960's or early 1970's (from Compton-Hall 1984:42-43).
collection grew, the building was needed for another exhibit and again a new location needed to be found.

In April 1999 *Intelligent Whale* traveled up the eastern seaboard on a flatbed truck, returning to New Jersey after a 128-year absence. The journey had its difficulties, as two different attempts were made before the 39,000-pound (14,556.36 kg) vessel was place onto the truck. Its final destination was the National Guard Militia Museum of New Jersey in Sea Girt, where it is currently on display (figure 29).

Figure 29. *Intelligent Whale* being lifted by crane in Sea Girt, New Jersey, in 1999 (from *Asbury Park Press*, 1 May 1999).
CHAPTER V

CONSTRUCTION OF INTELLIGENT WHALE

DOCUMENTATION OF THE SUBMERSIBLE

Documentation of the Intelligent Whale occurred on three separate occasions. In February 1996, a preliminary investigation of the vessel was conducted at the Washington Navy Yard’s Navy Museum in Washington, D.C. The purpose of this visit was to become acquainted with the museum’s staff and videotape the interior of the submersible. This was done by Brett Phaneuf, Richard Wills, and the author—all graduate students of Texas A&M University’s Nautical Archaeology Graduate Program. In June of the same year, I returned to the navy yard to record the hull, focusing primarily on the vessel’s internal features. In 1998 Alan Flanigan, another Nautical Archaeology student, joined me at the Washington Navy Yard and assisted in the photographic recording of the submersible. In March 2002 I traveled to the National Guard Militia Museum of New Jersey in Sea Girt to take final measurements of the vessel’s exterior.

The documentation of the submersible focused on gathering information to assess its hull characteristics, hull construction, and individual system configurations. Direct measurements and offsets were used to record the vessel’s features and determine its principal dimensions. All measurements were recorded in Standard...
English inches and feet—the same unit of measurement used during the construction of the submersible. In addition to directly recording the hull, an extensive photographic record was compiled on all three occasions.

The physical condition of the Intelligent Whale is excellent. During the time it was displayed at the Brooklyn Navy Yard and the Washington Navy Yard, several coats of paint were generously applied to the hull’s interior and exterior. This helped preserve the submersible by protecting the metal from corrosive elements when the vessel was exhibited outside. While the hull and its components are in near perfect condition, there are unfortunately some missing items. Among the missing items are the propeller basket, the rudder, the windlass’s covers, and a ballast tank cover. However, the missing items did not greatly affect the documentation or analysis of the vessel.

The only obstacle to present a problem during the recording process was the display stand upon which the submersible rests—a 5 ½-foot (1.68 m) tall box comprised of steel-girders. The sides of the stand were open but access to portions of the bottom midsection of the hull was somewhat limited. Furthermore, the resulting height to the top of the vessel was approximately 13 feet (3.96 m), so recording this area proved difficult. A ladder had to be used to document the sides and top of the submersible.
HULL CHARACTERISTICS

Principal Dimensions

The hull measures 29 feet ¼-inch (8.92 m) in length from the forwardmost tip of the nose cone ring to the after face of the propeller shaft. The vessel was originally designed with a propeller basket to protect the prop, but this has long since been removed (figure 30). An examination of early photographs indicates the basket would have increased the overall length of the vessel by an estimated 3 to 6 inches (7.62 to 15.24 cm). The maximum breadth of the vessel at midships is 7 feet 3 inches (2.21 m). The depth of the vessel was more difficult to obtain and required several internal and external measurements to be calculated. From the bottom of the keel to the outside surface of the hull plating at midships is 6 feet 11 ¼ inches (2.13 m). However, this measurement does not include the conning tower just forward of midships, which brings the total depth of the vessel to 7 feet, 10 ¼ inches (2.40 m).

Hull Shape

There is no record of a lines drawing for the Intelligent Whale, but based on measurements recorded directly from the hull one has been reproduced (figure 31). It appears Scovel S. Merriam based the design of the hull to be 28 feet (8.53 m) long, 7 feet (2.13 m) deep and 7 feet wide, giving the submersible a length to beam ratio of 4:1.
Figure 30. Two photographs comparing *Intelligent Waialani*'s stern with and without the propeller basket (after Lake 1918:152; Compton-Hall 1984:42).
Figure 31. Lines of *Intelligent Whale* based upon documentation gathered during the 2002 recording (author).
The actual recorded length is a foot (30.48 cm) longer, the difference being the length of the ring at the bow and the shaft that extends past the propeller at the stern. To generate the shape of the hull, Marriam first drew a line representing the boat's 28-foot length. A second line, centered perpendicularly to the first, was drawn to indicate the boat's midship section. On both sides of this line, points were placed whose distance to the intersection equaled half the vessel's depth. An arc was drawn connecting the two ends that passed through the point at midships. The resulting "cord," or segment of a larger circle, is the general shape of the Intelligent Whale. This process was done for both the top and bottom halves. Unlike the top, the bottom of the hull near midships was squared off at the bilge to provide more room for the crew and a flat surface for the bottom hatches to be placed. Each half of the submersible, fore and aft of the midship frame, is symmetrical in terms of hull shape. Both sides have four sections, represented by the location of three frames. The distance from the center of each frame to the midship frame is nearly identical on both sides, but spacing of the frames is not distributed equally throughout the total length of the hull.

**Hull Weight**

According to navy records Intelligent Whale weighs 39,000 pounds (14,556.36 kg). This figure was obtained when it was moved from the Washington Navy Yard to the National Guard Militia Museum of New Jersey (Judith McCabe, personal communication 2001). Its weight took many people by surprise since previous calculations estimated its weight to be between 10,000 and 15,000 pounds (3,732.4 and
5,598.6 kg). One problem in determining the weight of the vessel was the uncertainty of the material used for its hull plating. During the 1860’s, iron manufacturers primarily produced two types of metal plating—hard rolled cast iron and hard rolled wrought iron. The weight of each type differs; a 1-inch (2.54 cm) thick square foot of cast iron weighs 37.54 pounds (14.01 kg), whereas wrought iron of the same dimension weighs 40.28 pounds (15.03 kg) (Desmond 1919:213). Manufacturers typically used wrought iron for most boiler work and armor plating, as it tended to be less brittle than cast iron and could be hammered and shaped when reheated (Pool 1982:191, Gordon 1996:18). This would lead one to think the plating was wrought iron. However, two manufacturer’s marks discovered while recording the interior suggested portions of the hull could be mild steel, which is denser and heavier than wrought iron, weighing 48 pounds (17.92 kg) for the previous dimension given (Reed 1869:389). This may explain some of the vessel’s additional weight and the difficulty in moving it.

