Research Report No. 13

Oaken Whale with a Cast Iron Tail:

The Single-Decked Wooden Bulk Carrier *Monohansett*

Claire P. Dappert

SPONSORING ORGANIZATIONS:

Program in Maritime Studies
East Carolina University, Greenville, North Carolina

Thunder Bay National Marine Sanctuary
and Underwater Preserve
National Oceanic and Atmospheric Administration
Alpena, Michigan

Maritime Heritage Program Mini-Grant
National Oceanic and Atmospheric Administration
Office of National Marine Sanctuaries
Washington, D.C.

Office of the State Archaeologist
Department of History, Arts, and Libraries
Lansing, Michigan

Primary Investigators: Bradley A. Rodgers and Nathan Richards 2006

Research Report No. 13

Oaken Whale with a Cast Iron Tail:

The Single-Decked Wooden Bulk Carrier *Monohansett*

Claire P. Dappert

Nathan Richards, series editor.

Printed in the United States of America.

ISBN 0-9741937-4-7 (Volume 13)

Cover: Loper style propeller of the *Monohansett* as the vessel lies today in Thunder Bay.
(Photograph courtesy Program in Maritime Studies, East Carolina University)

Abstract

This study explains the marine transition from Great Lakes steambarge, to wooden bulk carrier, and to iron and steel bulk carrier designs. It also defines the morphological characteristics of wooden bulk carriers. First, a historical narrative explores influential shipbuilders, technological innovations, and economic factors that contributed to the development of wooden bulk carriers. Next, *Monohansett*'s working career explores dangers in operating wooden bulk carriers on the lakes. Then, the archaeological investigations of *Monohansett* are presented, allowing an internal view of its design. Last, *Monohansett*'s construction techniques, as seen in the archaeological record, are compared to other archaeologically studied wooden bulk carriers, allowing this study to set a definition for their internal design characteristics. In this way, this approach demonstrates how these ships transfer both their form and function into twentieth-century steel bulk carriers, while setting a clear definition for their construction techniques.

Acknowledgements

As with any archaeological or historical endeavor, the success of this project was the culmination of several individuals and institutions working together. Gratitude must first go to East Carolina University archaeologist and historian Dr. Bradley Rodgers, who functioned as the Primary Investigator for the investigations of *Monohansett* and whose previous research proved vital for this study. Another individual who deserves my gratitude is East Carolina University archaeologist Dr. "Dingo" Nathan Richards, who acted as Co-Primary Investigator during the archaeological investigations and editor of this research report. I would also like to thank the Thunder Bay National Marine Sanctuary and Underwater Preserve and the Michigan Department of History, Arts, and Libraries for allowing the underwater archaeological investigations of the *Monohansett* to take place. Others who deserve my gratitude are: TBNMS Director Jeff Gray, Great Lakes historian Pat Labadie, Michigan State Maritime Archaeologist Wayne Lusardi, and Dr. Parkerson. Last, thanks to the dive safety officers, Steve Sellers and Mark Keusenkothen, to the crew chiefs, Jason Rogers, Jackie Piero, and Chris Valvano, and to the field crew, Rochelle Barainca, Mathew "Jersey" De Felice, Eva Klopotek, Chris McCabe, Franklin Price, Erica Seltzer, and Stephen Workman.

Contents

List of Tables

List of Figures

List of Abbreviations

APL	Alpena Public Library
ECU	East Carolina University
GLMHC	Great Lakes Marine Historical Collection
GLVI	Great Lakes Vessel Index
MPL	Milwaukee Public Library
NOAA	National Oceanic and Atmospheric Administration
NPS-SCRU	National Park Service Submerged Cultural Resource Unit
SCUBA	Self Contained Underwater Breathing Apparatus
SHSW	State Historical Society of Wisconsin
TBNMS	Thunder Bay National Marine Sanctuary
TBSRC	Thunder Bay Sanctuary Research Collection
US	United States
WGS	World Geodetic System

1

Introduction

The Great Lakes wooden bulk carrier is one link in a chain of vessel classes that transitions the gap between wooden sailing ships and modern steel cargo carriers. Originally designed as an improvement on a steambarge, also known as a steam schooner on the west coast, the wooden bulk carrier links wooden sailing schooners fitted with steam engines and the modern Great Lakes steel bulk carrier. In general, both a steambarge and a wooden bulk carrier boasted a screw propeller and carried unpacked bulk cargo in their holds such as grain, ore, lumber, coal, or ice.

By today's definition, a steambarge contained only a single cargo deck while a wooden bulk carrier contained a double cargo deck. Numerous scholars historically view *R. J. Hackett* as the prototype for wooden bulk carriers, but this vessel was constructed with only a single deck. It is unclear, historically, how closely the double-decked wooden bulk carriers adhered to the *R. J. Hackett* design. This study, therefore, asks how the nineteenth-century wooden bulk carrier transitions from a single deck to a double deck, and how this transition is characterized in both an historical and archaeological context, as exemplified by the single-decked wooden bulk carrier *Monohansett*.

Historically, bulk cargo transporting vessels on the Great Lakes played a significant role in the development of the US economy during the last quarter of the nineteenth century. The cargo transporting power represented by the wooden bulk carrier lowered the costs of bulk commodity transportation and boosted the national economy during recovery from the Civil War. Ironically, as the US international merchant marine declined following the Civil War, its Great Lakes merchant fleet fueled national growth through the cargo carrying vigor and efficiency of wooden bulk carriers (Rodgers 2003:1).

Despite their intrinsic value, wooden bulk carriers have only recently become an archaeologically and historically studied phenomenon (Rodgers 2003:1). Several submerged cultural resource studies and archaeological site reports concerning steambarges and wooden bulk carriers have emerged in the last few decades. These works include: C. Patrick Labadie's *Submerged Cultural Resources Study*: *Pictured Rocks National Lakeshore*. (1989), David J. Cooper's *By Fire, Storm and Ice: Underwater Archaeological Investigations in the Apostle Islands* (1996), and Bradley A. Rodgers's *The Bones of a Bulk Carrier: The History and Archaeology of the Wooden Bulk Carrier/Stone Barge City of Glasgow* (2003). These publications provide a firsthand look into their construction techniques, and, in this way, they proved instrumental in this study.

Other primary sources referenced for this investigation include enrollments, photographs, and newspaper articles. The repositories accessed for this assessment included: The Thunder Bay Sanctuary Research Collection (TBSRC) in the Alpena Public Library (APL), Alpena, Michigan; The Historical Collections of the Great Lakes (HCGL) at Bowling Green State University, Bowling Green, Ohio; and The Great Lakes Marine Historical Collection (GLMHC) located in the Milwaukee Public Library, Milwaukee, Wisconsin.

Various academic publications supplemented these primary sources. Many of these referenced works supplied leads to the primary documents, but in many cases secondary sources were used to fill in gaps where primary source material was absent. Numerous articles and books focus on the massive industrial growth of the Great Lakes during the nineteenth century, however, few deal with the construction schematics of marine cargo vessels involved in the bulk commodity trades. On the other hand, others proved to be quite beneficial for this study. The most useful secondary sources are as follows: J. B. Mansfield's *History of the Great Lakes* (1972) provided an overview of the general history of the Great Lakes. Mansfield divided his two-volume set into sections based on topics, such as lake canals, development of lake vessels, the lake carriers, iron ore, iron industries, and lumber traffic, to name a few. This publication proved exceptionally useful in recreating the history of the Great Lakes iron ore trade and its influence on the development of the wooden bulk carrier.

Mark L. Thompson's publication, *Steamboats and Sailors of the Great Lakes* (1991), sheds light on modern Great Lakes bulk commodity industries and their impact on the development of the wooden bulk carrier. Specifically, it discusses loading and unloading technological improvements over time and their affect on the Great Lakes ore trade and vessel design.

The purpose of this study is to understand the marine transition from steambarge to wooden bulk carrier, to iron and, later, to steel bulk carrier designs, and to set a clear definition for the morphological characteristics of wooden bulk carriers. To do this, this investigation utilizes a combination of historical and archaeological data and is organized according to a research design that first calls for the historical development of both the single-decked and double-decked wooden bulk carrier and specifically the *Monohansett*. Chapter 2 documents the development of wooden bulk carriers by highlighting environmental, technologic, and economic factors that contributed to its defined form and function. This chapter also explores builders' motivations for the switch from wood hulls to steel hulls.

Chapter 3 recreates the story of *Monohansett*, a single-decked wooden bulk carrier constructed by Linn & Craig of Gibraltar, Michigan, in 1872 (GLMHC 2005). The historical record represents this vessel well, but it has received little historical analysis. Until her demise in 1907 by fire, all aspects of her past are examined in order to place this vessel in an historical context.

Chapter 4 incorporates *Monohansett*'s features, as defined in the historical investigations, and compares it to the vessel's archaeological remains. The Program in Maritime Studies at East Carolina University (ECU) conducted underwater archaeological investigations on this wrecksite during the summer of 2004, and this chapter outlines the methodology and presents and interprets the recovered data.

Last, Chapter 5 examines *Monohansett*'s construction details, as seen in the archaeological record, with other archaeologically investigated single- and double-decked wooden bulk carriers, including *R. J. Hackett* (historically dubbed the prototype for wooden bulk carriers), *Mary Jarecki*, *Sitka*, *Frank O'Conner*, *Fedora*, *City of Glasgow*, and *Pretoria* (one of the last constructed wooden bulk carrier) (See Figure 1). This study also includes the steambarge *C.H. Coffinberry*, enabling the research to set apart wooden bulk carriers from steambarges. This chapter compares these archaeologically investigated vessels, setting a general definition of the typical construction techniques of nineteenth-century steambarges, single-decked wooden bulk carriers, and double-decked wooden bulk carriers.

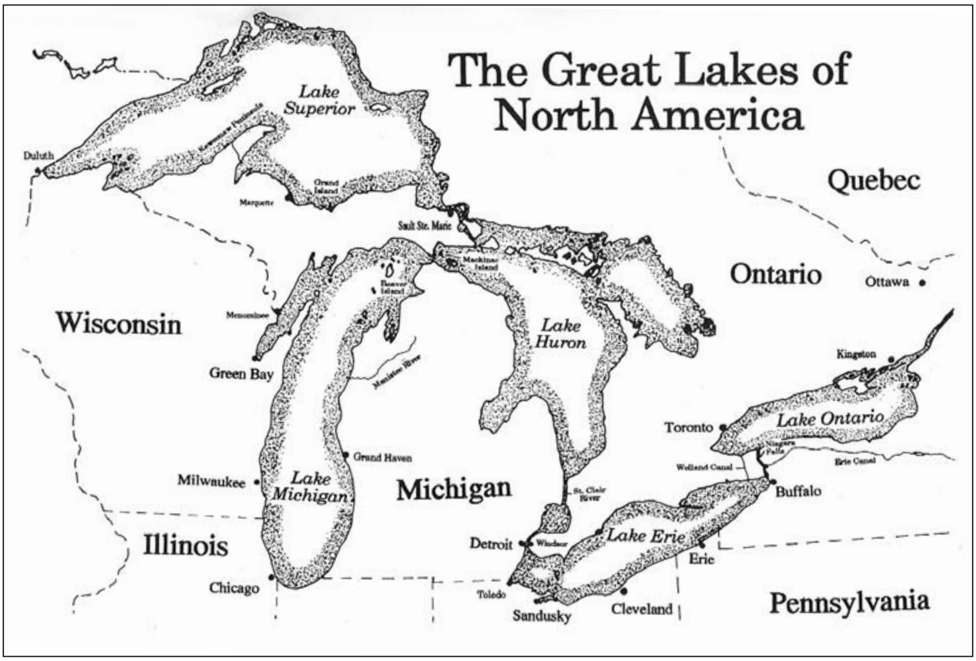

Figure 1. Theater of operations for Great Lakes wooden bulk carriers (Rodgers 1996:85).

By illustrating the development of the wooden bulk carrier and setting a clear definition for its construction characteristics, this study determines whether single-decked vessels adhering to the *R.J. Hackett* design were wooden bulk carriers, or if the *R.J. Hackett* design was just an improvement on the steambarge. *Monohansett* provides a lens to view this distinction, as its historical and archaeological investigation allow a unique look into the service and construction techniques of these ambiguous, single-decked vessels.

2

The Development of the Great Lakes Wooden Bulk Carrier

Introduction

The nineteenth-century US iron ore industry added a unique vessel type to Great Lakes maritime heritage: the wooden bulk carrier. The development of this vessel class did not occur immediately after the discovery of iron ore in the Upper Great Lakes, but, rather, it evolved over several decades through technological innovation and economic demand. While its development was intricately linked to the Great Lakes iron industry, its efficiency resounded in other domains of Great Lakes bulk commodity trades, including coal, copper, limestone, and bulk agricultural products. By the third quarter of the nineteenth century, as US industry more efficiently exploited these bulk commodities, the Great Lakes transportation industry produced what Rodgers identifies as, “the integrated bulk carrier system” (Rodgers 2003:37). Rodgers describes this as a transport system of bulk commodities that utilized new methods of storing, loading, transporting, and off loading bulk materials, all of which are facilitated with mechanized machines and purpose built ships. He goes on to say, “The sole purpose of a wooden bulk carrier was to move large quantities of bulk commodities such as ore, coal, stone, and later wheat and corn without the need to receive the cargo packaged for shipment” (Rodgers 2003:37). The system required bulk cargo handling technologies, such as gravity fed pocket docks and self-unloading systems that could load or unload a bulk carrier in a matter of hours. Rodgers claims, “The efficiency of the integrated bulk carrier system greatly reduced the cost to move bulk agricultural and mineral commodities to the east coast, and is, therefore, largely responsible for the affluence of America’s heartland and east coast” (Rodgers 2003:37).

Christer Westerdahl acknowledges that vessel form reflects its function. He states that vessels “adapted to the conditions of the route in concern and to the character of the harbors (havens) for which they are intended. This is mainly seen in their hull form” (Westerdahl 1996). He also finds that vessels are adapted to certain categories of goods. Westerdahl, however, states that innovations, in this case loading and unloading technologies, could influence vessel form, but they do not necessarily explain change. This statement implies that modifications on a vessel represent changes in the character of trade and in economic patterns. He goes on to say, “Acceptance of an innovation is needed both receptivity at the right moment and suitable socioeconomic conditions” (Westerdahl 1996). Westerdahl, therefore, sees hull form as reflective of environment, function, and economic need, providing a general theory. He does not specifically apply it to wooden bulk carriers. Rodgers, on the other hand, applies all three of these factors specifically to Great Lakes wooden bulk carriers.

The purpose of Chapter 2 is to elaborate and clarify the link between environment, function, and economy to the development of the bulk carrier. In this chapter, the development of the bulk carrier is explored using qualitative observations of innovations in ship construction in relation to loading and unloading technologies and canal enlargements on the Great Lakes during the nineteenth century. At the same time, a database presenting vessel construction dates, depth of holds, and modification dates shows the relationship between canal improvements and the development of the wooden bulk carrier. Finally, this section puts forth several shipbuilder motivations for the transition to metal hulls. In this way, this study addresses how the nineteenth-century wooden bulk carrier developed in both its form and function from a single-decked vessel to a double-decked wooden bulk carrier, and, subsequently, to twentieth-century steel bulk carriers.

The Beginning of a New Shipping Era

In 1869, a new, innovative, propeller-driven vessel rolled down the stocks at Cleveland, the *R.J. Hackett* (See Figure 2) (Thompson 1994:23; Mills 2003:122). Elihu M. Peck designed the vessel for the Northwestern Transportation Company of Detroit, Michigan, a company involved in the Great Lakes iron ore trade (Labaree et al. 1998:373; Thompson 1994:23). *Hackett* measured 208 feet in length, 32 feet in width, and had a 12 foot depth of hold, endowing it with 749 gross tons (Thompson 1994:23; Mills 2003:122). The vessel carried a spritsail, fore mast, and a main mast that the captain could use as auxiliary power to its steeple compound engine (Thompson 1994:24; Cooper and Jensen 1995:13). The steeple was a Great Lakes vernacular engine developed from the tandem compound engine, designed by William Holt in 1862 for oceanic trade. Great Lakes shipbuilders and shippers preferred the steeple compound engine because of its compact size, allowing more room for cargo (Bradley A. Rodgers 2005, pers. comm.).

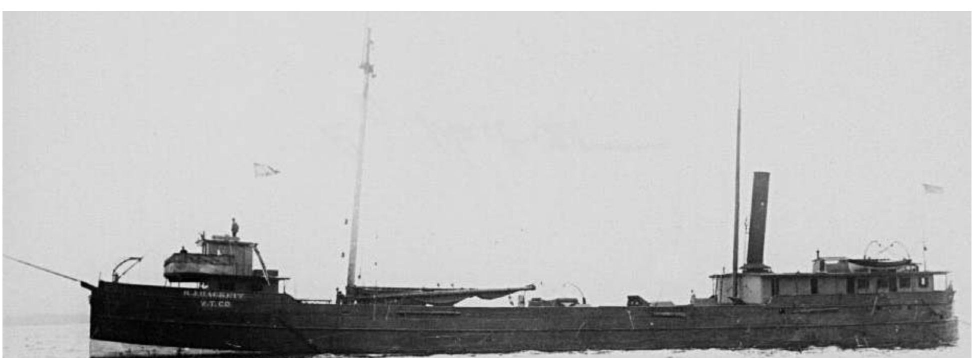

Figure 2. Photograph of *R.J. Hackett* (Courtesy TBSRC).

R.J. Hackett's hull design incorporated features of both steambarges and sailing vessels. For example, drawing on the design of a steambarge, Peck placed its engine house towards the stern, eliminating a long propeller shaft and a wasteful shaft alley running through the hold. Unlike the steambarge, however, *R.J. Hackett* featured a pilothouse with cabins at the bow of the vessel. Shipbuilders called this configuration the fore and aft design (Thompson 1994:23-24). The position of the pilothouse allowed a relatively clear amidships deck plan like that of a sailing vessel with a Grand Haven rig. Moreover, this modification allowed the placement of 24-foot centered hatches matching the specifications of Marquette's pocket docks (Mills 2002:122; Thompson 1994:23). Before the introduction of the pocket dock, workers manually loaded cargo into a vessel via shovels and wheelbarrows. In 1859, the Cleveland Iron Mining Company, later known as Cleveland-Cliffs, built the first ore docks at Marquette (See Figure 3). These "pocket docks" had a trestle with tracks on top for ore cars. The cars dumped their ore into pockets, or storage bins, located under the tracks. The pockets then discharged ore into a ship below by gravity fed chutes via gates at the bottom of the pockets. These gravity fed mechanisms reduced the time it took to load a cargo vessel from days to hours (Thompson 1994:22). Designed to capitalize on this loading method, the *R.J. Hackett* could carry more ore on a tight, regular schedule than could steambarges and sailing vessels.

Iron ore was discovered on the south shore of Lake Superior nearly 18 years before the launching of *R.J. Hackett*. In 1841, Lieutenant Douglas Houghton,

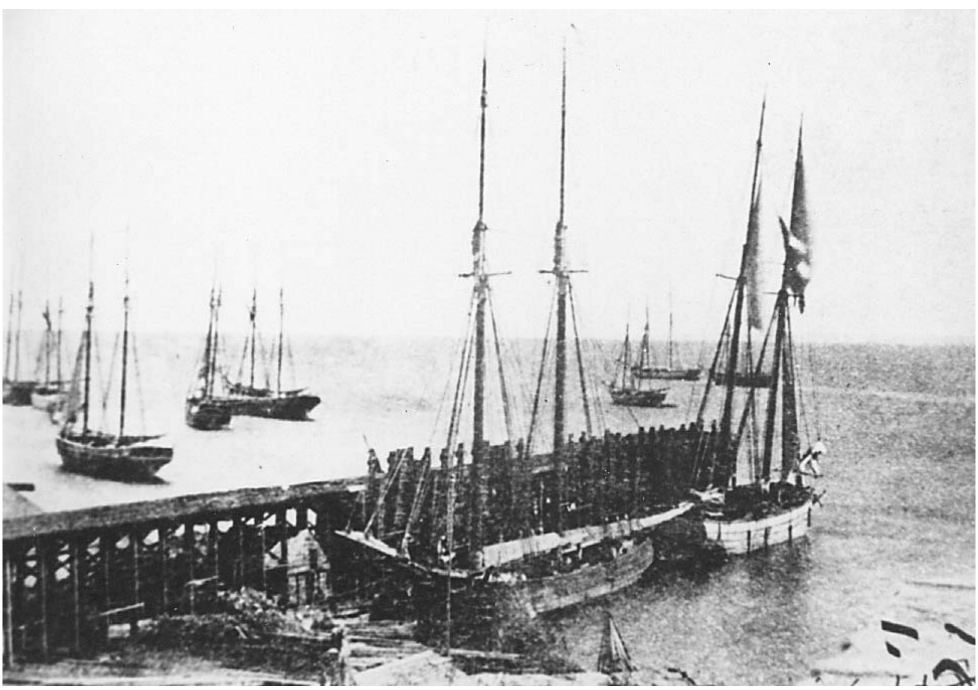

Figure 3. The pocket docks at Marquette, Michigan (Courtesy TBSRC).

a geologist with the US Army, submitted several reports declaring merchantable quantities of minerals in this area (Mansfield 1972 [1899]:554; Thompson 1994:21). Three years later, in 1844, William Burt, who surveyed section and township lines, located an ore deposit in this same area. His find came about when his magnetic compass deviated substantially, indicating the presence of a large deposit of magnetic rock. Within two years of Burt pinpointing the discovery, a number of mining companies initiated the first mining operations in the Upper Peninsula; however, the businesses did not turn a profit (Mansfield 1972 [1899]:554).

Producing iron in the Upper Great Lakes was a conundrum during the early nineteenth century. Michigan lacked the coal supply necessary for smelting ore, and the ore had to be manually loaded onto a vessel and shipped across the lakes to coal-rich areas, such as Ohio or Pennsylvania. Transportation of ore presented a problem because the rapids at Sault Ste. Marie, a bottleneck where Lake Superior and Lake Huron converge, necessitated manual portage of the cargo in wheelbarrows around the rapids, which was both costly and time-consuming.

To make transport of iron ore economically viable, government officials and several businesspersons decided that the bottleneck at the Sault Ste. Marie River required elimination. Charles T. Harvey along with August Belmont, Erastus Corning, and John Murray Forbes exchanged mineral lands with the state of Michigan for the construction of the Sault lock. These men contracted with the state and formed the St. Mary Falls Ship Canal Company to construct two 350-foot long, 70-foot wide, and 12-foot deep locks at Sault Ste. Marie, connecting Lake Superior with Lake Huron and raising and lowering vessels a height of 18 feet (See Figure 4).

Figure 4. The Sault locks, 1855 (Courtesy TBSRC).

After their completion in 1855, the Sault locks came under jurisdiction of the State Board of Control, allowing the state to charge a toll rate on the registered tonnage of all vessels passing through the canal. Nearly a month after completion of the Sault locks, the schooner *Columbia* carried the first iron ore shipment through its gates. The *Illinois* carried the first load across by a steamer. Shippers transported a total of 1,400 tons that year, 11,500 the following year, and 35,000 tons in 1857 (Mansfield 2005). The canal allowed a relatively cheap passage around the Sault rapids as compared to the previous labor-intensive method of manually portaging cargo in wheelbarrows.

As the commerce of the Lake Superior region increased, shipbuilders designed vessels to take full advantage of the size of the Sault locks. The *R.J. Hackett*'s hull design, rectangular in cross section with a plumb bow and fantail stern fitted with a propeller, allowed the vessel to fit through the Sault locks with a maximum cargo capacity (Rodgers 2003:34). The ore carrier naturally took on a long and shallow shape because the depth of the Sault locks restricted its draft to 12 feet. Its long length and shallow depth created potential problems in certain environments and conditions such as heavy seas (Labaree et al. 1998:373). Peck's forward placement of the pilothouse provided superior visibility, thus, partially alleviating the problem of maneuvering a long ship in tight channels, congested ports, and foul weather. On the Great Lakes a forward pilothouse became a necessity for the safety of the crew and vessel.

Peck's *R. J. Hackett* greatly influenced future designs of Great Lakes ore carriers in general. The *R. J. Hackett*'s construction schematics allowed versatility, as shippers could switch between bulk cargos easily by sweeping and hosing out the hold (Mills 2002:4). The flat bottoms and straight-hopper like sides facilitated removal of loose ore cargo through mechanized loading and unloading methods. These methods also demanded removal of all interior hold obstructions above and below decks.

In addition to featuring an unobstructed cargo hold, the *R.J. Hackett* design capitalized on innovations in bulk cargo loading and unloading techniques. In 1867, J. D. Bothwell, a Cleveland dockmaster, employed Robert Wallace to construct a steam engine to power winches that pulled buckets of ore out of a ship's cargo hold (Barry 1970:94; Labaree et al. 1998:373). Bothwell proposed this "donkey engine" after watching a steam engine hoist wooden piles through the air before workers drove them into the riverbed (See Figure 5) (Barry 1970:373). He envisioned using a similar engine to lift ore laden buckets through hatches from a vessel's hold. His invention cost $1,200, but the shipping companies ultimately saved a great deal of money as the innovation cut unloading time by nearly a third. Many other shippers followed suit as Wallace immediately received nine more orders for donkey engines (Barry 1970:373). Peck allowed for this innovation on the *R.J. Hackett*, by including 24 foot centered hatches that allowed top access for loading with pocket docks and unloading with the donkey engine. These modifications made his vessel particularly suited to iron ore transportation.

Although numerous scholars have recognized the *R. J. Hackett* as the prototype for the wooden bulk carrier, this vessel lacked a second deck, considered a modern defining characteristic for the wooden bulk carrier (Mills 2002:1; Thompson 1994:26; Devendorf 1996:7). Peck's fore and aft design allowed room for a series of hatches. This improvement on the steambarge proved a success as many other shipbuilders followed suit. As Thompson states,

> If imitation is indeed the sincerest form of flattery, the staid Peck, who undoubtedly chafed at the uncomplimentary comments that greeted the launching of the *Hackett*, must have taken great solace in the fact that her unusual design was almost immediately copied by other shipbuilders and shipowners…The number of sailing craft on the lakes began to decline in 1869, almost as if in direct response to the launching of the *Hackett*. By 1886, there were more steam freighters than sailing vessels (Thompson 1994:25).

The launching of the *Hackett* coincided with an increasing demand for iron ore in the home market, yet, the US international merchant marine was in economic decline during and after the Civil War. Many vessels went into military service and were either captured or destroyed by Confederate raiders. Those not requisitioned paid high insurance rates because of the risk of capture. Furthermore, because of competition from foreign ships, American vessels suffered a 25% higher shipping cost than foreign competitors. Many vessels, therefore, transferred registry to a

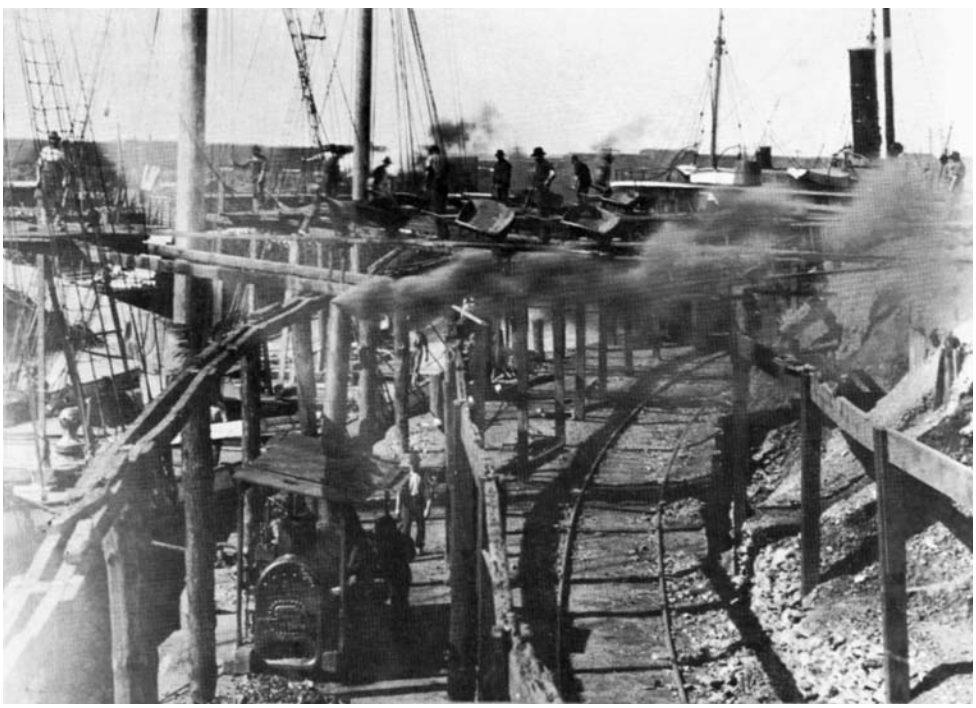

Figure 5. Workers manually unloading a vessel with wheelbarrows. Note the donkey engine located in the lower left hand corner of the photograph (Courtesy TBSRC).

foreign flag, achieving a neutral status during the war. In 1870, Congress specified that if any American shipper sold a vessel to a foreign nation or registered it under a foreign flag, the shipper could not repatriate the vessel (Labaree et al. 1998: 355).

The Panic of 1873 further compounded this problem. During the Panic, the military auctioned back many of the merchant ships used in the blockades to civilians at bargain prices. The demand for new ship construction plummeted, and many wooden shipyards located along the eastern seaboard went out of business (Heinrich 1997:9). On the other hand, the US inland merchant marine boomed during and following the Civil War. The Union military operations demanded iron, and, by the end of the war in 1865, more than 236,000 tons of ore had moved down the lakes (Thompson 1994:22). By 1869, the same year that *R.J. Hackett* launched, that number nearly tripled to 617,444 tons (Mansfield, 1972 [1899]: 566).

On the Great Lakes, the introduction of *Hackett*-style vessels in addition to the advent of the consort system set in motion what Rodgers defines as the "integrated bulk carrier system." Rodgers states, "The advent of the consort towing system in the late 1850s began a period in maritime transportation whereby a steamer's cargo space was supplemented by towing several manned barges in line astern" (Rodgers 2003:3-4). Steam tugs and steambarges could tow several sailing barges at the same time by "hooking" them together, forming an escort and a consort (Thompson 1991:22). The consort system proved cost-effective because of the large carrying capacity of the entire consort. It allowed for the slow, yet reliable and cheap movement of cargoes across the lakes. Over the next few decades, development and organization made this system extremely efficient (Rodgers 2003:37).

"Cost-Reducing Economies of Scale"

According to Robert H. Mills, author of *Wooden Steamers on the Great Lakes*, shippers pushed shipbuilders to construct ships that were "cost-reducing economies of scale" (Mills 2002:3). In short, shipping companies wanted to reduce the unit tonnage cost of shipping by moving more cargo across the lakes. Eventually, not only were the ships enlarged, but the dimensions of the Sault locks increased correspondingly, while unloading methods also improved (Labaree et al. 1998:429).

The original Sault locks, under jurisdiction of the State of Michigan, charged a toll based on the registered tonnage of vessels. The overhead of toll charges increased as shipbuilders constructed larger ships. Private firms initiated the earliest canal construction on the Sault Ste. Marie, but the Sault canal became too difficult for local interests to maintain. The federal government overtook jurisdiction and maintenance in the 1870s, eliminating the toll (Labaree et al. 1998:373; Mansfield 2005).

In 1870, the federal government commenced construction on the Wetzel Lock, which was completed in 1881 (See Figure 6). The canal measured 515 feet long, 88 feet wide, and allowed vessels with a 16 foot draft to pass (Labaree et al. 1998:373; Mansfield 2005:244). US Congress, recognizing the developing commerce of Lake Superior, deepened the Wetzel Canal in 1886 to 21 feet.

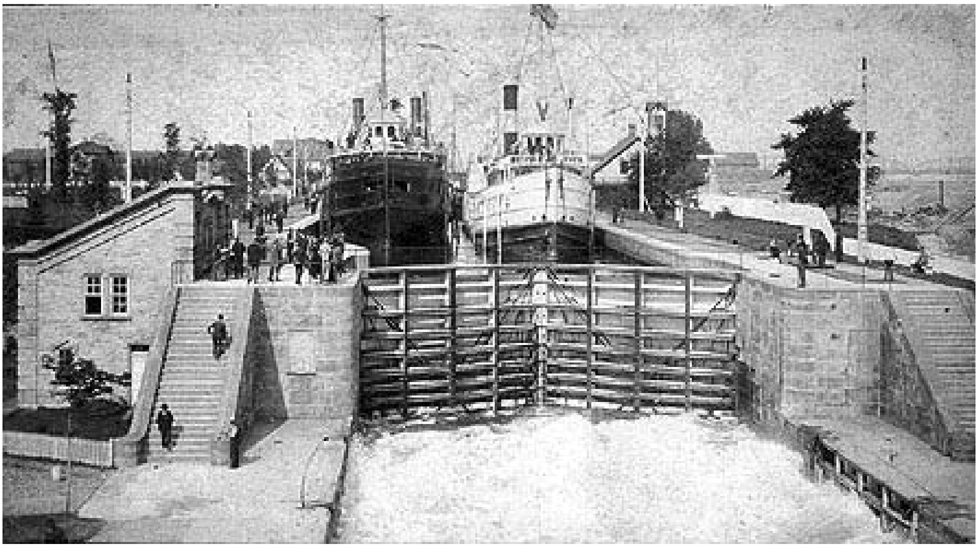

Figure 6. The Wetzel Lock (Courtesy TBSRC).