In addition to the 39,000 pounds, the submersible is missing items that would have increased the weight. The heaviest items, two ball anchors, weighed approximately 350 pounds (130.63 kg) each. Other items, such as the windlass covers, prop basket, rudder, anchor line and a variety of miscellaneous equipment, would further add to the total figure. Including these items, the weight of *Intelligent Whale* was probably closer to 40,000 pounds (14,929.6 kg).
HULL CONSTRUCTION

*Intelligent Whale*'s hull construction is addressed in the following categories: materials used in its construction, the keel and skids, the internal frames and stringers, the hull plating and fasteners, the conning tower, the ports, the upper and lower hatches, and end cone pieces. The descriptions of these categories are supplemented with external, internal, and section drawings of the vessel (figures 32, 33, and 34). The drawings were generated from measurements taken directly from the vessel, which in most cases was measured to the nearest 1/8-inch. In the event an item was missing, dashed lines on the construction drawings represent its location in the hull.

*Materials*

The type of metal used to construct *Intelligent Whale* was primarily iron—wrought iron, cast iron and mild steel. Several of the vessel’s components such as the windlasses, hatches, end pieces, anchors, pumps, gearing and prop are made from cast iron. Two large rectangular weights located in the aft ballast tank are pig iron, which is a type of cast iron. As indicated by the vessel’s overall weight, the plating may be mild steel; however, this has not been confirmed. The frames and stringers are stamped with mark indicating they may be steel. The historical record indicates other metals are used throughout the vessel. Some of the valves and pipes are copper or brass.

Unfortunately, a thick layer of paint covers the exterior surfaces of these items and positive identification of the metal was not determined. However, these items are non-
32. External construction views of *Intelligent Whale*, depicting the starboard profile, topside, and bottom (drawing by [Name])
Figure 33. Internal construction views of *Intelligent Whale*, depicting the top and the bottom half from the sheer (drawing by author).
Port and starboard sections views of *Intelligent Whale*, depicting the centerline profile (looking towards the port side) and sheer (drawing by author).
Figure 34. Transverse section views
Figure: Cross section views at the location of the frames (drawing by author).
magnetic, so it can be assumed they are not iron. Glass was also used in the vessel to
cover the eight ports and four conning ports. The lenses are no longer present but some
glass shards were discovered in the gasket material around the ports. Organic material
found on the vessel was rubber and wood, although limited in amounts.

Keel and Skids

Located at the bottom of the hull is a keel, and to each side near the bilge are
two skids. These features are not individual components, but are apart of a large
rectangular bottom plate made of cast iron. The keel is in line with the central
longitudinal axis of the vessel and does not run the length of the hull, but terminates 4
feet 6 inches (1.37 m) on either side of midships. Its total length is 9 feet (2.74 m), with
the ends tapering into the rise of the bow and stern giving it a rockered appearance. The
sided dimension throughout its length is 12 inches (30.48 cm), while the maximum
molded dimension at midships is 4 inches (10.16 cm). The middle 3 feet (.91 m) of the
keel was in contact with the ground when the boat is out of the water and helped
support the vessel’s weight.

No definitive information can be stated about the top surface of the keel. As
mentioned, the bottom plate appears to be a single piece, the top being the floor inside
the hull. With the exception of the bottom hatches and raised sides it is a relatively flat
surface. The are no fasteners located above the location of the keel, further suggesting
it is a single piece. A post does rise from the deck directly above the keel that holds one
end of the crank assembly and at one time had a seat attached to it for the pilot. Since
the weight of the pilot and the motion of the crank required a firm mounting on the
cabin floor, the post is likely to be seated well into the bottom plate and perhaps even
into the keel.

Parallel with the keel and located 29 ½ inches (74.93 cm) from either side of the
keel are two "skids." While they may provide some longitudinal support to the hull,
their primary purpose is to balance the vessel on an even keel when it is out of the
water. Like the keel that appears rocker, the ends of the skids fore and aft taper into
the bottom plate. The skids are 8 feet (2.44 m) in length and terminate 4 feet (1.22 m)
on either side of midships. In profile, the skids' molded dimensions are 4 inches (10.16
cm) as is their maximum sided dimensions at midships. The outboard surface of the
skid is set in from the side of the hull by approximately 2 ½ inches (6.35 cm) and
follows the longitudinal curvature of the hull. However, the inboard face remains
straight throughout the length of the skid.

Frames and Stringers

The plating is fastened to an internal framework of frames and stringers running
throughout the hull (figure 35). Seven frames are oriented perpendicularly to the keel
but are not evenly spaced over the vessel's length. Three are forward of the midship
frame and three are aft. As previously mentioned, the fore and aft halves of the hull are
almost identical, with the frames having an equal distance to midships. Their center to
center distances are (from the closest frame to midships to the furthest) 36 ½, 83 ½, and
118 inches (92.71, 212.09, 299.72 cm). Past the third frame, the ends of the hull are
Figure 35. A picture taken inside the hull facing the stern to illustrate the orientation of the frames and stringers (photo by author).
fitted with cast iron cone pieces approximately 20 inches (50.8 cm) beyond the third frames. There are two types of frames used in the hull. The midship frame and the frames immediately fore and aft are "T" shaped in appearance, with the flat surface facing outboard. These have a 4 ¼-inch (10.79 cm) sided dimension and a 2-inch (5.08 cm) molded dimension (figure 36). The remaining four frames are flat steel bands that measure 4 inches (10.16 cm) by ¾-inch (1.91 cm). It is most likely that the "T" shaped frames are located at the center of the hull for reinforcement since it is the widest point of the vessel and the location of three hatches. On the second frame in the aft section is one of the manufacturer marks stamped into the metal that reads, "W. P. & Co. [crown] BES." Research of possible foundries in the New England area has concluded that the only business with these initials is that of the West Point Foundry in West Point, New York. The "BES" most likely identifies the process used to manufacture the metal, which was Henry Bessemer's patented method of making steel (Gordon 1996:222-223).

There are nine steel bands running from the bow to the stern, which are similar to longitudinal stringers in a traditionally built ship. The "stringers" are not continuous runs and are not from a single strip of metal, but overlap one another between the frames. They measure 4 inches (10.16 cm) wide by ½-inch (1.27 cm) thick and overlap the frames (figure 37). Between the midship frame and the two immediately fore and aft, there are two stringers located on each side of the hull. The two pairs of stringers are adjacent to one another, again illustrating that the fore and aft halves of the hull are identical. Further proof of the vessel's symmetry is located at the bow and stern. In the stern, the stringers do not continue past the third frame to provide room for the dive plane stuffing boxes. At the bow, where there are no dive planes, the straps also stop
Figure 36. A photograph of the "T"-shaped midship frame (photo by author).

Figure 37. Detail of a stringer overlapping a frame (photo by author).
(figure 38). One stringer, located on the port side past the third frame aft, again has the
maker’s mark stamped into the metal. In addition to this stamp, several of the frames
are labeled with Roman numerals (figure 39). While the thick layer of paint has
prevented all of the numbers from being readable, the numeric pattern seems to indicate
the placement of the frames in the hull.

_Hull Plating and Fasteners_

A total of 46 plates make up the “skin” of the hull (figure 40). As previously
mentioned, the weight of the vessel may suggest that these are also made of mild steel.
The plates are ½-inch (1.27 cm) thick throughout the entire vessel and are riveted to the
frames and stringers. However, the plates at the top of the hull also have a random rivet
pattern at their centers that is not associated with the vessel’s framework (figure 41).
This suggest that two ¼-inch (.63 cm) plates were used. There are seams on the vessel,
though they are difficult to see. It appears that efforts were taken to create a smooth
exterior surface. The edges of the plates are flush against one another and the seams are
welded. There are no random marks on the exterior surface of the plates indicating that
they were shaped on the hull. It is more likely they were pre-shaped or cast to fit the
vessel’s curvature.

A survey of the interior rivet heads shows that over 3,000 fasteners were used to
attach the plates to the frames and stringers. Most of the rivet heads are round, 1-inch
(2.54 cm) in diameter and are spaced 1-inch (2.54 cm) apart. However, there are
approximately a dozen larger round heads, 1 ½ inches (3.81 cm) in diameter and about
Figure 38. Detail of the stringer in the stern (right) and in the bow (left), illustrating the symmetry of the vessel’s fore and aft sections (photo by author).

Figure 39. Detail of the Roman numerals inscribed on stringers. This particular stringer reads “XXXX V III” (photo by author).
Figure 40. A simplified diagram of the top, bottom, and starboard side showing the hull plating arrangement (drawings by author).
Figure 41. Detail of the random rivet pattern on the top hull plates (photo by author).
an equal number that are 1 1/2-inch (3.81 cm) squares. On the exterior surface of the hull, the rivets are hammered completely flat, having an average diameter of 1 1/2 inches (3.81 cm). Since the ends are hammered flat, the overall length and diameter before use can only be speculated. The majority of the rivets pass through the 1/2-inch (1.27 cm) thick plating as well as the 1/2-inch thick strap. It can therefore be assumed these are at least 2 inches (5.08 cm) long. In some cases they pass through the plating as well as the frames and stringers. These are most likely 3 inches (7.62 cm) in length. The longest rivets on the vessel were those used to attach the plates to the cast iron cone ends and are at least 5 inches (12.7 cm) in length.

*Conning Tower*

The conning tower is centrally located between the midship frame and the first frame forward and is directly above the location where the pilot sat (figure 42). It is cast as a single piece of metal and is fitted through a hole cut into the top of the hull. Viewed from the outside, it is a round-shaped dome with a flat top, which dips slightly towards the bow as it follows the curvature of the hull. It measures 22 inches (55.88 cm) in diameter by 11 3/4 inches (29.85 cm) in height. This measurement includes a square 1-inch (2.54 cm) nut located at the center of the 14-inch (35.56 cm) diameter flat top. There is a collar at the base of the dome on the inside, which is riveted to the hull and holds the conning tower in place. The interior diameter of the dome is 1 foot, 2 inches (35.56 cm) wide by 1 foot (30.48 cm) tall. There are four ports or "sights" located in the tower (figure 43). Three of these are identified with numbers: the one
Figure 42. Exterior (left) and interior (right) photographs of the conning tower (photo by author).

Figure 43. Detail of the conning tower port (photo by author).
facing the stern (I), the one facing port (II), and the one facing the bow (III). There was no number found for the sight position towards starboard. A round 4 1/2-inch (11.43 cm) diameter, 3/4-inch (.64 cm) thick glass lens covered each port and was held in place by a round metal frame hinged so it could be opened. The sights viewed from the outside are small keyholes in the conning tower, measuring 1/2-inch (.64 cm) tall by 1/2-inch (1.27 cm) wide.

Ports

In addition to the four sights in the conning tower, the *Intelligent Whale* has eight ports for the crew to see out of the submersible as well as illuminate the interior. There are two different types of ports, two pairs of each kind on both sides of the hull. The first type projects out from the side of the hull and allowed the crew to view objects in front of and behind the submersible (figure 44). They are positioned immediately before and after the first frames, just below the upper stringers. The external dimensions for this type of port are 14 1/2 inches (36.83 cm) long, 9 1/2 inches (24.13 cm) wide and 4 1/4 inches (11.43 cm) tall. In front of the opening there are three iron bars to protect the 4 inch (10.16 cm) lens. This same port viewed from the inside reveals that it is a single piece of cast metal, which is riveted to the side of the hull. The interior dimensions are 18 inches (45.72 cm) long, 13 inches (33.02 cm) wide and 4 1/2 inches (11.43 cm) deep.

The other type of port is round, sits flush against the hull and is meant to view objects to the side of the submersible (figure 45). These ports are located in the frame
Figure 44. Exterior (left) and interior (right) photographs of the larger port. This specific type of port allowed the crew to see objects behind and in front of the submersible (photo by author).

Figure 45. Exterior (left) and interior (right) photographs of the smaller port. It is mounted flush on the hull and allowed the crew to see objects to the sides of the submersible (photo by author).
bays between the midship frame and the first frames. Viewed from the outside, this type of port appears to be a 4-inch (10.16 cm) hole in the side of the vessel protected by three parallel bars welded to the hull. Viewed from the inside, the port is revealed as being a cast iron ring riveted to the hull. The 4-inch (10.16 cm) lens sat in a brass ring and would have been held in place by a cover, which was hinged at the bottom and could be tightened down with a thumb screw at the top. While the rubber gasket material use to seal the ports remains, none of the lenses or covers have survived for any of the eight ports.

_Hatchways_

Located behind the conning tower, between the midship frame and the first frame aft, is the upper hatch. This served as the crew's entry into the submersible (figure 46). Currently the hatch cover is not attached to the vessel, but it was once fastened to the aft side of the hatchway. The dimension of the opening into the hull is 29 inches (73.66 cm) by 20 inches (50.8 cm). Around the perimeter of this opening is a ledge for the hatch cover to sit upon, which was probably sealed with a rubber gasket.

The dimensions of the hatch cover are such that when closed, it would have sat flush with the exterior surface of the hull. The cover is convex in shape and is made from a ½-inch (1.27 cm) thick plate of metal (figure 47). Located at the center of the cover is a 1 ¼-inch (3.18 cm) wide hole, which may have served as an attachment point for the locking mechanism. On the inside of the cover are several slots that once held
Figure 46. Exterior view of the upper hatch facing the stern (photo by author).