As the Sault canal increased in depth, shipbuilders constructed vessels to almost the exact dimensions of the canals. Likewise, as vessel dimensions increased, shipbuilders faced problems with vessel stability as ships took on an even higher length to beam ratio, while retaining a relatively shallow draft. In order to compensate, shipbuilders added a series of deck beams, or a second deck, to provide longitudinal support and to reinforce the sides. The addition of the second deck marked the ultimate difference between the single-decked wooden bulk carrier and the double-decked wooden bulk carrier form (Also see Chapter 5).

David W. Rust was one of the first wooden bulk carriers constructed with two decks. Constructed by Thomas Arnold from Saginaw, Michigan, in 1873, *David W. Rust* measured 201.8 feet in length, 33.5 feet in beam, and had an 18.5 foot depth of hold (Mills 2002:50). As Rodgers indicates, the addition of a second deck completed the transition from steambarge to wooden bulk carrier (Rodgers 2003:34). The deepening of the Wetzel Canal, therefore, allowed shipbuilders to transition the bulk carrier into a double-decked, fore and aft upper deck configured, top-loading vessel.

Figure 7 demonstrates several important implications of the relationship between canal enlargements and wooden bulk carrier construction. The chart represents a large sample of steambarges, single-decked wooden bulk carriers, and double-decked wooden bulk carriers constructed between the years 1869-1900. This sample is outlined in Table 1. The chart compiles data from *Wooden Steamers on the Great Lakes* (2002) by Robert Mills and *Great Lakes Bulk Carriers 1869-1985* (1996) by John Devendorf. The compiled data was double-checked with Bowling Green State University's Historical Collections of the Great Lakes online vessel index. The vessel index also provided photographs of each vessel. Only vessels built with fore and aft configurations, as indicated by the photograph, were used for this study. The table includes the name of the vessel, date of construction, length, beam, draft, and gross tonnage. It also indicates any change in the gross tonnage of a particular vessel, suggesting a modification in the hull.

Devendorf recognizes that in the nineteenth century the differences between steambarges and wooden bulk carriers were as obscure as they are today. Some bulk carriers had 'tween decks' instead of two decks, and lumber carriers frequently carried bulk cargoes. Following Devendorf's considerations, this analysis makes a distinction between the single-decked wooden bulk carrier and the double-decked wooden bulk carrier in the wooden bulk carrier class. Double-decked wooden bulk carriers, therefore, must have a draft of at least 15 feet (Devendorf 1996:50). The upper deck plan follows the fore and aft configuration, like that of R.J. Hackett, allowing room for hatches accessible to mechanized loading and unloading machines.

It should be noted that Table 1 and Figure 7 represent three types of vessels: steambarges, single-decked wooden bulk carriers, and double-decked wooden bulk carriers. Single-decked vessels constructed after 1880, however, were most likely steambarges and not single-decked wooden bulk carriers. As explained in Chapter 5, the wooden bulk carrier construction design incorporated a complex system of heavy flooring, a modification making it specifically suited for use in the iron ore trade. Unfortunately, the historical record does not indicate whether these vessels contained a heavy flooring system. Many of the single-decked vessels constructed after 1880 were used in trades other than iron, and, therefore, the probably were not constructed with this complex flooring system.

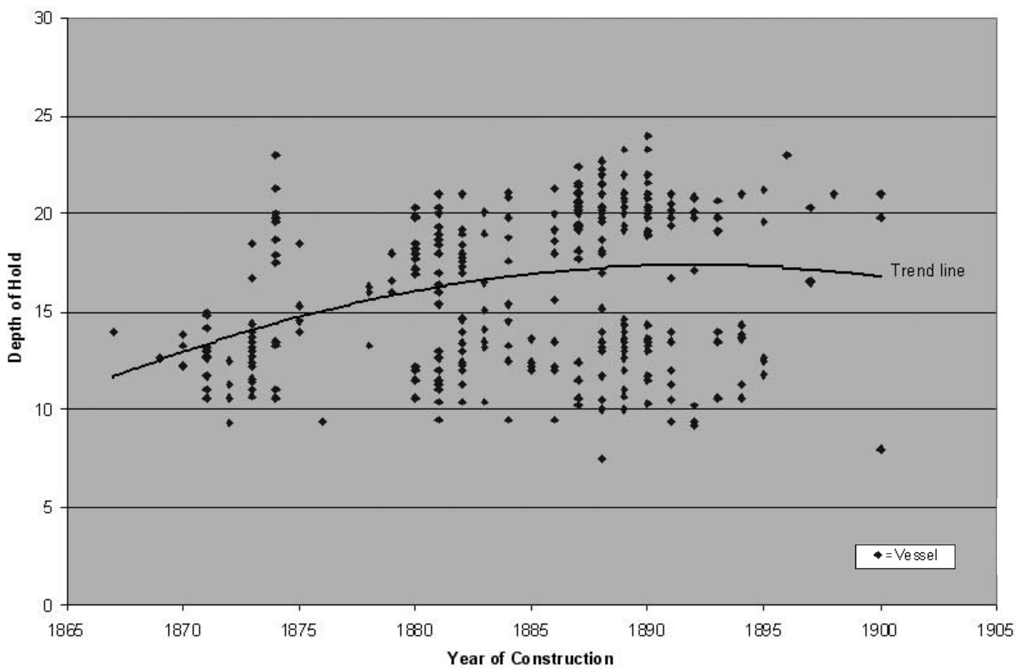

Figure 7. Chart showing increasing depth of hold by year of construction.

TABLE 1.

Wooden Bulk Carriers Constructed on
the Great Lakes 1869-1900 and their Dimensions.

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
William T. Graves	1867	207	35	14	1001	1881		1075
R. J. Hackett	1869	208.1	32.5	12.6	748	1881	19.2	1129
B.W. Blanchard	1870	212.3	32.4	12.2	1173			
Forest City	1870	216	32.5	13.8	743	1881	21.3	1236
James Fisk Jr.	1870	216.3	32.6	12.3	1456			
P.H. Birckhead	1870	156.8	27.9	13.3	378	1874		578
Annie Laura	1871	133	24.5	10.6	356			
D.W. Powers	1871	140.1	26	11.7	302			
Gordon Campbell	1871	205.4	32.4	13	996	1888		1100
H. B. Tuttle	1871	179.6	31.1	12.7	580	1877	12.7	844
Raleigh	1871	227	34	15	980	1885	15	1206
Fred Kelley	1871	212	32	14.2	926			
Joseph S. Fay	1871	215.6	33.6	14.8	882	1875	14.8	1220
Mary Jarecki	1871	179.6	32.7	13.2	502	1881		645
Raleigh	1871	227.3	34	15	980	1880		1205
S.C. Baldwin	1871	160	30	11	418			
W. L. Wemore	1871	213	33.4	12.6	850	1879	21	1216
Fayette	1872	141.3	27.9	10.6	322			
Glasgow	1872	138.8	26	11.3	303			
Irah H. Owen	1872	164.8	31.9	9.3	572			
Tempest	1872	159	30	12.5	412			
Alvin A. Turner	1873	135	26	11.4	309			
Anna Smith	1873	178.5	32.6	13.7	636	1886		939
Argonaut	1873	213	35.2	12.4	1118			
Cormorant	1873	218.4	34.6	14	872	1878		1200
D. M. Wilson	1873	179.1	32.7	12.2	757			
David W. Rust	1873	201.8	33.5	18.5	894			
David Ballentine	1873	221	34.6	13.5	972	1890	21.7	1395
Egyptian	1873	232.4	36.2	14	1065	1878		1430
Garden City	1873	133.4	26	11.6	436			
Leland	1873	148	27.6	11	324	1889		366
Nahant	1873	213.3	35	16.7	909	1885	16	1204
Oscar Townsend	1873	192	33	14.4	817	1879	14.4	1038
Scotia	1873	231.7	35.7	13	1502			
Superior	1873	187	33.1	12.7	586	1878	19.5	855
Tecumseh	1873	200	29.9	13.2	633	1878		840
Vienna	1873	191.6	32	14	745	1875		1006
William H. Barnum	1873	218.6	34.8	16.7	937	1879	21.3	1212
William L. Crippin	1873	150	30	10.7	365			
Alpena	1874	154.4	30.4	19.8	369			
Charles J. Kershaw	1874	223	37	20	1323			

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
Chauncy Hurlbut	1874	184.8	32.2	21.3	1009			
E. B. Hale	1874	217.7	34.8	17.9	1186			
George King	1874	176.4	30.7	13.3	532			
Havana	1874	217.7	34.8	17.9	1186			
James Davidson	1874	230.6	37	19.6	1456			
N.K. Fairbank	1874	205	36.7	11	980			
Persian	1874	243.7	40.1	18.7	1629			
Porter Chamberlain	1874	134	26	10.6	257	1876		387
Sparta	1874	202	34	17.5	1017			
V. Swain	1874	187.5	33.5	13.5	685	1877	13.5	955
V. H. Ketchum	1874	233	40	23	1661			
Waverly	1874	191.2	33.7	13.3	1104			
Commodore	1875	265.4	42.2	15.3	2082			
John Pridgeon Jr.	1875	221.3	36.3	14	1121			
Ohio	1875	203.2	35	18.5	1101			
Portage	1875	238	34.8	14.5	1608			
Tempest	1876	150	26	9.4	283	1890	11	369
Alcona	1878	185	34	16	723	1885	22.6	952
Delaware	1878	252.5	36	16.3	1731			
Oscoda	1878	145	32.4	13.3	529			
John N. Glidden	1879	221.7	35.7	16	1322			
Morley	1879	181.2	33	16.6	869			
William Edwards	1879	226	35	18	1271			
A. Everett	1880	211.5	34.8	17.2	1088			
A.L. Hopkins	1880	170.8	32.4	12.2	756			
Henry Chisholm	1880	256.5	39.3	20.3	1775			
Hiawatha	1880	234.6	36.1	19.9	1398			
Wocoken	1880	251.6	37.2	18.5	1400			
H. Luella Worthington	1880	148.6	27.9	11.5	375	1881	19	647
Iron Age	1880	176	34.1	16.9	859	1887		1114
James P. Donaldson	1880	185	30.4	12	521			
Minnesota	1880	206	36	18	1138			
Progress	1880	255.2	37	19.8	1596			
Smith Moore	1880	223.4	35	18.2	1191			
Stephen C. Hall	1880	161.2	30.4	10.6	447			
Thomas W. Palmer	1880	205.5	34.5	17.7				
W.H. Gratwick	1880	173	30	12	474			
Wocoken	1880	251.6	37.2	18.5	1400			
Albert Soper	1881	143.5	23.3	10.4	410			
Business	1881	191	34	16	985			
C.H.Green	1881	197.6	33.1	15.4	700	1884		920
C.H. Starke	1881	149	30	9.5	317			
Charles H. Davis	1881	145	31	20.3	390			
City of Rome	1881	268.2	40.2	20	1906			
Clyde	1881	252.5	36.4	19.3	1306			
Columbia	1881	235.4	35.6	18	1373			

continues next page. . .

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
Cumberland	1881	251.5	38.3	19	1601			
Escanaba	1881	201	35.6	20	1160			
Fred McBrier	1881	161	31	12	442			
H.C. Ackley	1881	231.6	35.1	18.7	1187			
Iron Duke	1881	212.6	35	17	1152			
James H. Shrigley	1881	171.6	31.2	11.5	459			
Jesse H. Farwell	1881	212.3	35.6	19	1200			
John B. Lyon	1881	255.9	38.8	20	1710			
Kate Buttironi	1881	174	31	20	865			
Massachusetts	1881	235	37	18	1415			
Merrimac	1881	235	37	18	1389			
Oceanica	1881	262.8	37.2	19	1490			
Ogemaw	1881	167	32.8	13	625			
Queen of the West	1881	215	32.6	16.4	818			
R. McDonald	1881	135	28	11.3	344			
Republic	1881	235	35.7	18	1343			
Robert A. Packer	1881	209	33.8	18.4	921			
Rube Richards	1881	175	33	17	815			
Rufus P. Ranney	1881	247	36	17	1392			
Saginaw Valley	1881	161	31	10.4	720	1888	11.3	1112
Sylvannus J. Macy	1881	164	31	11	548	1887	11.4	753
Samuel F. Hodge	1881	149.4	30	12.6	585			
Silvanus J. Macy	1881	164.6	31.8	11	548	1887	11.4	752
Tacoma	1881	260.9	38.7	21	1879			
Virginius	1881	160.6	31	11.5	422			
C.F. Curtis	1882	196.5	32.4	14	532	1887		691
City of Cleveland	1882	255.7	39.5	18.4	1609			
Colonial	1882	244.5	36.2	19.2	1501	1903		1713
Continental	1882	244.7	36.4	19	1586			
D.C. Whitney	1882	229	40	14.7	1090			
D. Leuty	1882	178.5	33.9	12.3	646			
Fred Mercur	1882	232	35.4	18	1224			
Harry E. Packer	1882	225.8	35.2	17.3	1183			
Hecla	1882	230.6	35.3	17	1167			
John M. Osborn	1882	178	32	14	646	1884	14	891
Lora	1882	161	32	17.6	616	1897	21.8	859
Louis Pahlow	1882	155.4	30.4	10.4	366			
M.M. Drake	1882	201	34.5	14.6	915	1885		1102
Manistique	1882	157	31	12.4	473			
Marshall F. Butters	1882	164	30	10.4	376			
Nevada	1882	170.5	30	12	634	1887		791
Oregon	1882	197	33	13	536	1888	13.6	974
Osceola	1882	183.5	33.9	13.4	980	1905	22	981
Robert Wallace	1882	209.4	36.2	17.8	1189			
Siberia	1882	272	30	18	1618	1903	22.4	1892
Wallula	1882	260.2	39.8	21	1924			
White and Triant	1882	152	28.7	11.3	459			

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
D.D. Calvin	1883	209	34.9	15.1	750			
Edward Smith	1883	194	32.9	16.5	700			
Geo C. Markham	1883	141.4	28.2	10.4	404			
George T. Hope	1883	263	39.1	19	1558	1907	22	1748
Jim Sheriffs	1883	182.8	42.9	13.2	634	1883		841
Kittie M. Forbes	1883	209	34.9	14.1	742	1884		968
Nipigon	1883	191	34	13.5	626			
Specular	1883	263.7	38.4	20.1	1687			
Australasia	1884	282	39	21.1	1820			
Clumet	1884	256.8	37.2	19.8	1526			
George Spencer	1884	230.5	37.2	18.8	1360			
H.S. Pickands	1884	181.4	32.5	13.3	625			
Kalkaska	1884	178	33.8	15.4	679			
Kasota	1884	246.9	38.2	20.9	1660			
Monteagle	1884	213.5	35	19.8	1273			
Philetus Sawyer	1884	152	31.6	9.5	449			
Rhoda Emily	1884	166.1	32	12.5	570	1887	19.6	875
Schoolcraft	1884	180.1	34.2	14.5	745			
Waldo A. Avery	1884	240.1	38	17.6	1294			
A. Folsom	1885	180	33	13.6	672	1887	21	940
James H. Prentice	1885	286	42.5	12.2	485	1886		760
New Orleans	1885	231.8	38	13.6	531			
T.S. Christie	1885	160	30.3	12	533	1886		769
W.B. Hall	1885	157.6	27.9	12.4	608			
Canisteo	1886	182.2	34.3	12	595			
Charlemagne Tower Jr.	1886	255.8	40	21.3	1825			
J.H. Outhwaite	1886	224	37.4	18.6	522			
James Pickands	1886	232.6	40	19.2	1545			
John F. Eddy	1886	259.2	37.6	20	1678			
Josephine	1886	165	31.6	12	474	1887	19	775
Simon Langell	1886	195.3	34.6	13.5	845			
Veronica	1886	202	34.8	18	1092			
W.J. Carter	1886	122	27.8	9.5	317			
W.R. Stafford	1886	184.8	34.2	12.2	744			
William H. Stevens	1886	212.4	37.2	15.6	1332			
A D Hayward	1887	137.9	28.6	10.6	305			
Aurora	1887	290	41	22.4	2282			
Bulgaria	1887	280.3	39	21	1888			
Chenango	1887	175.6	33.8	20.4	938			
Edward S. Tice	1887	159.91	32.1	12.4	728			
F.W. Wheeler	1887	265.5	40.5	19.4	1687			
Frank L. Vance	1887	257.6	39.5	20.2	1731	1900	23.3	1952
Gettysburg	1887	208.5	35.5	21.6	1358			
Gogebic	1887	227.2	40.4	19.5	1680			
Horice A. Tuttle	1887	250	38.8	20	1585			
Iron King	1887	259.3	37.4	20	1702			

continues next page. . .

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
J.C. Gilchrist	1887	252	42	20.4	1827			
Kaliyuga	1887	269.6	40.2	20.7	1941			
Louisiana	1887	267	39.6	20	1753			
M.T. Greene	1887	155	30	11.5	532			
Manhattan	1887	252.4	38	19.4	1545			
Margaret Olwill	1887	177.3	34.2	10.2	541	1890	10.2	925
Maurice B. Grover	1887	272	40.1	21.4	1995	1898	23.4	2213
Missoula	1887	272	40.6	21	1926			
Omaha	1887	22.8	34.8	18.1	1251			
R.P. Fitzgerald	1887	256.6	38	20	1681			
Robert R. Rhodes	1887	246	40	19.3	1576			
Roswell P. Flower	1887	264	38.1	17.7	1593			
Roumania	1887	273.5	39.5	21.1	1837			
Samuel Mather	1887	246	40	19.3	1576			
Sitka	1887	272.5	40.5	19.4	1740			
Wiley M. Egan	1887	252	39	20	1677			
Wm. H. Wolf	1887	285	42.9	19.2	2265			
William H. Gratwick	1887	265.5	40.5	19.4	1687			
Wyoming	1887	250.4	40.1	19.3	1492			
Yakima	1887	279	40.5	20.6	1986			
Albert Y. Gowen	1888	120	27.6	7.5	213			
Alfred P. Wright	1888	286	41.5	22.3	2207			
Britannic	1888	219.2	36.2	17	1121	1896	21.3	1319
Charles A. Street	1888	165.3	31.4	13	697			
Charles Hebard	1888	184	34.3	13.5	763			
Charles McVea	1888	123	24.1	10	264	1889		331
Charles Stewart Parnell	1888	256.4	38.5	19.8	1561	1889		1739
Elfin-Mere	1888	190.5	34	21	1054			
George H. Dyer	1888	208.8	35.1	21.6	1372			
George G. Hadley	1888	287.6	40	21.6	2073			
George W. Morley	1888	192.9	41.4	21	1045			
George W. Roby	1888	281	41.3	21.6	2073			
Germanic	1888	216	36	18	1131	1901	22.3	1391
Gladstone	1888	283	40	22	2112	1901	22.4	2453
Helena	1888	275.5	40.2	20.3	2083			
Henry J. Johnson	1888	260	40.2	19.6	1713	1900		1997
J. Emory Owen	1888	256.4	38.5	19.8	1739			
John Craig	1888	275	41.6	20.4	2044			
John Rugee	1888	223.5	35.3	18.7	1261			
Mark Hopkins	1888	186	32.6	13	732			
Mary H. Boyce	1888	181.4	34.2	14	700			
May Durr	1888	162	31.4	11.7	582			
Mecosta	1888	281.7	40.6	20	1776			
Neosho	1888	266	41	21	1982			
Pacal P. Pratt	1888	272.2	40.5	21.5	1927			
Pawnee	1888	174	32.6	13.2	639			
Philip Minch	1888	275	40.6	22	1988	1900		2010

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
R.R. Buell	1888	194	36.4	22.7	1438			
Robert C. Wente	1888	141	30	10.5	409			
Robert L. Fryer	1888	281.1	41.4	20	1810			
Robert Mills	1888	256	40.2	20.2	1790	1909	23.4	2070
Samuel Marshall	1888	198	34.2	15.2	775			
Servia	1888	242	40	18.1	1425			
Thomas Davidson	1888	285.8	41.7	20.4	2226	1917	23.4	2483
Tom Adams	1888	281	41.4	20	1810			
Volunteer	1888	270.8	41.6	20.4	1944	1903	22.3	2316
Wm. B. Morley	1888	277.2	42	13	1846	1901	24.6	2197
A.G. Lindsay	1889	196	37.6	14.3	881	1892	21.6	1354
Aztec	1889	180	33.3	13.6	834			
C.W. Elphicke	1889	273	42	20.4	2058			
Charles A. Eddy	1889	281	40.8	20.7	2075			
Cherokee	1889	208.7	35.7	14.4	1002	1891	22.1	1304
Fedora	1889	282.2	41.5	21.1	1848			
Francis Hinton	1889	152.2	30.9	10.7	417			
George F. Williams	1889	280	41.4	20.3	1888			
George W. Roby	1889	281	41.4	20	1843			
George Presley	1889	265	41	20	1936	1900	23.4	2164
Gov. Smith	1889	240	42	23.3	2044			
Isabella J. Boyce	1889	138	29.6	11	368			
Italia	1889	289	42	20.8	2036			
J.C. Ford	1889	172	32.9	12	520			
James C. Lockwood	1889	286	42.5	22	2278			
James R. Langodon	1889	240	42	23.3	2044			
John M. Nicol	1889	263	41.6	13.5	2126			
John Mitchell	1889	283	41.4	20	1864			
John Owen	1889	281	41	20	2127			
John Plankinton	1889	267	40.9	21	1821			
Majestic	1889	291	40	21.1	1985			
Marion	1889	217.1	34.7	19.4	1206			
Neshoto	1889	284.2	42.5	22	2255			
Niko	1889	189	35	13	782	1890	13	1039
Olympia	1889	276.5	41.5	12.6	2065			
Oscar T. Flint	1889	218	37	14	823	1896	22	1127
P.J. Ralph	1889	211.4	37	14	964			
Pasadena	1889	250	40	13.2	1760	1899	24.8	1982
Philip D. Armour	1889	264	40.6	21	1990			
R.C. Reid	1889	129	25.6	10	322	1893		460
						1895		554
Sachem	1889	187	33.5	14.6	739			
Thos. W. Palmer	1889	281	41	20	2134			
Toltec	1889	191.3	32.6	13.6	684			
Topeka	1889	228.3	36	19.2	1376			

continues next page. . .

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
A. McVittie	1890	240	42	23.3	2047			
Alex. Nimick	1890	298.4	40	21	1968			
Byron Whitaker	1890	220	38	20.4	1404	1903	23.3	1586
C.B. Lockwood	1890	285.2	45	18.9	2139	1899	21.8	2323
Denver	1890	222.4	37	19	1295			
Edward Smith	1890	201	37	13	748			
F.H. Prince	1890	240	42	23.3	2047			
Fred Pabst	1890	287.3	42.6	24	2430			
Henry R. James	1890	240	42	23.3	2048			
Hesper	1890	250.3	41.6	20.2	1858	1899	24	2105
Hiram W. Sibley	1890	221	37	21.6	1418			
Indiana	1890	201	35.4	14.3	1178			
Ionia	1890	209.2	38.1	21	1287	1903	21.3	1287
John Harper	1890	298	40	20.8	1951			
James Oades	1890	212	36.6	22	1455			
John Schroeder	1890	154.8	29.8	11.7	372			
Langell Boys	1890	151	30	11.7	387	1921		467
Maggie Duncan	1890	164.5	31.8	11.5	535			
Nyanza	1890	280	41.4	20.3	1888	1904	23.3	2296
Panther	1890	237	36	19	1374	1901	22.2	1634
R.E. Schuck	1890	265.7	41.5	19.1	1867	1903	22.3	2122
S.S. Wilhelm	1890	185	35	13.6	683			
Sidney O. Neff	1890	149.6	30.2	10.3	435			
St. Lawrence	1890	239.2	41.1	20	1437			
Tampa	1890	291.6	41	19.8	1972			
W.H. Sawyer	1890	201.1	37	13.5	746			
Walter Vail	1890	210	34.7	13.3	789			
Atlanta	1891	200.1	32.2	13.5	1129			
City of Berlin	1891	298	41	21	2052			
City of Glasgow	1891	297	41	20.5	2002			
City of London	1891	297	41	20.5	2005			
City of Paris	1891	298	41	21	2063			
Edward Buckley	1891	154.3	31.7	10.5	415			
F.W. Fletcher	1891	161	32	11.3	496			
Ferdinand Schlesinger	1891	305.7	43.4	20.2	2607			
Iosco	1891	291	41	19.8	2051			
J.D. Marshall	1891	154.5	33.5	12	531			
John Duncan	1891	225.2	37.8	16.7	1267			
Norwalk	1891	209.2	38.8	14	1007			
O.O. Carpenter	1891	127.6	30.6	9.4	364			
Pueblo	1891	225.7	36.6	19.4	1349			
William F. Sauber	1891	291	42	19.8	2053			
C.F. Bielman	1892	291	41	19.8	2056			
City of Genoa	1892	301	42.5	20.1	2446			
City of Naples	1892	301	42.5	20.1	2109	1905	22.7	2340
City of Venice	1892	301.5	42.5	20.1	2105			
Desmond	1892	149	30.5	9.4	456			

Vessel Name	Year Built	Length	Beam	Depth	Gross Tonnage	Year Dimension	New Depth	New Tonnage
E.A. Shores Jr.	1892	176	34.2	10.2	519			
Harvey J. Kendall	1892	141.6	30.7	9.2	398			
Iroquois	1892	242	41	20.8	1769	1902	24.7	1957
John J. Hill	1892	170	40.9	17.1	974			
Uganda	1892	291	41	19.8	2054	1905		2298
W.B. Morley	1892	249	42.5	20.9	1748			
George Stone	1893	270	40.1	19.1	1841			
L.R. Doty	1893	291	41	19.8	2056			
Lloyd S. Porter	1893	159	30.6	10.6	536			
Santa Maria	1893	203	37.3	14	982			
Thomas Cranage	1893	305	43	20.7	2219			
Wotan	1893	191.5	36.5	13.5	886			
Adella Shores	1894	195.2	34.9	11.3	734			
Madagascar	1894	241	37	13.8	1203	1899		1697
Minnie E. Kelton	1894	171	35	11.3	632	1914		831
Mohegan	1894	234	30	13.6	1216	1917		1234
Nicaragua	1894	248	37	13.7	1204			
Normandie	1894	160	35.3	10.6	567			
Pentland	1894	192.8	35.5	14.3	827			
Shenandoah	1894	308	43	21	2251			
Argo	1895	192	35	12.6	721			
George Farwell	1895	182.4	34.8	19.6	977			
I. Watson Stephenson	1895	172	35	11.8	639			
Linden	1895	206	35	12.5	894			
Rappahannock	1895	308.1	42.6	21.2	2380			
Sacramento	1895	308.2	42.6	21.2	2380			
Appomattox	1896	319.8	42	23	2643			
Bermuda	1897	220	41	16.6	1312			
Black Rock	1897	237	43	16.5	1646	1903	23	1997
Venezuela	1897	263.3	25.5	20.3	2125			
Amazonas	1898	295	44	21	2228			
Orinoco	1898	295	44	21	2226			
Alfred Mitchell	1900	255	39.5	21	1751			
Alvah S. Chisholm Jr.	1900	151	35	8	435			
Cartagena	1900	241	40	19.8	1532			

Table 1 and Figure 7 also imply that shipbuilders constructed deeper-drafted vessels in speculation of the Wetzel Lock's completion and subsequent deepening. Shipbuilders and shippers recognized that larger vessels with deeper drafts would allow shippers to transport more cargo with less overhead. According to the database, in 1873, shipbuilders constructed at least four vessels with double decks: *David W. Rust*, *Ohio*, *Cormorant*, and *Nahant*. Builders launched nine others in 1874, and approximately a dozen more before the completion of the Wetzel Canal in 1881. All of these vessels boasted a maximum draft over 18 feet. The same pattern appears with the deepening of the canal in 1886.

Table 1 indicates an important exception to these rules. Several vessels, such as *R. J. Hackett*, obtained a second deck during their career on the Great Lakes. These vessels started their careers as single-decked wooden bulk carriers, but with the addition of a second deck, these ships transitioned into the constructs of double-decked wooden bulk carriers. Shippers and shipbuilders may have added this second deck in order to compete with the growing carrying capacities of larger bulk carriers, as the additional deck deepened its draft and increased its gross tonnage. The vessels still profited as ore carriers, as they were enlarged in order to compete with larger vessels.

Figure 7 indicates that shipbuilders fabricated many vessels with single decks up until the turn of the century. Unlike the *Hackett*, many of these never had a second deck added. One hypothesis was that their single deck form functioned better in other industries such as the lumber or coal trades. These vessels may have been specifically constructed for an industry other than that of the ore trade, or their occupation switched from the ore trade to a less lucrative trade before the completion and subsequent deepening of the Wetzel Canal. The latter suggests that the larger, more efficient double-decked wooden bulk carriers pushed the single-decked wooden bulk carriers into less lucrative trades. In fact, many photographs of single-decked, transitional vessels portray the vessels carrying loads of coal or lumber.

Great Lakes shipbuilders confined their vessel designs to the dimensions of the canals. The vessels took on a long, narrow, and shallow design, creating structural problems in the hull. The long shape inevitably succumbed to severe hogging and sagging stresses. According to Charles Desmond's *Wooden Shipbuilding*, hogging occurred when the "strength of hull structure is not sufficient to withstand the strain the ends of ship will drop, relative to center, and hull will ultimately change its form and become 'hogged'" (Desmond 1998 [1919]:31). Likewise, sagging strains,

> Are nearly always present when a ship is floating without cargo in still water, but if it should happen that condition of weight and buoyancy are such that there is an excess of buoyancy at ends and an excess of weight near middle, the middle would drop relative to ends and change of form, if hull is weak, (sagging) would occur near middle length (Desmond 1998 [1919]:31).

Shipbuilders determined that the maximum length of a wooden vessel was approximately 300 feet. Beyond this length, the rigidity of a wooden vessel diminished, thus hogging and sagging greatly increased, as did leakage (Labaree et al. 1998:390). Shipbuilders attempted to compensate for this with innovative designs such as iron cross bracing, an innovation first applied to the clipper ship *Challenge* in 1851 (Cooper and Jensen 1995:18; Rodgers 2003:29). In 1887, Frank W. Wheeler's *Sitka* borrowed the idea of using iron cross bracing to provide longitudinal support for the superstructure of wooden bulk carriers (Labadie 1989:108-111). *Sitka*, a double-decked wooden bulk carrier, measured 272.55 feet in length, 40.50 feet in beam, and had a 19.4 foot depth of hold. Wheeler constructed *Sitka* with diagonal, steel-reinforcing straps. The straps extended a short distance under the turn of the bilge, indicating that they were intended to provide side rather than bottom support (Labadie 1989:111-118).

James Davidson improved on Wheeler's iron cross bracing design. In *The Bones of a Bulk Carrier*, Rodgers indicated that *City of Glasgow*, constructed in 1891, was unique in that Davidson constructed the vessel with an "iron basket truss" (Rodgers 2003:1). The *City of Glasgow* was one of the largest wooden bulk carriers built on the Great Lakes, measuring 297.0 feet long, 41.0 feet wide, and it had a 20.42 foot draft. This basket truss provided extra support against hogging and sagging stresses commonly associated with cargo vessels exhibiting a large length to beam ratio. Davidson used the basket truss because it provided an "ideal way to improve the strength of his bulk carriers while integrating the flexibility for the chief materials, iron and wood. The basket truss was able to flex with the wood, loaning it support from beneath while it did no harm to the relatively soft material that made up the ship's hull" (Rodgers 2003:8, 32).

Thompson indicates that regardless of the size of the ship, the rate at which cargo was unloaded remained unchanged until the 1880s. In the early to mid-nineteenth century, unloading a vessel took longer than transporting ore from the Lake Superior to Erie, Cleveland, or Chicago. Vessels often waited several hours to access the unloading docks. A few shipowners believed that a larger vessel was less efficient to load or unload than smaller ships, but these shipowners failed to recognize an important fact. As Thompson explains, "On a per-ton basis, the larger ship would spend the same amount of time at the dock as a smaller one. The larger ship would still be more efficient because it could move the 3,000 tons of cargo down the lakes in a single trip, with a single crew" (Thompson 1994:34). Thompson indicates that this fact is a principle guiding the industry today. "The greatest efficiency is achieved through the use of the largest vessel possible, taking into consideration the amount of cargo to be moved and the size restrictions imposed by the trade route" (Thompson 1994:34).

The expansion of the locks and the transition to the double-decked wooden bulk carrier allowed shippers to transport, without a toll, larger amounts of ore in a single trip. To keep up with increased transportation of ore, many mechanized unloading machines were introduced after the 1880s. For example, Alexander Brown, a dockmaster and son of iron-ore magnate Fayette Brown, developed one such unloading system. The system carried a series of buckets along a steel cable from a vessel to a pier. He improved on this design and later developed the Brown Hoist, also called an unloading bridge (See Figure 8). The Brown Hoist consisted of numerous buckets raised and lowered by a crane operator on a dock. Unloading facilities utilized several cranes simultaneously, unloading cargo from several hatches of a single ship. The first Brown Hoist system was set up in Erie, Pennsylvania, in 1880 (Thompson 1994:34). It soon gained popularity at other ore docks. The disadvantage of the Brown Hoist was that the operator could not see into the hold, and, therefore, the buckets required manual loading below decks. Despite this problem, this innovation cut unloading time by a third (Barry 1970:121-123; Labaree et al. 1998:373).

Figure 8. The Brown Hoist (Courtesy TBSRC).