Figure 47. Detail of the outboard (left) and inboard (right) surfaces of the upper hatch (photo by author).
clamps for the lock, as indicated in a historical document (NARA, AY Box 132, pieces 6).

Centered at the bottom of the hull at midships are two larger, side-by-side hatchways that would have been used by a diver exiting the submerged vessel (figure 48). They are centrally located at midships and are 42 inches (106.68 cm) long by 31 inches (78.74 cm) wide. The hatch covers are attached to the deck by two hinges located on the outboard sides of the hatchways. Each cover is a 2-inch (5.08 cm) thick piece of cast iron that fits securely on an inset ledge around the perimeter of the hatchway. When the covers are open, they are held in place by dog clips mounted half way up the midship frame (figure 49). When closed, the covers are held in place by four locks that swivel over the door (figure 50).

Bow and Stern Cones

At the bow of the submersible is a cast iron cone that measures (not including the ring) 2 feet 5 inches (73.66 cm) in diameter at the base and is 2 feet 4 inches (71.12 cm) long (figure 51). It is not solid, but has much of the center hollowed out and has a 2-inch (5.08 cm) hole bored through its middle. The sides of the cone are 2 inches (5.08 cm) thick. There is a 6 ½-inch (16.51 cm) overlap of the hull plating around the base of the cone, and in this space, two rows of rivets attach it to the hull. A 29-inch (73.66 cm) I-bolt, which includes a 6 ½-inch (16.51 cm) diameter ring at the end and a 2-inch (5.08 cm) shank, passes through the center of the cone. It is securely held in place with a large hexagonal nut.
Figure 48. A photograph of the lower hatches and main deck area (photo by author).

Figure 49. Detail of a dog clip on the midship frame to hold bottom hatch up (photo by author).
Figure 50. Detail of a lock that swivels over the bottom hatch (photo by author).

Figure 51. External (left) and internal (right) photographs of the *Intelligent Whale*’s bow (photo by author).
The dimensions and appearance of the cone located at the stern is almost identical to the one at the bow; however, it is modified to accommodate the drive shaft passing through its center (figure 52). While most of the inside of the cone is also hollowed out, there are three arms that meet at the center to support a 1 ½-inch (3.81 cm) thick collar through which the 2-inch shaft is bored. A stuffing box is mounted in front the collar to prevent water from entering the hull from the hole with the drive shaft. Unlike the cone at the bow that has nothing attached to its exterior surface, this cone has six bolts holding the remains of the propeller basket (figure 53).

**External Rigging Attachments**

In addition to the ring at the end of the bow nose cone there is one other rigging attachment mounted on the hull. A rigging eye is fastened on the plating at the top of the vessel between the second and third frames aft (figure 54). It is cast from a single piece of metal, which is 1-foot (30.48 cm) long and has a 3-inch (7.62 cm) eye at its center. The attachment points, which are 8 inches (20.32 cm) apart at the ends, are riveted to the hull by four large round rivets with heads located inside the hull that measure 1 ½ inches (3.81 cm) in diameter. The rigging eye was most likely used for mooring purposes and was not intended as a lifting point, as the rivets would not been able to support the weight of the vessel. Interestingly, there are four identical large rivet heads located inside the hull located between the second and third frames forward. This suggests that at one time the submersible had another rigging eye. An examination of early photographs has failed to confirm its existence.
Figure 52. Exterior (left) and interior (right) photographs of the stern (photo by author).

Figure 53. Detail of the remaining propeller basket straps and fastenings (photo by author).
Figure 54. Detail of the aft rigging eye (photo by author).
SYSTEMS CONFIGURATIONS

The remaining components of the *Intelligent Whale* are items that are associated with different systems in the hull and are best described by the function they serve within each system. These systems are categorized as: the buoyancy control system, the air replenishing system, the propulsion system, the steering control system, the depth control system, the anchoring system, and the weapons system.

The Buoyancy Control System

In order for a submersible to be effective it has to have a way of changing its buoyancy between positive, negative and neutral states. This can be done by adding or removing fixed weight, such as pig iron, or by emitting and expelling fluid weight, such as water. The latter method requires a submersible to have a system that allows water into the hull, or more appropriately, into a ballast tank. Likewise, it must have a way of evacuating the water, either by pumps, compressed air, or a combination of both. The *Intelligent Whale* used fluid weight to regulate its buoyancy and the components of that system will be discussed in terms of how the water entered the submersible and how it left.

There are two ballast tanks in the submersible, both starting 45 ¾ inches (116.84 cm) forward and abait of midships. The height of the tank located in the bow is 33 inches (83.82 cm) from the deck; whereas the one in the stern is seven inches (17.78 cm) shorter. The after tank was lowered to fit the propulsion system, which needed
room for the gearing and drive shaft. Otherwise the two tanks are identical in terms of their construction. Both are made of ½-inch (1.27 cm) thick rolled iron and have access hatches mounted on their vertical faces (figure 55). The estimated volumes of the bow and stern tanks are 82.13 and 61.75 cubic feet (2.33 and 1.75 cubic meters), or 657.04 and 494.0 gallons (2,487.16 and 1,869.99 liters), respectively. Each cubic foot of salt water weighs 64 pounds (23.89 kg); therefore, the submersible could carried roughly 9,208.32 pounds (3,436.91 kg) of fluid ballast. To compensate for the smaller size of the stern ballast tank, cast iron bars weighing approximately 100 pounds (37.32 kg) each were laid inside. This, and the extra machinery mounted on the top of the tank, more or less balanced the ends of the submersible.

Both tanks have a post protruding through a round stuffing box near their vertical faces, upon which a turn wheel was likely mounted (figure 56). Turning the wheel opened and closed a drain at the bottom of the tank, permitting water to flow inside. Viewed from the exterior, the drain cover at the bottom of the hull is a round ¾-inch (22.23 cm) wide disk with a perforated center (figure 57). The ballast tanks are completely sealed and trapped air had to pass through a fixture mounted at the top of the tank near the edge of the hull (figure 58). One interesting feature in regard to this fixture is that it has a pressure or water gauge to determine the water level in the tank. Unfortunately, the “glass” has been painted and it is impossible to tell what it would have indicated. To properly function, this gauge must have included a valve capable of being closed so water did not flow back into the tank.