Whirly cranes (Figure 9) also developed around the same time as the Brown Hoist. They were considerably less expensive and more flexible. James P. Barry describes the whirly crane as:

> a steam derrick, mounted on railroad wheels; the cab of the derrick and its attached arm could pivot and the whole thing was self-propelled. It rode on a track – much wider than a normal railroad track – which was laid along the edge of the unloading dock. Usually a regular track to carry gondola cars ran beside the wider track. The crane would move into position beside the open hatch of a laden ship, lower a bucket on a cable into the hold, pull out a bit of ore or coal, then spin around and dump the bite into a waiting rail car. Before long everyone called such cranes 'whirlies' (Barry 1970:145).

The construction of the Wetzel Locks and the development of more-efficient unloading mechanisms paralleled an increasing demand for iron. Transportation of ore across the lakes increased dramatically following the enlargement of the Sault locks. Upon completion of the Wetzel Lock in 1880, nearly 1,900,000 tons of iron ore moved down the lakes. By the time workers deepened the Wetzel Lock in 1886, shippers were capitalizing on the new unloading mechanisms, and iron ore transportation topped over 3,000,000 tons (Mansfield 1972 [1899]:566).

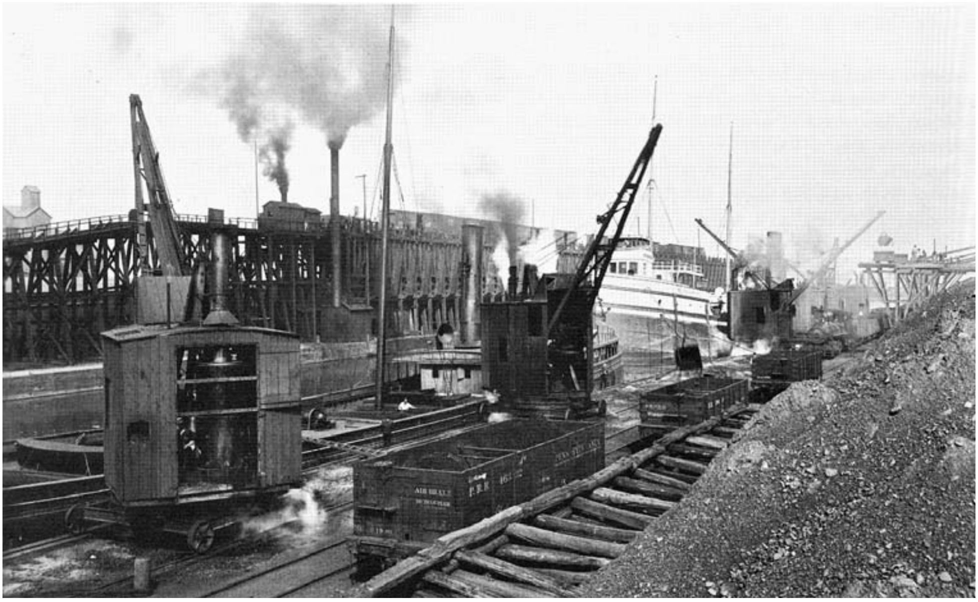

Figure 9. Whirlies (Courtesy TBSRC).

The Question of Wood or Steel

As the double-decked wooden bulk carrier replaced the single-decked wooden bulk carrier in the ore trade, the very cargo that it carried formed the basis of the next phase in the integrated bulk carrier system. From the ore transported by wooden bulk carriers, shipbuilders fashioned entire ships of iron and steel. In 1882, Philip Minch introduced the first iron hulled bulk carrier, *Onoko* (See Figure 10). The vessel measured 302.5 feet in length, 38 feet in beam, and had a 20 foot depth of hold, endowing her with 2,164 gross tons. Following the design of *R.J. Hackett*, Minch placed *Onoko*'s pilothouse forward and engine house aft, leaving a clear amidships deck plan for the placement of hatches matching the specifications of the pocket docks. The only obvious difference between *R.J. Hackett* and *Onoko* was in construction material and size. Thompson states that many people regarded *Onoko* as the first modern bulk carrier (Thompson, 1994: 29, 33).

Five years later, in 1887, the first steel-hulled bulk carrier, *Spokane*, slid down the stocks of the Globe Shipbuilding Company in Cleveland, Ohio (Wright 1969:5). Originally designed as an iron-hulled vessel, her owners, Captain Thomas Wilson and several other investors, decided to change the vessel's construction material, hoping insurance underwriters would recognize that steel allowed for a stronger hull than iron. Cheaper insurance premiums and the declining cost of steel compared to wood prompted shipbuilders to switch to steel hulls. Thompson indicates that the use of this new technology in ship construction materials was only possible after several refinements of the mid-century Bessemer process. By the mid-1880s, the Siemen-Martin process allowed relatively low cost steel to become available for ship construction purposes (Thompson 1994:39).

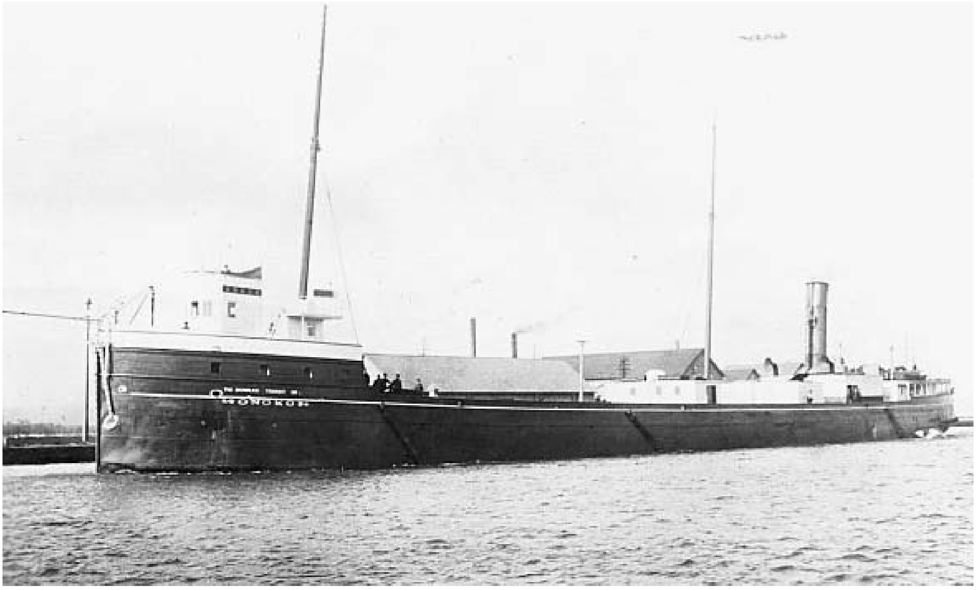

Figure 10. Photograph of *Onoko* (Courtesy TBSRC).

The transition from wood to steel bulk carriers on the Great Lakes was slow for several reasons. First, wooden construction cost less than iron or steel construction. Mechanization in logging activities nearly cut in half the amount of labor required for sawmills, which in turn reduced the cost in wooden construction. Shipyards that constructed wooden vessels required far less investment in equipment, training, and labor than a yard producing iron or steel vessels (Cooper and Jensen 1995:17). Iron shipbuilding, on the other hand, required more investment in complex equipment and precise ship plans (Rodgers 1996:9).

Second, the cargo carrying capacities of wood hulled vessels were surprisingly similar. This was only because of the consort system. Shippers practiced the consort system into the twentieth century, building purpose-built barges to go along with each steamer produced. For example, *Monohansett* towed *Jesse Linn*, a barge constructed by Linn & Craig of Gibraltar without a propulsion system, solely to be used as a consort (GLVI 2005). Shippers were content to continue transporting products in wooden vessels because they remained efficient and cost-effective (Copper and Jensen 1995:29).

By the turn of the century, however, lumber companies had depleted the supply of white oak and pine around the Great Lakes. Wood prices began to rise. At the same time, steel prices fell because of the newly adopted Siemen-Martin process. Insurance rates lowered on steel vessels for two reasons: they allowed for a reliably dry compartment ideal for perishable cargoes, and they lasted a long time in freshwater environments in comparison to wooden vessel. Inevitably, a wooden vessel rots and its timbers become extremely dry. Mills indicates that a wooden vessel on the Great Lakes could safely service for approximately 15 years. After 15 years, shippers expected to begin replacing parts of the hull. In addition, the sparks from a steam engine or a boiler explosion gave older vessels a higher risk of fire, and heavy weather could open up the seams of a vessel. Pounding waves also, invariably, break wooden vessels into pieces within a short time of their loss, destroying the chance for salvage (Mills 2002:2). Thus, wooden vessels by the turn of the twentieth century cost more to build and maintain on the lakes than steel-hulled vessels (Cooper and Jensen 1995:19; Mills 2002:3).

Moreover, an iron or steel bulk carrier was lighter, less prone to leakage, stronger, and more durable than its wooden predecessor. Wood and iron behave differently under stress, and, when used together for ship construction, they have a tendency to work against each other. Rodgers asserts that wood flexes to a certain degree while iron "takes stress as a solid, homogenous unit" (Rodgers 1996:22-23). Wood vessels with iron fastenings, therefore, were more prone to leakage as the fastenings eventually work themselves loose from the flexing wood (Rodgers 1996:22-23). Iron and later steel-hulls created a rigid, watertight hull, uninterrupted by dissimilar properties of construction members.

During the end of the nineteenth century, two technological innovations made iron ship construction more efficient on the Great Lakes: the gantry crane and pneumatic tools. In the early 1800s, iron shipbuilding required a large work force. Workers constructed entire vessels with manual labor, including lifting steel plates and hammering rivets. In 1887, Alexander Brown constructed a mechanized lifting crane for the Cleveland Shipbuilding Company. It was capable of lifting 2,000 pounds and moving the load 150 to 200 feet per minute, a feat that previously required considerable manual labor (Wright 1969:12). News of the specialized crane spread fast, and several other shipyards followed suit, including F. W. Wheeler and the Chicago Ship Building Company.

The gantry crane cut labor costs dramatically in shipyards, but shipbuilders still faced high costs in the riveting department. Workers had to set all plates and rivets manually. Shipyards organized the riveters into gangs, consisting of a heater, a holder-on, and two riveters. A gang could only drive 300 to 500 rivets in a single day. The pneumatic riveter appeared in shipyards about 1896. This mechanized riveting process cut down construction time and reduced labor expenses by using unskilled laborers rather than skilled riveters (Wright 1969:14-15, 33).

In the late 1890s, two innovations solidified the steel bulk carrier as the primary vessel in the integrated bulk carrier system: the Hulett unloader and the construction of the Poe lock. In 1899, George H. Hulett improved on Brown's unloading system by adding a clamshell bucket that could hold 15 tons. Because Hulett's system used a larger bucket, it required enlarged hatches. The design of Great Lakes ore carriers changed; steel bulk carriers could accommodate the new hatches, but wooden bulk carriers could not without compromising the integrity of the vessel. The Hulett unloader, proficient for servicing steel bulk carriers, became the standard until the introduction of the self-unloading system in the twentieth century (Labaree et al. 1998:373).

In 1896, the Poe Lock at Sault Ste. Marie, with a length of 800 feet, a width of 100 feet, and a depth of 22 feet, opened to facilitate the longer lengths achievable with stronger, steel construction materials (Labaree et al. 1998:373; Mansfield 1972 [1899]:244). By the 1880s, ore shipments surpassed all other cargoes in tonnage on the lakes. Iron ore shipments from Lake Superior increased almost ten fold, from 1,908,745 gross tons in 1880 to 10,429,037 gross tons in 1890 (Labaree et al. 1998: 373). Most of these shipments were destined for Pittsburgh, which soon became the center of the nation's iron and steel industry. Other cities along the Great Lakes, including Chicago and Detroit, also developed steel plants. Today, steel bulk carriers carry more tonnage through the Sault locks than any other lock in the world, including the Suez and Panama Canals.

Conclusion

This chapter demonstrates how the nineteenth-century Great Lakes wooden bulk carrier developed into its modern steel form. Epitomized early on by the *R.J. Hackett*, these vessels capitalized on the advantages of both steambarges and sailing vessels. Peck designed the *Hackett* with a relatively clear deck and inner hold plan, like that of a sailing vessel, allowing room for hatches matching the specifications of the pocket docks. Its innovative design facilitated technological advancements associated with the iron ore industry, such as loading and unloading mechanisms. Its deck plan, conforming to the fore and aft configuration, and its shape, having a rectangular cross-section, allowed the vessel to operate with maximum efficiency in the Great Lakes canal environment. Its main design restriction was limited to the shape of the locks at Sault Ste. Marie.

As the economic value of the Lake Superior region was realized, the locks underwent a series of subsequent enlargements during the later part of the nineteenth century. Shipbuilders pushed the limits of wooden ship constructing as they attempted to maximize their designs. They added a second deck, combating hogging and sagging stresses caused by the high length to beam ratio, and this marked the transitional point between the single-deck wooden bulk carrier and the double-decked wooden bulk carrier.

Ultimately, shippers and shipbuilders realized that wooden vessel construction could not exceed the 300-foot length without loosing integrity. Despite the emergence of a new construction material, allowing longer length to beam ratios, wooden shipbuilding persisted on the Great Lakes until almost the turn of the century. Finally, dwindling timber supplies and the inherent disadvantages of wooden ship construction pushed the bulk cargo trade to explore new shipbuilding materials for its transportation needs. The form and function of the wooden bulk carrier proved so effective that its modifications, highlighted by *R.J. Hackett*, carried over into iron and steel bulk carrier construction.

3

The Tale of An Oaken Whale: The History of the *Monohansett*

Introduction

Monohansett's career on the Great Lakes embodies an important period of technical change in ship construction techniques. Linn & Craig, who founded their shipyard in Gibraltar, Michigan, in 1866, designed *Monohansett* to carry bulk cargoes. The vessel was so successful an ore carrier that it served the iron ore industry for nearly 20 years.

Monohansett, originally named *Ira H. Owen*, represents a transitional phase between wooden steambarges and wooden bulk carriers in Great Lakes ship construction. This chapter examines the career of this vessel, placing this single-decked wooden bulk carrier in an historical context. As Rodgers states, "The notion that all working ships lead a charmed life until the day of their demise is patently false" (Rodgers 2003:11). The captains and crew of *Monohansett* faced collisions, groundings, founderings, and fire. In this way, *Monohansett* truly represents bulk commodity tradition and history in relating the experiences and hardships of shipbuilders, seamen, and shippers on the Great Lakes during the late nineteenth century.

The Formation of Linn & Craig

The tale of this oaken whale begins with a brief historical account of her shipbuilders, John Craig and Robert W. Linn. Historical documentation on Linn and Craig is limited. *Freshwater Whales: A History of the American Ship Building Company and Its Predecessors* (1969) by Richard J. Wright provides insight into the formation of Linn & Craig. Wright bases much of his research on a few private documents owned by descendants of Craig.

Wright indicates that John Craig was born and raised near the New York shipyards. At the age of 21, Craig signed on with the U.S. Navy as a ship carpenter. He remained stationed in his hometown, where he helped convert merchant vessels into gunboats during the Civil War. During his service, Craig met a reputable New York shipbuilder named Simonson and entered into a partnership with him. They founded a shipyard in Keyport, New Jersey. After the war, however, the demand for shipbuilding on the east coast was almost nonexistent. Craig was forced to look elsewhere for work (Wright 1969:246).

In 1866, Craig's brother-in-law, Alexander R. Linn, informed Craig of a shipbuilding prospect in Gibraltar, Michigan. Linn's uncle, Robert W. Linn, wanted a shipbuilder to construct a vessel out of timber from his land. Craig took the job offer and moved with his wife, Annie, to Gibraltar. During his first year in Gibraltar, he successfully constructed the schooner *Jane Ralston*, receiving $500 and a partnership offer from R. W. Linn. He accepted the offer, forming the shipyard known as Linn & Craig (Wright 1969:246).

Construction of *Monohansett*

During Craig's partnership with Linn, the Lake Michigan Transportation Co., from St Clair, Michigan, contracted Linn & Craig to construct a steamer for the burgeoning iron ore trade. The shipping company was engaged in the transportation of iron ore from Escanaba, Michigan, to Union Steel, located in the Chicago area (Temin, 1976: 171, 191).

In 1872, Linn & Craig launched a 164.8-foot long vessel for the company (GLVI 2005). The Lake Michigan Transportation Company christened the vessel *Ira H. Owen* after a member of the company (Figure 11). Linn & Craig charged the Lake Michigan Transportation Co. $50,000 for the construction of this oaken whale (*Chicago Times* 1872).

Ira H. Owen's official number was registered as 100156. The vessel boasted a beam of almost 32 feet and 9.4-foot depth of hold. The vessel's combined length, width, and breadth endowed her with 572 gross tons (GLVI 2005). On March 3, 1872, the *Chicago Times* indicated that *Ira H. Owen* was capable of carrying 800 tons of iron ore in a single trip (*Chicago Times* 1872).