How much water was needed in the ballast tanks to make the vessel submerge is speculative. Based on the calculated volume of the submersible, which is 660.92 cubic
Figure 55. Detail of the aft ballast tank cover (photo by author).
Figure 56. Detail of the forward ballast tank drain assembly. The circular object on the is used to open and close the drain at the bottom of the hull (photo by author).
Figure 57. Exterior photograph of the forward ballast tank drain cover (photo by author).
Figure 58. Detail of a fixture (gauge) on the forward ballast tank. (photo by author).
feet (18.72 cubic meters), it had to displace 42,298.88 pounds (15,787.63 kg) of water in order to sink. The weight of the vessel is estimated to be 40,000 pounds (14,929.6 kg); therefore, approximately 2,300 pounds (858.46 kg), or 276.11 gallons (1,043.7 liters) were needed to submerge.

Each ballast tank operated independently, as there is no pipe connecting the two for equalizing the water level. Fine tuning the submersible’s trim, or the angle of the its longitudinal axis, was done by releasing compressed air into the ballast tank to expel small amounts of water until the boat was on even keel. This was done by the use of two compressed air tanks mounted on each ballast tank (figure 59). They are constructed out of 5/16-inch (.79 cm) thick metal (not iron –probably copper) with slightly rounded ends. Both are 13 inches (33.02 cm) in diameter; however, forward air tank is 5 feet 2 inches (1.62 m) long whereas the aft air tank is only 4 feet (1.21 m). On the top of each is a ½-inch (1.27 cm) threaded hole, which may have been the location of a pressure gauge. Each is fitted with two valves at the end of the tank facing amidships. One of these valves is connected to a pipe leading directly into the ballast tank, which stops after 5 inches (12.7 cm). The other valve has an open end and may have been used to pressurize the atmosphere of the hull –needed if the bottom hatches were to be opened. The end of the valve is threaded, suggesting it may have once been connected to another fixture in the hull or possibly to an air hose for a diver.

Removing water from the ballast tanks was accomplished by two different methods. Compressed air in the storage tanks could expel water through the drain at the bottom of the tank. The other method employed four large air pumps located on the ballast tanks near the sides of the hull (figure 60). This system relied on surface-
Figure 59. Detail of the forward compressed air tank (photo by author).
Figure 60. One of four large air pumps used to empty the ballast tanks (photo by author).
supplied air through a snorkel that consisted of either a pipe or a float. Historical records indicate the submersible was connected by a long hose to a floating snorkel that was the size and shape of a wild duck (NARA, AY, Box 132, piece 42). The earliest photograph of the *Intelligent Whale* depicts a pipe extending above the hull that resembles a snorkel with a self-sealing valve at the top (figure 61). While it cannot be confirmed if the pipe shown in the picture is mounted on top of the submersible or is actually part of something behind the vessel is unclear. Its location, however, is in the general proximity of a 2-inch (5.08 cm) hole at the top of the hull where a snorkel would have been attached. Directly beneath the hole inside the submersible is a fitting that consists of two pipes with open ends joined together at right angles (figure 62). The forward section of the hull has an identical fitting with a hole above it as well. The lower portion of the fitting has two identical openings that were probably connected to the pumps. In order for the system to work properly, the remaining openings (the ones on top) needed to be plugged with stoppers. The pumps operated on a locomotive type principal each having a 40-inch (1.01m) piston arm that is connected to the adjacent pump (figure 63). The two arms meet at the midship frame and immediately above them is a 2-inch (5.08 cm) long bolt that served as central axis for a wheel or pump handle. By manipulating the wheel or handle, the piston arms moved a head gasket back and forth in a piston chamber, drawing air in for one pump while compressing it for the other. The air passed through a valve and into the ballast tank, increasing the pressure and forcing the water out through the drain. Unlike the compressed air tanks, this method expelled the water in both ballast tanks simultaneously. However, the valve is a gate valve and is capable of being lowered to close the opening into the
Figure 61. The earliest known photograph of the \textit{Intelligent Whale} taken during the 1870's. A snorkel pipe may possibly be mounted on its top surface (from Middleton 1976:28).

Figure 62. Detail of a fixture mounted on the upper hull that is a part of the snorkel assembly (photo by author).
Figure 63. Detail of the pump arms that join at midships. Directly above is a post where a wheel or handle was mounted for pumping (photo by author).
ballast tank. By doing this, the air is forced through another opening on the side of the valve. This opening is threaded, which suggests it was connected to another fixture in the hull. There is a strong chance it was this was the method used to replenish the compressed air tank.

The Air Replenishing System

According to a Navy document written in 1872, the only means of providing air for the crew was by releasing it from the compressed air tanks. Apparently, this system would sustain the crew for several hours and if the air became "foul," thumb valves were turned to release it from the hull (ANJ, 14 September 1872:69). The thumb valves the officer spoke of are located at the top of the hull just behind the hatchway (figure 64). The valves are round and stand out from the bottom surface of the hull plating by approximately 2 inches (5.08 cm). Viewed from the outside, they are small indentations one 1-inch (2.54 cm) in diameter. They do not rotate but they are threaded, again suggesting an attachment that did rotate. This is most likely not the extent of the air purification system. When Halsted signed the contract with the Navy for the sale of the submersible, one of the stipulations was that he reveal all secrets, specifically concerning the air purification system (NARA, AY, Box 132, piece 10). This leads one to believe that the system included items presently not on the vessel. What these were and how they worked may never be discovered. While this remains a mystery, a statement made by Norris Halsted in a letter to the Navy dated 1874 claims the submersible was equipped with a snorkel float and allowed the crew to remain
Figure 64. Detail of the two thumb valves mounted on the upper hull behind the hatchway (photo by author).
submerged 12 to 14 hours (NARA, AY, Box 132, piece 42). This system has already been discussed, and if applied correctly, may very well have lived up to its claim.