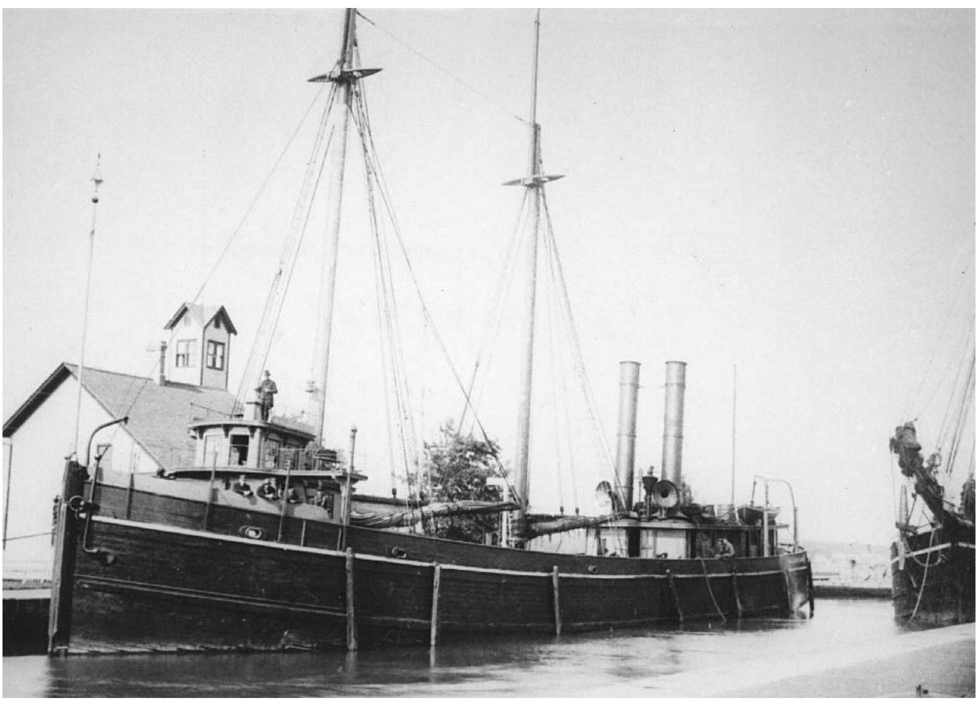

Figure 11. Photograph of *Ira H. Owen* during her early years of service on the lakes (Courtesy TBSRC).

Since Linn & Craig designed *Ira H. Owen* to carry bulk cargo, particularly iron ore, its deck plan resembled that of the pioneer carrier *R.J. Hackett*. A pilothouse with cabins rested on the forward deck while an engine house with additional cabins rested towards the stern. This fore and aft configuration allowed for a relatively clear amidships deck plan, providing room for hatches matching the specifications of the pocket docks at Marquette.

An early photograph (Figure 12) of *Ira H. Owen* indicates that the vessel carried two masts fitted with fore and aft sails. The sails assisted its steeple compound engine with cylinders rated at 16 and 27 inches in diameter with a 32-inch stroke. The engine was constructed by S.F. Hodge & Co. from Detroit, Michigan (GLVI 2005).

The photograph (Figure 12) also depicts *Ira H. Owen* carrying two boiler stacks. This suggests that she was fitted with two boilers. The historical record, however, indicates that she only carried one firebox boiler, measuring 9 feet 8 inches in diameter with a length of 13 feet 5 inches (GLVI 2005).

Another discrepancy exists in the historical record as to whether *Ira H. Owen* had a single or double deck. Enrollments from 1872, 1879, and 1882, record that the vessel carried two decks, but the 1888 enrollment indicates that the vessel carried only one deck (GLMHC 2005). Adding further confusion, the "Ship Information and Data Record" from The Great Lakes Marine Historical Collection indicates that *Ira H. Owen* had a second deck added in 1879 (GLMHC 2005).

In *Great Lakes Bulk Carriers 1869-1985*, Devendorf states that the earliest bulk carriers had a shallow hull with a forecastle and poop deck (Devendorf 1996:58). Given *Ira H. Owen*'s relatively shallow depth of hold of 9.4 feet, it seems unlikely that the vessel carried two decks in this limited space. Following Devendorf's description of early bulk carriers, it is possible that enrollment officials counted her forecastle and poop deck as a second deck.

Life as an Ore Carrier

For seven years, *Ira H. Owen* hauled iron ore across the lakes from Escanaba to Chicago for the Lake Michigan Transportation Company. Figure 12 captures the vessel laden with ore. Although the date of the photograph is unknown, it probably depicts the vessel during her service for this company.

Her seven-year career with the Lake Michigan Transportation Co. did not pass without incident. In 1874, *Ira H. Owen* and her consort, *Jesse Linn*, foundered on rocks on the Door Peninsula in Wisconsin. The crew of *Ira H. Owen* managed to maneuver the vessel off the shoals, but the tug *Wood* had to pull *Jesse Linn* off the rocks (*Door County Advocate* 1874).

Three years later in 1877, *Ira H. Owen*, laden with iron ore and towing a consort, ran aground while entering the channel at Port Erie. The *Erie Morning Dispatch* reported that *Ira H. Owen* came to an abrupt stop, but its consort retained momentum. Crewmembers let go of the towline, but the line tangled up in *Owen*'s wheel. The crew of the tug *Thompson* pulled *Owen* off the shoal and towed the vessel to Reed's dock in Erie. Technicians labored for several hours before finally cutting the towline from *Owen*'s wheel (*Erie Morning Dispatch* 1877). Her consort was apparently unscathed.

On February 10, 1879, the Lake Michigan Transportation Co. sold *Ira H. Owen* and *Jesse Linn* to the Inter-Ocean Transportation Company of Milwaukee (GLMHC 2005). Stephen Clement, James C. Ricketson, and Francis Hinton composed the charter members of this company (*Milwaukee Sentinel* 1878). They continued this vessel in the ore trade between Escanaba and Chicago.

After Inter-Ocean's purchase, the company painted *Owen*'s hull black (*Chicago Inter-Ocean* 1879). Figure 12 depicts *Owen* with her new paint job in Port Chicago. Although not indicated in the historical record, when compared to Figure 13 it is apparent that several improvements were made to the hull and deck plan. The forward bulwark was raised, and the vessel boasts a pilothouse with three windows instead of two. *Owen*'s sails were removed, and its rigging was reduced, indicating that the captain relied solely on the engine rather than the sails.

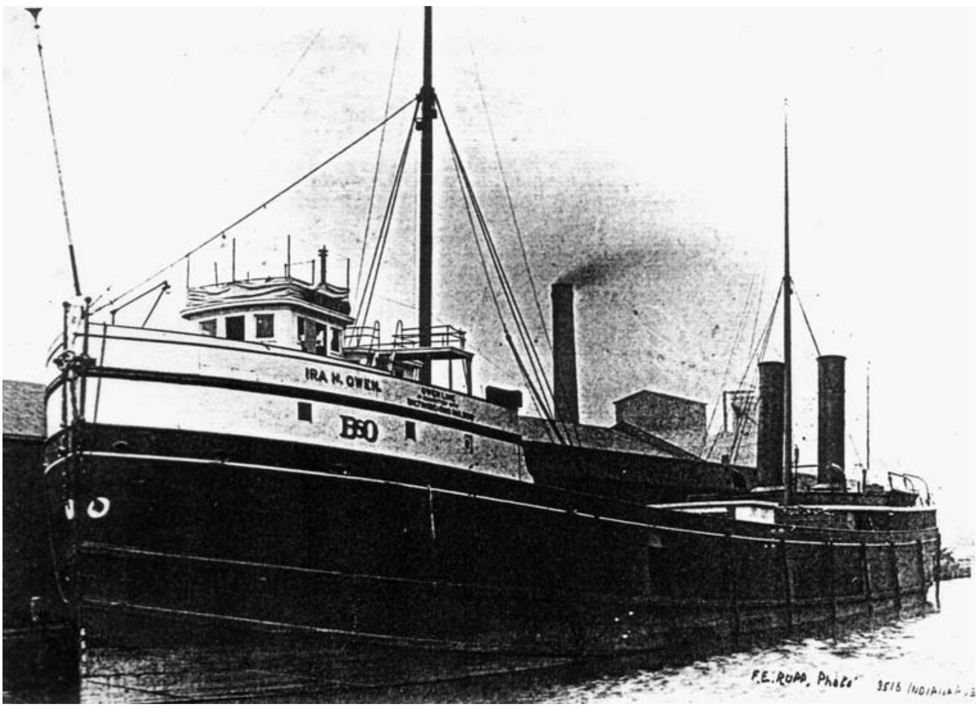

Figure 12. Photograph of *Ira H. Owen* light in Port Chicago (Courtesy TBSRC).

In 1882, Clement, President of Inter-Ocean Transportation Company, and Joseph E. Max, captain of *Ira H. Owen*, changed the vessel's name to *Monohansett* (GLMHC 2005). In *Namesakes 1900-1909*, John O. Greenwood describes the origin of the name *Monohansett*:

> This ship name comes from the Siuan tribes of the east. It is a form of the word Monahassano which is of uncertain etymology. It is

> believed the word is connected with the Tutelo sect and was used by them to refer to themselves. The Tutelo were tall and warlike and carried three arrows in their totem. They lived on the Staunton River in Virginia in 1671, but migrated toward the Great Lakes by 1800. They made good use of the Lakes' sea routes and, it is presumed, this freighter was renamed in 1882 because of this fact and that the owner hoped this name would bring good luck and success to this vessel (Greenwood 1975:366).

It was a superstition amongst sailors, however, that changing a name of a vessel brought bad luck. *Monohansett* had already faced collisions and foundering, but the worst was yet to come. In the case of *Monohansett*, this superstition may have proven true.

On May 25, 1883, *Monohansett* escorting the barge *Metacomet* was light and headed up Lake Michigan towards Escanaba to pick up a load of ore. That same night the schooner *Metropolis* set out from Bark River on her way to Grand Haven. It was loaded with cedar ties. A dense fog had rolled in, and the air was thick. After passing through the Door and settling into her regular course, *Metropolis* emerged from the fog to find it was in a collision course with *Monohansett*. *Metropolis* sounded its whistle, but to no avail. *Monohansett* struck the schooner on its bow. The captain of *Monohansett* tried to reverse the engines, but its consort *Metacomet* retained momentum and struck the schooner in the same spot as *Monohansett*, smashing an 8 foot wide hole on the port bow apparently above the waterline. *Metropolis* remained afloat and was towed to Chicago for repairs. Fortunately, *Monohansett* and *Metacomet* sustained minimal damage (APL 1883).

On 19 February 1888, Ricketson told the *Milwaukee Sentinel* that he sold *Monohansett* to a party of three from Buffalo. The three buyers, Leander Burdick, George H. Hadley, and Charles Hubbard, paid cash (*Milwaukee Sentinel* 1888). Unfortunately, the historical record lends few clues to these individuals. *Monohansett*, however, did not go unnoticed.

On the afternoon of 22 August 1889, the captain of *Monohansett* faced another incident. The *Duluth Evening Herald* reported that the vessel met an equinoctial gale near Big Point Sable in Lake Superior. The vessel's consort, *Massasoit*, broke her iron cable, tearing off a large section of *Monohansett*'s rear bulwarks and damaging her compressor. The wheelsman told reporters that a monster wave threw him into the water, but a counter wave threw him back into the vessel. At the same time, a section of the pilothouse caved in from a wave over the bow, rendering its steering gear useless. To make matters worse, the vessel's seams opened up and 4 feet of water poured into the hold. Even though several members of the crew were badly hurt, they managed to get the siphons working and manually handle the rudderpost. With the engine and steering damaged, the crew floundered in the heavy seas for 48 hours. According to the newspaper, the vessel eventually made it back to Huron Bay, and the *Massasoit* safely arrived at White Fish Point apparently under sail (*Duluth Evening Herald* 1889; *Duluth Daily Tribune* 1889). Repairs to *Monohansett* cost $1,000 (*Duluth Evening Herald* 1889).

On July 20, 1889, *Monohansett* ran aground in Black Hole, Michigan. The captain missed the channel because earlier a log raft had displaced several buoys. Workers released the vessel the following morning. Before workers could replace the channel buoys, however, another steamer, *Corsica*, ran aground in the same spot, severely damaging its hull (*Marquette* 1889).

Burdick, Hadley, and Hubbard decided to sell the vessel in 1892 (Mills 2002:76). Unfortunately, the historical record does not indicate the determining factor of the sale.

The *Monohansett* Becomes a Lumber Hooker

The Davidson Transportation Company from Hampton, Michigan, purchased *Monohansett* in 1892 (Mills 2002:76). James Davidson, President of the company, was both a shipwright and shipbuilder. Davidson owned one of the most renowned shipyards on the Great Lakes. Davidson founded his yard in West Bay City, Michigan, in 1880 (Cooper and Jensen 1995:12-16). Between 1880 and 1901, Davidson constructed over 35 wooden steamers(Mills 2002:13). Several of these pushed the 300 foot limit of wooden construction, including *Pretoria*, *City of Genoa*, *Thomas Cranage*, and *Shenandoah*. With large vessels such as these, Davidson's shipyards required a constant stream of timber. By the time he purchased *Monohansett*, the local timber stocks were becoming exhausted (Cooper and Jensen 1995:19). Davidson had to look elsewhere for lumber. He began importing lumber from the Georgian Bay region in Canada. Davidson engaged *Monohansett* in the lumber trade, and it is likely that the vessel made many trips to Georgian Bay (*Duluth Daily Tribune* 1892).

Monohansett's career under Davidson is not well documented in the historical record. Although Cooper and Jensen provide an historical investigation of James Davidson's shipbuilding career in *Davidson's Goliaths*, they barely tap Davidson's numerous shipping businesses. Mills' *Wooden Steamers on the Great Lakes* indicates that Davidson registered *Monohansett* under his own name in 1893 and under the Davidson Steamship Co. in 1899. He sold the vessel in 1900 (Mills 2002:76).

Reduced to a Coal Carrier

In 1900, the Ohio Cooperage Transportation Co., from Willoughby, Ohio, purchased *Monohansett* from Davidson. The Ohio Cooperage Transportation Co. belonged to a larger fleet of vessels named The Bradley Group. Their homeport was located in Fairport, Ohio (Mills 2002:76).

Alva Bradley, proprietor of the company, bought his first steamer in 1871, and acquired approximately eight steamers after that date. Upon his death in 1885, his son, Morris A. Bradley, resumed the family business. The Bradley family owned most of their vessels through partnerships, including those vessels servicing the Ohio Cooperage Transportation Co (Mills 2002:76). The Company employed *Monohansett* as a coal carrier, hauling coal to the northern mining ports.

Figure 13 depicts *Monohansett* carrying a load of coal upbound on the

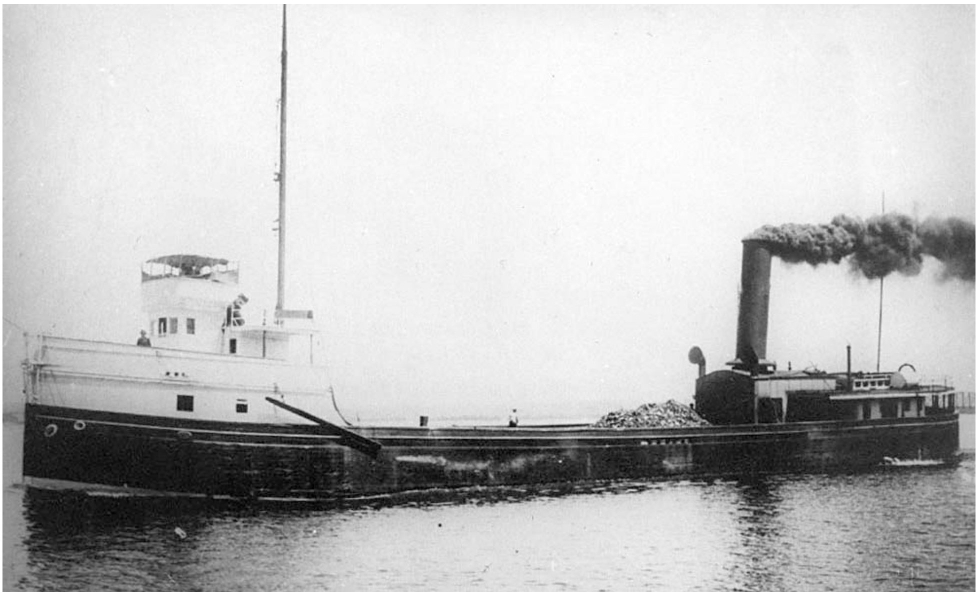

Figure 13. *Monohansett* upbound on the lakes with a load of coal (Courtesy TBSRC).

lakes. The date of the photo is unknown, but it was likely taken while the Ohio Cooperage Transportation Co. owned her, as indicated by her cargo. A few changes are apparent when comparing Figure 13 to Figure 12. The mainmast was removed, and she carried only a single boiler stack instead of two, suggesting that her boilers may have been replaced, or changed.

The Burning of *Monohansett*

In late November 1907, The Ohio Cooperage Transportation Co. sent *Monohansett* and her crew of 12 to deliver 900 tons of coal from Cleveland to Collingwood, Ontario (Stonehouse 1992:25-26). On Saturday the 22nd, *Monohansett* was about to round Thunder Bay Island near Alpena, Michigan, when a fierce gale started blowing. Captain Joseph Inches sought shelter 2 miles off the lee shore of Thunder Bay Island. As the captain waited for the inclement weather to pass, a crewmember sounded the fire alarm shortly after 10 o'clock in the evening. A lantern had tipped over in the engine room. Flames quickly engulfed *Monohansett*'s seasoned timbers (*Alpena Argus-Pioneer* 1907).

Fortunately, the US Coast Guard maintained a lifesaving station on Thunder Bay Island. Captain Inches signaled Captain Persons and his life-savors on Thunder Bay Island, who managed to get all of the crew off safely. The *Alpena Argus-Pioneer* reported, "The fact that the boat was near a life saving station is perhaps all that prevented loss of life," as *Monohansett*'s lifeboat was only a small yawl, incapable of holding twelve adults (*Alpena Argus-Pioneer* 1907).

> As the Monohansett is an old boat and well seasoned she went rapidly before the blaze and was soon a venerable furnace. Most

> of the crew succeeded in saving their clothing. Second engineer, John Stockwell lost part of his wardrobe, as did others who occupied the after end of the vessel. Mr. Stockwell had his hair singed in trying to rescue his effects (*Alpena Argus-Pioneer* 1907).

Captain Persons sent a mayday call to Captain Peppler, who managed the tug *Ralph* in Alpena. *Ralph* arrived on the scene about midnight. By that time, the fire had penetrated the cargo hold.

Extinguishing a coal fire was extremely difficult in a wooden vessel. Hoses could be used to pump water into the hold until the last ember was drowned, but too much water could cause the vessel to sink (Stonehouse 1992:25-26). Captain Persons, Captain Peppler, and *Ralph*'s crew decided to tow the vessel towards Thunder Bay Island and beach it against the shore. In this way, if too much water entered the vessel, it would already rest on the lakebed. *Ralph*'s crew pumped water on her for several hours, finally subduing the flames (*Alpena Argus-Pioneer* 1907).

Captain Peppler got *Ralph* underway to Alpena around 9 o'clock Sunday morning. Unfortunately, the fire was not completely out. That afternoon it reignited in the cargo hold, destroying the vessel to the waterline. After determining the vessel was a complete loss, Captain Persons transported the crew of *Monohansett* to Alpena. They returned to Cleveland on the evening train (*Alpena Argus-Pioneer* 1907). *Monohansett* remained in her watery grave since that fateful day in late November, 1907.

Conclusion

The sailing career of *Monohansett* exemplifies the dangers that crewmembers and shippers faced on the Great Lakes during the nineteenth century. In particular, fire represented a major threat to wooden vessels, as seen in the case of *Monohansett*. Ironically, even though the types of hazards that these wooden vessels faced often ended in disaster, their wrecking process deposited their remains in the cold, fresh water of the Great Lakes, sealing their intrinsic value and ultimately allowing a first-hand view of their construction techniques through underwater archaeology.

4

Archaeological Investigation of the *Monohansett*

Introduction

In June 2004, the Maritime Studies Program at ECU conducted a pre-disturbance survey of the suspected *Monohansett* wrecksite. Dr. Bradley Rodgers, Primary Investigator, and Dr. Nathan Richards, Co-Primary Investigator, led a survey team of eight graduate students in the investigations. Based on historical evidence, site location, the presence of charred timbers, and coal, the wrecksite appeared to be that of the *Monohansett*

The suspected *Monohansett* wrecksite is located in Lake Huron adjacent to the southwest shore of Thunder Bay Island near Alpena, Michigan (See Figure 14). The wrecksite lies within the boundaries of the Thunder Bay National Marine Sanctuary and Underwater Preserve (TBNMS). TBNMS developed through the efforts of the US and Michigan governments over the past few decades. In 1981, the state of Michigan designated Thunder Bay as its first Great Lakes Bottomland Preserve. The purpose of the underwater preserve was to "protect abandoned underwater cultural resources" (Department of Commerce 1999:III). The preserve included Thunder Bay, Sugar Island, Thunder Bay Island, and its surrounding waters. In 1999, the National Oceanic and Atmospheric Administration (NOAA) proposed, "To designate waters encompassing and surrounding Thunder Bay on Lake Huron as a National Marine Sanctuary, in partnership with the State of Michigan" (Department of Commerce 1999:III). In 2000, NOAA and Michigan established the area as the TBNMS. TBNMS provides protection and management to underwater cultural resources contained within the 448 square nautical miles (720.99 square kilometers) boundary of the sanctuary (Department of Commerce 1999:III). ECU's investigation provides the TBNMS with a baseline for future monitoring activities pertinent to the *Monohansett*.

The purpose of this chapter is to summarize the methodology and the findings of ECU's underwater archaeological investigation. The archaeological remains of the *Monohansett* are compared to the historical documentation of her construction details. In this way, this investigation offers unique insight into the construction techniques of single-decked wooden bulk carriers.

Justification and Project Goals

ECU's Phase II pre-disturbance survey provides a valuable source of information on several levels. The research serves as a baseline for site management

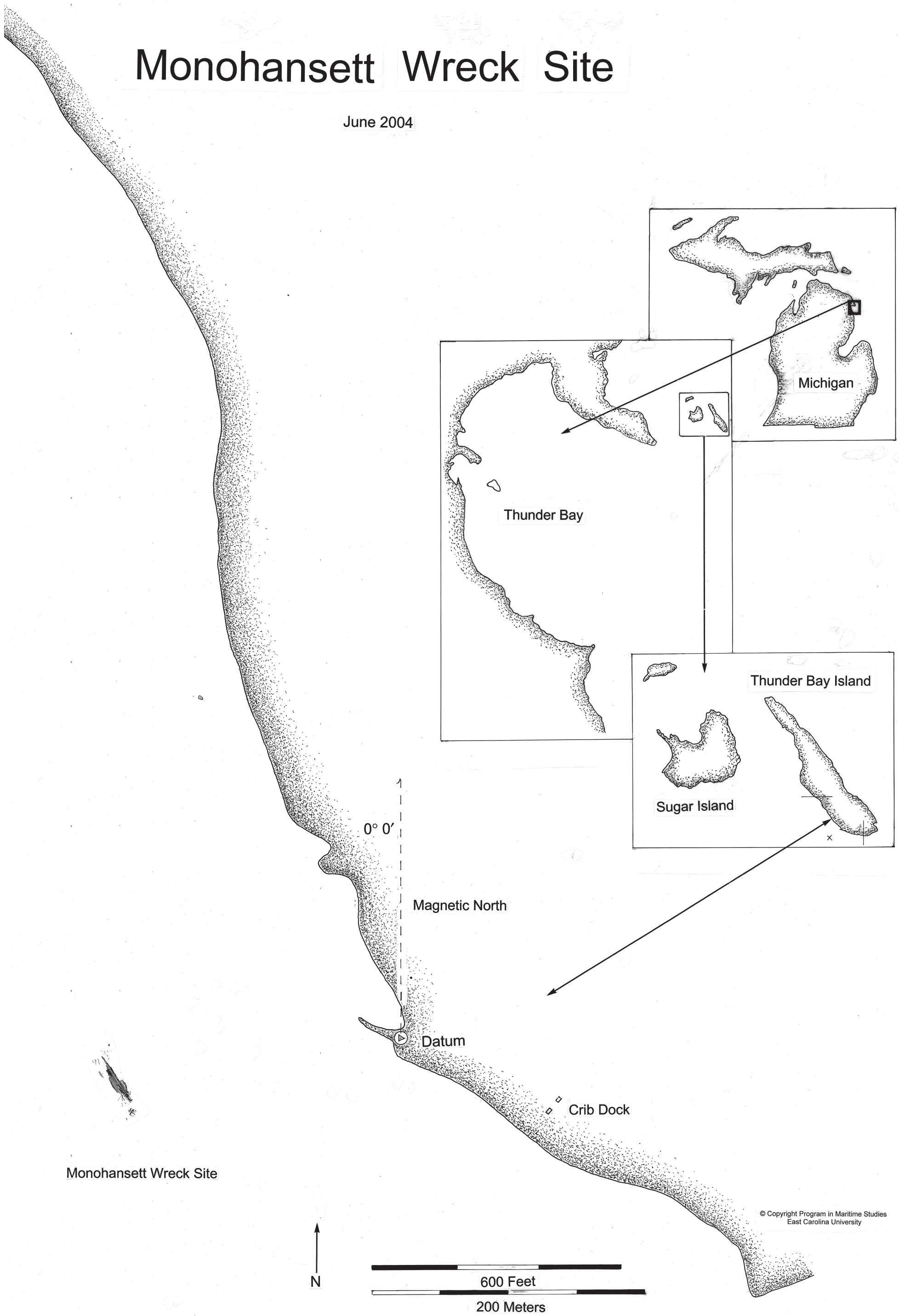

Figure 14. Scaled representation of *Monohansett* in relation to Thunder Bay Island (Courtesy Program in Maritime Studies, ECU).

and monitoring purposes of the *Monohansett* and other submerged archaeological resources in the sanctuary. The research also contributes to the broader spectrum of Great Lakes maritime heritage, as *Monohansett* represents the transitional phase between wooden steambarges and double-decked wooden bulk carriers in Great Lakes ship construction. Previously, this ship class received little archaeological or historic attention. A few key submerged cultural resources assessments, including *The Bones of a Bulk Carrier* (2003) by Rodgers and *Davidson's Goliaths* (1995) by Copper and Jensen, document wooden bulk carriers in detail. The investigation of the *Monohansett*, however, allows an intrinsic view of ship construction techniques represented in early bulk carriers, known in this study as single-decked wooden bulk carriers.

Previous Investigations

Discovery of the *Monohansett* wrecksite was the culmination of several historical investigations and previous archaeological surveys. A general location for the *Monohansett* appeared in several newspapers when it burned in 1907. In particular, the *Alpena Argus-Pioneer* cued that the general whereabouts of vessel remains lie near the shore of Thunder Bay Island (*Alpena Argus-Pioneer* 1907). The *Monohansett* wrecksite first appears in scholarly literature in 1975, following completion of an archaeological survey of Thunder Bay Island by Michigan State University. Thomas D. Warner and Donald F. Holecek provide coordinates locating the wreck "at the southern end of Thunder Bay Island approximately 500 feet from shore." They describe the wreck as, "Broken into three sections, some sidewalls intact, large prop, boilers" (Warner and Holecek 1975:16).

In 1990, Steve Harrington published *Divers Guide to Michigan* (1990), which gives a Loran (30822.6/48681.4) for the site (Harrington 1990:307). Harrington states,

> Because this shipwreck was weakened by fire and it sank in relatively shallow water where it is exposed to the forces of waves and ice, it is broken up into three large pieces. A variety of artifacts, including machinery, are found at the site, which is only 15 to 20 feet deep. Because this area is somewhat protected from the weather, visibility here is generally good (Harrington 1990:307).

Michigan State archaeologists produced a preliminary site report in March 2001, and designated the site number as 2OUH56. The report describes the location of vessel remains as lying "500 feet west of the Thunder Bay light (house)." The surveyors found articulated bottom hull remains, a boiler, miscellaneous engine parts, and a 14-foot propeller (MHC 2001:17).

Michigan State Maritime Archaeologist Wayne Lusardi, along with Brian Link of NOAA Coastal Survey, conducted a side scan survey at the wrecksite and surrounding debris in the summer of 2003. Lusardi also completed a visual survey of the wreck and established a permanent mooring on the site astern of the vessel adjacent to the displaced boiler. Lusardi documented the capstan, stern deadwood, and large section of side located northwest of the main site (Lusardi 2005: pers. comm.).

In 2004, *Monohansett* was the focus of an undergraduate senior thesis for Kalamazoo College, which is located in Kalamazoo, Michigan. Sarah Kolascz researched the history of the vessel, focusing particularly on its early career as *Ira H. Owen*. Kolascz visited the site but only briefly touched upon its archaeological interpretation (Kolascz 2004).

The Maritime Studies Program at ECU conducted a Phase II pre-disturbance survey of the wrecksite in June 2004. ECU plotted the position of the site, finding it to lay approximately 550 feet (167.64 meters) adjacent to an old crib dock on the southwest shore of Thunder Bay Island. Using non-invasive techniques, students produced a scaled representation of the wrecksite. The survey also included a photographic and visual assessment to determine vessel integrity.

Environment

Thunder Bay Island lies on the northeast perimeter of the ancient Michigan Basin. The Michigan Basin formed during the volcanic Precambrian Era and became a basin for a shallow Ordovician sea. Today this sea bottom is seen mostly as limestone bedrock. Soils and other lakebed sediments date to the last glacial period of the Cenozoic Era. The Pleistocene Epoch of the Cenozoic Era was characterized by a series of glacial events named Nebraskan, Kansan, Illinoian, and Wisconsinian, respectively. The glaciers advanced and receded, and during their retreat, the melting ice caused floodwater to deepen and widen ancient river systems. The rivers eroded, expanding to form the Great Lakes basins. The surface of the Lake Huron Basin contains glacial till, or unconsolidated rock materials, deposited during the last glacial event, Wisconsinian (Hough 1958:90-93, 103; U.S. Department of Commerce 1999:168).

The *Monohansett* wreck site lies on a limestone seabed under approximately 18 feet of water during current lake levels. The wind prevails from the west, except during May and June when the wind flows from the southeast (Hough 1958:90-91; U.S. Department of Commerce 1999:168-170). Average temperature during the summer months range from the low to mid 60s with an average high of 77 degrees Fahrenheit. Winter temperatures often reach below zero. Heavy thunderstorms with damaging winds frequently occur during the summer, and during the winter, the Thunder Bay region receives an average of 85.7 inches (217.68 centimeters) of snow per year. Lake sediments around Thunder Bay Island include undifferentiated glacial till, bedrock, and less than 25% lacustrine clay. Surface sediments have a pH of 7.0 – 7.5 and contain less than .05% nitrogen and 0.022% phosphorus. Marine life includes phytoplankton and several benthic invertebrates, such as crayfish, sponges, bivalve clams, and mussels. Perch, salmon, sculpin, trout, and walleye also inhabit Lake Huron (U.S. Department of Commerce, 1999: 168-170). A light spread of zebra mussels, classified as an invasive species, have colonized the wrecksite.

Methodology

Site investigations utilized standard archaeological protocols as defined by ECU methodology and experience for Phase II work, as well as some concepts outlined in *Archaeology Underwater: The NAS Guide to Principles and Practice* (2000) by the Nautical Archaeology Society. Diving platforms consisted of a 24-foot Carolina Skiff and a 24-foot Sea Hawk, property of ECU. Boats were hauled to Alpena from Greenville, North Carolina, along with a mobile air compressor for refilling dive tanks. Divers used both SCUBA and surface supplied air, or hookah.

The survey crew easily located the *Monohansett* wrecksite on 1 June 2004, as NOAA staff had already established a permanent mooring. The survey crew also conducted a visual surface inspection of the wrecksite and a reconnaissance on Thunder Bay Island.

Phase II pre-disturbance survey of the wrecksite commenced on the 2 June 2004. Using the WGS 1984 datum, the Primary Investigator and a survey crew established a temporary datum on Thunder Bay Island with GPS UTM coordinates:

N 45º 02.061
W 83º 11.856

The surveyors used a transit, with an electronic distance meter (EDM), and a prism rod to georeference both ends of the baseline, the shore, and any prominent features to an accuracy approaching inches over the distances covered. The surveyors established UTM coordinates for *Monohansett* as:

N 45º 01.880
E 83º 11.870

The following day, divers laid a steel cable baseline down the center of the wreck, dividing the vessel into arbitrary 10 foot sections. The 0.0 point of the baseline was set on the remains of a capstan near the forward section of the hull (See Figure 15). The baseline ran along the rider keelson to 104.65 feet, where it angled towards the port side of the vessel. From this point, the baseline continued towards the mooring anchor, where the working end was attached to its base. Divers tightened the steel cable with a come-along winch.

The Principal Investigators assigned 10 foot sections, or units, on the port or starboard sides of the vessel. Each student was equipped with a measuring device and dive slates. Using triangulation and baseline offsets, the students produced measured sketches of the units in feet and tenths of feet. The measured drawings were pieced together and transferred to graph paper, ultimately producing a scaled representation of the entire wrecksite (See Figure 15). Photographic documentation was also conducted on the entire site through videography and still photography.