*The Propulsion System*

The propulsion system on *Intelligent Whale* used human power to rotate a stern mounted screw propeller and was capable of moving at a rate of 4 knots (7.41 km/hr) (ANJ, 14 September 1872:69). This was achieved by turning a crank mechanism located in the main deck or central cabin of the submersible (figure 65). A 31-inch (78.74 cm) post, rising from the deck 58 inches (1.47 m) forward of the stern ballast tank’s vertical face, supports the forward end of the crank. There is approximately 3 feet (91 m) on either side of the crank, providing enough room for four crewmen to work in pairs on each of the two crank handles; however, the system could function with as few as two men. The crank itself consists of a 1½-inch (3.81 cm) thick bar bent in six right angles, producing the two 23-inch wide handles. At each handle a 2-inch (5.08 cm) diameter pipe fitted over the crank and prevented the friction of turning from wearing at the crewman’s hands. The aft end of the crank rests on a fixture mounted slightly to the port side of the vessel’s centerline (figure 66). Here it is attached to a round crankshaft that is 2 inches (5.08 cm) in diameter and 4 feet 3 inches (1.29 m) long. The shaft is connected to a large, 11 ½-inch (29.21 cm) diameter vertical spur gear, the first of two in a reduction gear (figure 67). The smaller spur gear is 6 inches (15.24 cm) in diameter and the ratio between the two is 1 to 4—for every rotation of the larger wheel, the smaller one rotates four times. The gears are mounted on two “A”
Figure 65. Detail of the crank assembly (photo by author).
Figure 66. Detail of the pillow block that supports the crank shaft at the top of the stern ballast tank (photo by author).
Figure 67. Detail of the reduction gear from the crank shaft to the drive shaft (photo by author).
shaped frames. The smaller spur gear is connected to the main drive shaft that rotates the propeller. As mentioned earlier, it is a 2-inch (5.08 cm) shaft passing through the middle of the stern cone piece and is sealed with a stuffing box. The total length of the propeller shaft is 4 feet 4 inches (1.32 m) long. The exterior portion of the shaft beyond the cone has the propeller, boss nut and an end piece mounted on it (figure 68). The propeller is three bladed, with each blade inclined at a 45-degree angle. Each blade is 19 inches (48.26 cm) long and varies in width from 7 inches (17.78 cm) at its base to 23 inches (58.42 cm) at its widest point. At the extreme end of the shaft is a 2 1/2-inch (6.35 cm) long projection, which may once have supported a central ring at the after end of the propeller basket.

The Steering Control System

The steering control system, which turned the submersible’s rudder back and forth, was achieved by cables and fixed blocks. In front of the pilot was a wheel, no longer present in the hull. However, the 3-inch (7.62 cm) post that supported the wheel is mounted on the edge of the forward ballast tank. Rotating the wheel moved cables that led to the rudder assembly at the stern. The lines passed through two blocks on each side of the vessel; mounted horizontally near the forward ballast tank and just abaft the third frame aft (figure 69). The cables were attached to a short tiller, once mounted on the head of the rudder stock which is squared off at the top. A rudder stock stuffing box, which prevented water from flowing into the cabin, fit over the stock and was held
Figure 68. Exterior view of the drive shaft assembly, which includes the propeller and boss hub (photo by author).
Figure 69. Detail of the fixed blocks used in the rudder assembly. The block on the left is mounted next to the forward ballast tank, while the one on the right is mounted near the dive plane stuffing box (photo by author).
in place by two bolts to either side (figure 70). As the pilot rotated the wheel in front of him, the cables would have moved the tiller back and forth, thus moving the rudder.

Unfortunately, the submersible's rudder is missing; but what remains can provide some facts concerning its assembly. The rudder stock extends 10 ½ inches (26.67 cm) out from the bottom of the hull and is seated into a rudder plate, which is attached to a 25 ½-inch (64.77 cm) long skeg that protected the rudder (figure 71). The dimensions of the rudder are unknown and a survey of early photographs has failed to provide any further information. If it is similar to the dive planes, the inboard edge may have continued to follow the curvature of the hull over its length. Holes in the rudder stock indicate that the rudder was attached by four ½-inch (1.27 cm) bolts.

*The Depth Control System*

The depth control system is the method by which the submersible’s dive planes were raised and lowered. A 1 ½-inch (3.81 cm) shaft is mounted on the aft ballast tank just starboard of the centerline. The forward end of this shaft projects beyond the ballast tank by 3 inches (7.62 cm) and was probably the location where a wheel would have once been mounted. At the after end of the shaft a corkscrew-shaped attachment is threaded into a rocker arm, which is securely attached to a horizontal bar that passes through the hull (figure 72). Where it penetrates the hull there are stuffing boxes to make the arrangement watertight. When the wheel at the front of the ballast tank was turned, the shaft rotated causing the rocker arm to move across the threads. This in turn rotated the horizontal shaft that raised or lowered the angle of the dive planes.
Figure 70. Detail of the rudder stock (photo by author).

Figure 71. A photograph of the exterior rudder assembly, which includes the lower portion of the rudder stock, rudder plate, and skeg (photo by author).
Figure 72. Detail of the internal dive plane assembly (photo by author).
The dive planes, located on both sides of the hull at the stern, are \( \frac{1}{2} \)-inch (1.27 cm) thick plates of iron that are 27 inches (68.58 cm) in length (figure 73). The forward end of each has a 2-inch (5.08 cm) diameter collar that fits over [and appears to be welded onto] the ends of the horizontal shaft. At the collar the planes are 8 inches (20.32 cm) wide, but towards the stern the inboard edges follow the curvature of the hull and they are 15 \( \frac{1}{2} \) inches (39.37 cm) at their widest points. A skeg, similar to that on the outboard rudder assembly, protected the front of each plane. These skegs are 37 inches (93.98 cm) long and taper into the sides of the hull.

**Anchoring System**

Two 350-pound (130.63 kg) ball anchors anchored the submersible. The anchors are missing from the vessel but their location and method of deployment was obvious. Two semi-circular sockets for storing the anchors are located in the bottom of the hull in the forward and aft sections (figure 74). The sockets are 17 inches (43.18 cm) in diameter and are 10 inches (25.4 cm) deep. Two water-tight windlasses located on the top of the ballast tanks were used to raise and lower the anchors (figure 75). Several items were missing from the windlasses such as their covers, gearing components, anchor lines and levers. However, both windlasses are identical in construction and where one had a missing component it was sometimes located on the other. Since they are identical, a description of one will pertain to both. The windlass is located at the center front edge of the ballast tank. Its dimensions are 18 \( \frac{1}{4} \) inches (46.36 cm) high (not including the covers that were missing on both), 19 inches (48.26
Figure 73. A photograph of the starboard dive plane and skeg (photo by author).

Figure 74. A photograph of the recessed socket at the bottom of the hull to stow one of the anchor balls (photo by author).
Figure 75. A photograph of the stern anchor windlass (photo by author).
cm) wide, and 49 ½ inches (1.25 m) long. It consist of two parts: a water-tight box with a drum and a smaller extension with a guide wheel located directly above the anchor sockets at the bottom to the hull. A hand lever was used to rotate a small gearwheel, which in turn rotated a larger one that turned the windlass drum. A smaller wheel and a crank were found in the submersible, but were not attached to either windlass (figure 76). The anchor cable was wrapped around a 5-inch (12.7 cm) diameter drum that is 12 ¼ inches (31.12 cm) long. The cable passed through a 21 ½-inch (54.61 cm) long sealed extension that sloped down towards the forward (or after) portion of the windlass. This section consisted of another waterproof box containing a sheave for guiding the cable (figure 77). The cable passed through the ballast tank in a waterproofed enclosure (figure 78) and was connected to the anchor.

Weapon System

There currently is no weapon associated with *Intelligent Whale*, but General Sweeney’s account tells us that a diver deployed a torpedo through the bottom hatches. In order for this to take place, the submersible had to be located near the target with the anchors dropped and the vessel stabilized several feet above the bottom. The interior atmosphere needed to be pressurized with air from the storage tanks to prevent water from coming in when the bottom hatches were opened. A crewman in a dive suit would exit the craft, presumably supplied with air through a hose from the storage tanks or a pump, and carry a torpedo to the targeted vessel where it would be manually attached. According to Sweeney’s letter, pulling a lanyard attached to a friction primer detonated
Figure 76. A gearwheel and lever found inside the hull which were used with the windlass (photo by author).

Figure 77. Detail of the sheave above the anchor socket (photo by author).
Figure 78. The portion of the anchor ball socket viewed from inside the forward ballast tank. The anchor cable passed through the shaft and connected with the ball (photo by author).
the torpedo. The unnamed naval officer writing of the *Intelligent Whale* prior to its trial claimed that an alternative system was used, wherein a copper wire attached to a battery could also detonate the torpedo. So it is possible that the submersible used both methods (NHC, 14 September 1872:69).
CHAPTER VI

CONCLUSIONS

COMPARISONS TO CONTEMPORARY SUBMERSIBLES

All of the submersibles designed or constructed during the American Civil War, including *Intelligent Whale*, had a common purpose and shared many similar features. All had the same mission — to clandestinely attack an enemy ship while travelling beneath the water’s surface. The material used to construct the hulls was the same — iron (be it cast, wrought, or steel). While some inventors experimented with steam engines and electric motors for propulsion, all completed submersibles ultimately relied on human power. Each vessel included systems to regulate buoyancy, vertical movement, and horizontal movement through the water; however, the orientation and location of these systems differed. Providing and maintaining air for the crew was of utmost importance and each inventor or inventors relied either on air inside the vessel or the introduction of fresh air from the surface. These similarities stem from the fact that the submersibles’ function dictated its form. Furthermore, all inventors were working from the same pool of knowledge acquired from decades of experimentation prior to the war.

While *Intelligent Whale* includes many of the features common to all submersibles built during the war, more specific comparisons can be made in regard to the other two surviving vessels, the Louisiana State Museum Vessel and *H.L. Hunley* —
both Confederate efforts (figure 79). The Louisiana State Museum Vessel’s shape, hull construction, and weapons deployment differs dramatically from those of *Intelligent Whale*. The most noticeable difference between the two vessels is their appearance. *Intelligent Whales* is much larger. Proportionally it is 10 feet 4 ½ inches (3.16 m) longer, 3 feet 10 ½ inches (1.18 m) broader and approximately 1 ½ feet (31.75 cm) deeper. Consequently, *Intelligent Whale*’s weight and volume are more, by an estimated 35,000 pounds (13,063.4 kg) and 460 cubic feet (13.03 cubic meters). The difference in their sizes dictated the number of crew needed to man each vessel. Historical records indicate that *Intelligent Whale* operated with a crew of six men: a pilot, an assistant, and four who worked its propulsion system (ANJ, 14 September 1872:69). The Louisiana State Museum Vessel had an estimated crew of two: a pilot and another man to operate the crank (Wills 2000:162).

Air for both vessels appears to have been supplied by a snorkel system, although *Intelligent Whale* had the added luxury of releasing compressed air from two tanks. The entry hatch on *Intelligent Whale* is located immediately behind the conning tower, whereas evidence suggests the Louisiana State Museum Vessel used a combination conning tower and entry hatch at the top of the hull. Although they both have keels, the Louisiana State Museum Vessel lacks any internal frames or stringers. The hull plating on this vessel overlap one another and are riveted together, resulting in an uneven exterior surface. *Intelligent Whale*’s hull plates abut one another and are riveted to the frames and stringers, creating a relatively smooth exterior surface. Other features between the vessels differed as well, such as the position and number of Rudders and dive planes. *Intelligent Whale* has a single rudder at the stern, while the Louisiana State
Figure 79. Profiles of *H.L. Hunley*, the Louisiana State Museum Vessel, and the *Intelligent Whale*. Images are not to an exact scale (from Pesce 1906, Wills 2000, and author).
Museum Vessel has one at each end. While both submersibles have dive planes, the smaller vessel's are located forward of midships, unlike the stern-mounted planes of Intelligent Whale. Each submersible had a separate method for deploying the torpedo as well. The Louisiana State Museum Vessel's torpedo was mounted on the end of a long spar at the bow that was to be rammed into the side of an enemy warship. A diver was used to manually attach Intelligent Whale's torpedoes to the bottom of an enemy ship.

The other surviving vessel, H.L. Hunley, also differs from Intelligent Whale in shape, construction, systems design, and weapons deployment. The Confederate submersible is longer than its northern counterpart by 10 feet 4 ¼ inches (3.17 m), narrower by 3 feet 5 inches (1.04 m), and shorter by 3 feet 7 ½ inches (1.10 m). Several aspects of the submersibles' construction differed as well. H.L. Hunley was manufactured from a boiler, cut longitudinally and raised with 25-inch-tall (63.5 cm) strips of iron to increase its height. While it does have internal frames, it appears these were used purely to strengthen the hull and do not correspond with the attachment of the hull plating (Michael Scafuri, personal communication 2001). Two end pieces were affixed to the hull and tapered to vertical edges at the bow and the stern to cut through the water. H.L. Hunley has two conning towers instead of one, each serving as an entry hatch into the hull. The dive planes are forward of amidships, unlike Intelligent Whale's that are near the stern. On the bottom of the Confederate submersible was several hundred pounds of ballast that could be dumped in case of an emergency. This might be comparable to the two 350-pound (130.63 kg) anchors carried on the
*Intelligent Whale*, which could possibly have been dropped in an emergency (although there is no historical documentation to indicate this).

While both vessels share similar systems, they differ in many respects. Each have two ballast tanks at the ends of the hull to regulate their buoyancy, however, *H.L. Hunley* emptied its tanks by a small, manually-operated hand pump and did not use compressed air. There is evidence to suggest a long pipe running the length of the hull connecting these tanks equalized the water levels in each (Michael Scaufori, personal communication 2001). Furthermore, the tops of the ballast tanks were open, allowing water to spill into the main cabin. Propulsion for both submersibles relied on human power, but the orientation of the crew differed. The *H.L. Hunley* had six men in a straight line down the length of the vessel on either side of the crank, whereas *Intelligent Whale* had two pairs of men working side-by-side to turn the crank. While the northern submersible went to great lengths to supply air for its crew, its southern counterpart relied solely on the air trapped within the hull after being sealed. The method used to deploy the torpedoes differed as well. Originally *H.L. Hunley* towed its torpedo by a lanyard. After a near-fatal accident with its support vessel, the orientation of the torpedo changed and it was mounted on the end of a long spar projecting from the bow. The intended method of attack was to ram the hull of the enemy vessel, unlike the manually place torpedo of *Intelligent Whale*.

As conservation of *H.L. Hunley* and the Louisiana State Museum Vessel are completed, more information pertaining to their construction will emerge. While all three surviving Civil War era submersibles differ in many respects, perhaps the greatest difference between them is how each is viewed historically. Without a doubt, *H.L.*
*Hunley* is the best known of the three. While it is regarded as the first submersible to destroy an enemy warship and has been the subject of intense research, *Intelligent Whale* did not even pass a successful trial and has for the most part been forgotten.

**POTENTIAL DESIGN INFLUENCES**

It is unlikely that Scovel S. Merriam was familiar with the Louisiana State Museum Vessel or *H.L. Hunley* when he designed the *Intelligent Whale*; but it is more than likely he knew of similar efforts taking place in the North. Both of de Villeroi’s submersibles (the one built to salvage the H.M.S. *De Braak* and later the U.S.S. *Alligator*) were described in detail by local newspapers (*Philadelphia Inquirer*, 2 May 1862, evening edition). One feature common to both of these submersibles was a method that allowed divers to exit the craft. This is not found on any of the known submersibles constructed in the South. However, it was not unique to de Villeroi or Merriam, but predates their work. In 1852 Alexander Lambert designed and constructed a submersible called the *New York Submarine Boat*, which included a hatch at the bottom of the hull for divers to exit. Records indicate the vessel was used to lay telegraph lines in the Hudson River as well as retrieve pearls from the seafloor in Panama (Pesce 1906:104). Perhaps Merriam realized such a feature would not only be applicable for torpedo deployment, but also for the removal of obstructions in the water, including the underwater torpedoes used to defended Confederate harbors. Such was the intention of the submersible while it was being constructed in 1864, as indicated in a letter written by Woodruff Barnes to Secretary of the Navy Robeson (NARA, RG 45,
Entry M124, Letters Received by the Secretary of the Navy: Miscellaneous Letters, 1801-1884; cited in Ragan 1999:202). Other features appear on *Intelligent Whale* that can be traced to earlier submersible efforts, specifically that of Lodner Phillips. In 1851 Phillips constructed *Marine Cigar*. This submersible used compressed air to blow out its ballast tanks on demand as a method of trimming the vessel. Compressed air had previously appeared on submersibles as early as 1801, when Robert Fulton carried canisters on board the *Nautilus* to replenish its atmosphere. It was not until Phillips, however, that compressed air was used to regulate buoyancy, and Merriam appears to have adopted this idea. *Marine Cigar* also included two large ball anchors recessed at each end of the vessel. These anchors were each raised and lowered by a watertight windlass mounted above the anchor. While there are no known links between the two inventors, the strong resemblance between the compressed air tanks and the anchors leads one to conclude that Merriam was at least was familiar the work of Phillips.

HISTORICAL SIGNIFICANCE

Although *Intelligent Whale* failed as a submersible, its relationship to the American Civil War, the influence it had upon the navy after the war, and its present condition confirms its value as a unique artifact of American history. Of the few submersibles constructed in the North during the American Civil War, *Intelligent Whale* is the only example that is known to exist. De Villeroi's U.S.S. *Alligator* was lost at sea near Cape Hatteras, South Carolina, in 1863 and to this day its location has yet to be discovered. After the tragic accident involving Major Hunt at the Brooklyn Navy Yard
the same year, the fate of his one-man unnamed submersible is unknown. In 1864 Julius Kroehl built the Explorer, which like the Intelligent Whale the navy failed to approve; it was subsequently transported to Panama for oyster harvesting. Its fate also remains a mystery. While the historical record indicates several other submersibles were at least designed by northern inventors, there is no physical evidence to suggest any of these were built.

Intelligent Whale also represents the U.S. Navy's post-war interest in submersible technology as an underwater weapons platform. This interest began during the spring of 1866 with the unofficial trial conducted by General Sweeney before a committee of naval officers. Following the trial, a favorable report was submitted to the Secretary of the Navy. In 1869 the Navy Department finally agreed to purchase the vessel for $50,000 from its owner Oliver S. Halsted. The terms of the contract were never realized and Intelligent Whale's trial three years later was a dismal failure. In spite of the vessel having worked well under competent hands earlier, the result of the trial and the navy's unwillingness to pursue submersible technology at that time sealed the fate of the vessel. Over the following decade, other non-traditional methods of naval warfare were pursued; including self-guided surface launched torpedoes. Another 15 years passed before the U.S. Navy seriously reconsidered the use of submersibles. One of the reasons for this change in attitude was that while the U.S. Navy avoided submersible development and experimentation, other countries continued to do so (Harris 1997:114). By 1887, the Navy had no choice but to reconsider its position as these countries commissioned submersibles into their navies.
Perhaps the greatest asset of *Intelligent Whale* is its present condition. With the exception of the few missing items, the hull is in near perfect order and requires no immediate conservation, unlike contemporary submersibles Louisiana State Museum Vessel and *H.L. Hunley*. Its excellent state of preservation is due to the efforts of the U.S. Navy and the National Guard Militia Museum of New Jersey who have painted the interior and exterior surfaces to protect the metal. They have also kept the vessel indoors during the last twenty years. To date, the *Intelligent Whale* remains the best physical example of a submersible from the American Civil War.
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Oliver Halsted’s second contract with the U.S. Navy for sale of submersible, 29 October 1869. (piece 11)

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Letter from Nathaniel Halsted to the Secretary of the Navy concerning trial, 16 September 1872. (piece 32)

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van der Vat, Dan

Welch, James P.
Wills, Richard K.
VITA

Peter Winston Hitchcock

Citizenship: United States of America

Permanent Address: 1217 Glade
College Station, TX 77840
(979) 693-9819

E-Mail Address: pwhitch@hotmail.com


Texas A&M University, 1990-1993: B.A. Anthropology.

Experience: Research Assistant at the Conservation Research Laboratory,
Riverside Campus, Texas A&M University, July 1997 to
July 2001. Primary responsibility was to clean and reassemble
La Belle Ship Timbers.

Staff Archaeologist on the LaSalle Shipwreck Project, Matagorda
Bay, Texas, from July 1996 to May 1997. Primary responsibility
was to excavate, record, and raise the artifacts associated with the
shipwreck La Belle.

Assisted in H.L. Hunley’s preliminary Site Assessment during the
Spring 1996, Charleston, South Carolina.

Student Archaeologist for the Institute of Nautical Archaeology
(INA) Egypt. Primary goal was to assist in the excavation,
recording, and artifact removal of a shipwreck in the Red Sea,
near Safaga, Egypt.