Site Interpretation

The investigated portion of the *Monohansett* wrecksite covered an area of 11,136 square feet (1,034.6 meters). Vessel remains consisted of an articulated bottom hull, a boiler, and a light scatter of fastenings and various engine components. The bow section was broken-off and not located within ECU's designated site limits. Main structural components that were identified included the following:

The keel provided the principal longitudinal strength for *Monohansett* (Desmond 1999 [1919]:45). Her keel was square sided and measured 1.2 feet (1 foot 2.4 inches) sided by 0.6 feet (7.2 inches) molded (See Figure 15 and Figure 16). The forward portion of the keel was no longer preserved. Wrought iron through bolts attached the keel to the double frames and keelson assembly.

The garboard strakes ran parallel to and butted up against the keel (See Figure 16). The garboard strakes measured 0.5 feet (6 inches) molded and 1.2 feet (1 foot 2.4 inches) sided.

Outer hull planking transversely attached to the double frames. The outer hull planking measured 0.2 feet (2.4 inches) molded and 1.3 feet (1 foot 3.6 inches) sided. Near the chine, the planking was a bit thicker, yet narrower, measuring 0.3 feet (3.6 inches) molded and 1 foot sided. Outer hull planking was butt scarfed. The investigators did not record an average plank length or establish a fastening pattern.

The double frames of *Monohansett* endowed her with a relatively rectangular cross-section. Double frames measured 1 foot molded and 0.5 feet (6 inches) sided. Each frame pair had a space of 0.8 feet (9.6 inches) from the next set. The master couple was discernable approximately one-third of the way aft of the forward most part of the preserved keel. On the forward half of the vessel, the first futtock extended out 9.5 feet (9 feet 6 inches) from the centerline on the port side. The third futtock on the port side was missing. On the starboard side, the first futtock extended out 4 feet from the centerline. The second futtock, joined by butt scarf to the floor, extended out approximately 12 feet to the turn of the bilge. Each port side double frame exhibited a limber hole, measuring 0.3 feet (3.6 inches) wide and 0.2 feet (2.4 inches) in height. The limber holes prevented standing water from rotting the timbers, allowing water to run along the length of the vessel to the pumps (Desmond 1999 [1919]:101).

The keelson assembly consisted of one keelson, two sister keelsons, and one, central rider keelson. The keelson assembly united the keel, frames, stem, and stern into a homogenous working unit (Desmond, 1999 [1919]:55). It also provided additional support against longitudinal hogging and sagging stresses. Each member of the keelson assembly measured 1 foot square and exhibited square sides. The rider keelson was attached to the keelson, double frames, and keel via wrought iron through bolts. It also exhibited a butt scarf just forward of the master couple. A single fastening pattern, each frame connected to the keelson and keel with a single through bolt, was discernable on the keelson assembly (See Figure 17).

FOLD OUT TO REVEAL FIGURE 15

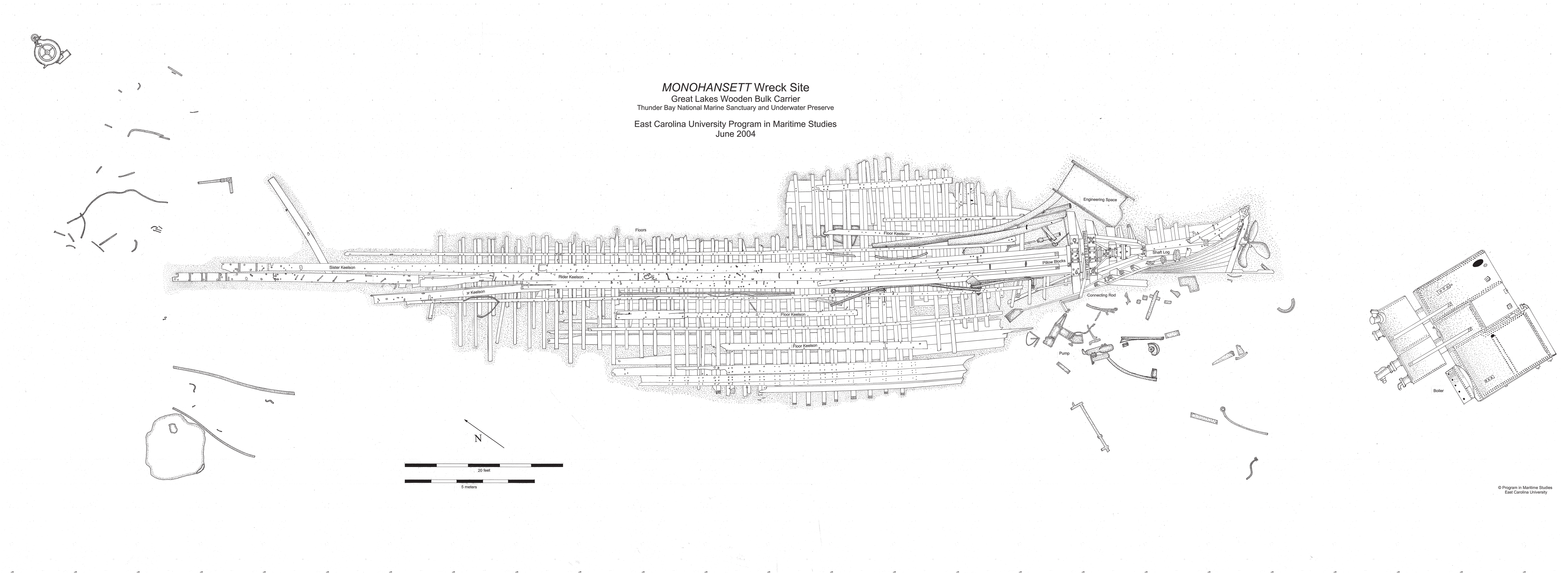

Figure 15. *Monohansett* Site Plan (Courtesy Program in Maritime Studies, ECU).

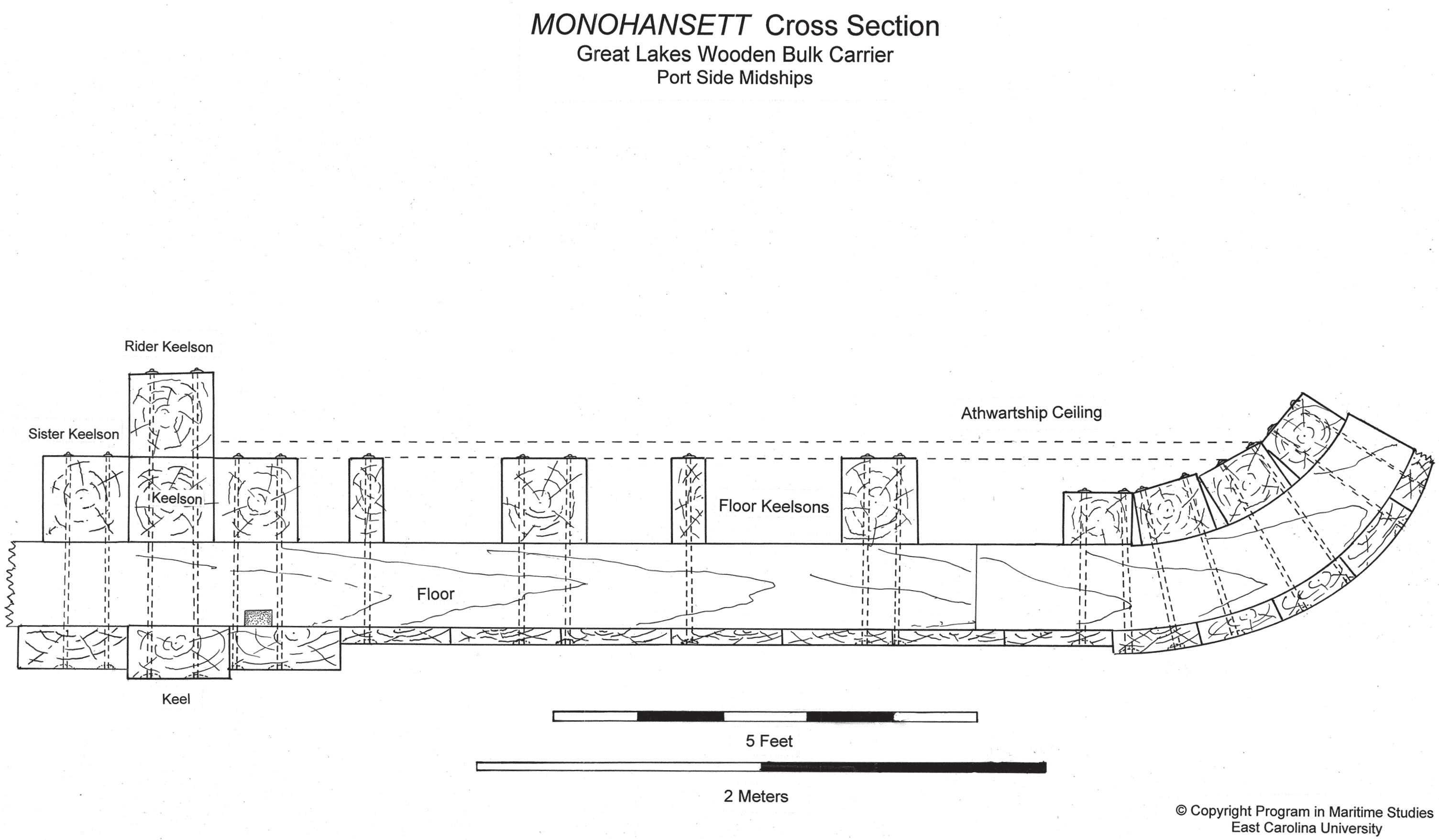

Figure 16. *Monohansett* Cross Section (Courtesy Program in Maritime Studies, ECU).

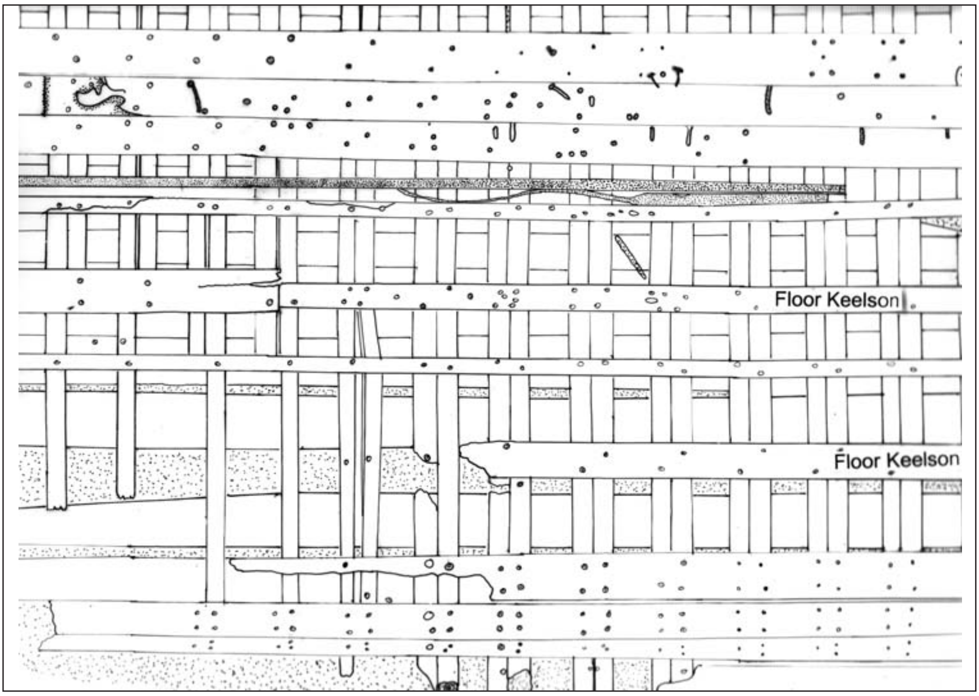

Figure 17. Detail of port side floor plan at amidships. The keelson assembly is located on the left with a single fastening pattern, and the thick strakes are located on the far right with a double fastening pattern (Courtesy Program in Maritime Studies, East Carolina University).

Four floor keelsons per side lay atop the double frames. The floor keelsons provided additional longitudinal support to the vessel and a foundation for athwartship ceiling planking. The floor keelsons alternated between 0.4 feet (4.8 inches) sided and 1 foot molded, and 1 foot square. The smaller keelson started closest to the sister keelson. Through bolts attached the floor keelsons to the double frames and outer hull planking. The floor keelsons exhibited the same single fastening pattern as the keelson assembly (See Figure 15 and Figure 17).

Four thick strakes, thicker ceiling planking at the turn of the bilge, were preserved near the chine, a high stress area necessitating reinforcement. Each thick strake measured 0.8 feet (9.6 inches) sided and 0.6 feet (7.2 inches) molded. The thick ceiling exhibited a different fastening pattern than that of the keelsons. Each plank attached to each double frame and the outer hull planking by two through bolts, or a double fastening pattern (See Figure 17).

Ceiling planking was not preserved. The ceiling planking would have been double-layered athwartship planked, similar to that of *City of Glasgow*, as indicated by the floor keelsons. Rodgers states that double layer athwartship ceiling planking provided additional support for heavy bulk cargo. It also could easily be replaced when damaged from the quick, yet relatively violent, loading techniques of the ore industry (Rodgers 2003:34). The ceiling planking also protected bulk cargo from water in the bilge.

Monohansett carried a steeple compound engine, known in oceanic steam parlance as a tandem compound engine. *Monohansett*'s steeple compound engine consisted of a 16 inch diameter high pressure cylinder on top of a 27 inch low pressure cylinder with a 32 inch stroke. This particular engine was constructed by S.F. Hodge & Co. of Detroit, Michigan. It would have rested on two pillow blocks, one on each side of the rider keelson. The flywheel and thrust bearing are still present on the site (See Figure 18). A few other engine members were identifiable. The connecting rod rested to the port side of the engineering space, and an iron pump and eccentric lay off the port stern (See Figure 18).

Figure 18. Photograph of crankshaft lying to port (Courtesy Program in Maritime Studies, East Carolina University).

The shaft assembly was still discernable on the hull remains. The thrust bearing distributes the power produced by the propeller into the hull with a series of plates surrounding the propeller shaft. This device prevents the power produced by the propeller from damaging the engine (Gardiner 1993:100). The propeller shaft runs through the shaft log and a through hull fitting where it connects to a 7-foot diameter, Loper-style propeller (See Figure 20). Loper-style propellers created less vibration in the hull compared to traditional Archimedean-style or windmill-style propellers. The rudder was no longer preserved, but, as seen in Figure 19, the skegs with attachments for the base of the rudder were still intact.

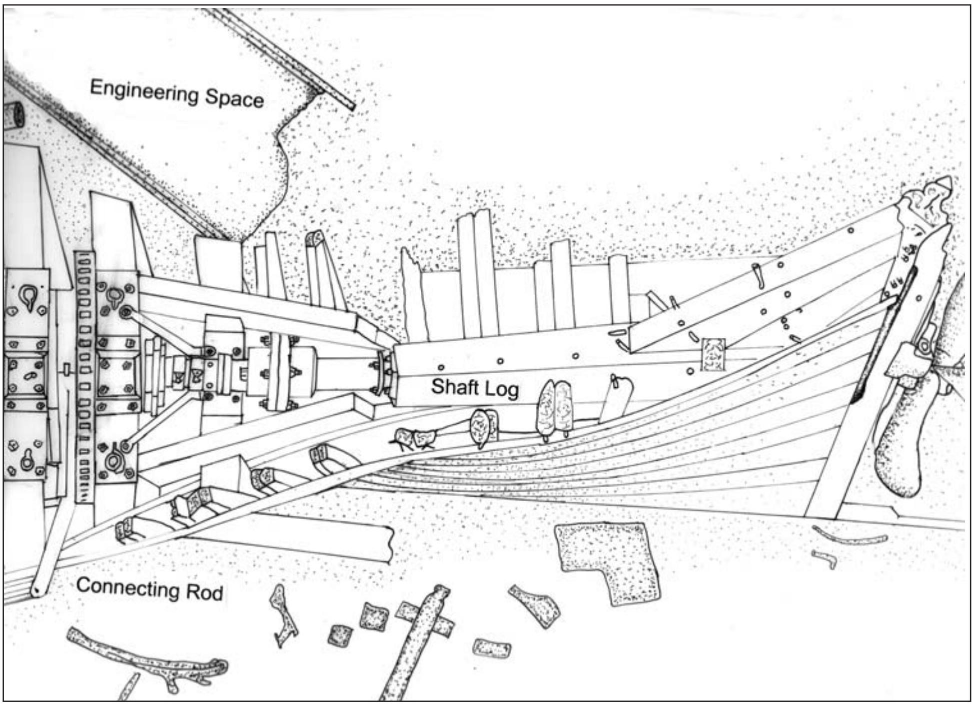

Figure 19. Detail of engine bed (Courtesy Program in Maritime Studies, East Carolina University).

Figure 20. Photograph of *Monohansett*'s Loper style propeller (Courtesy Program in Maritime Studies, East Carolina University).

The boiler rested approximately 14 feet southwest of the sternpost. The historical record indicated that *Monohansett*'s Scotch boiler measured 9 feet 8 inches in diameter with a length of 13 feet 5 inches. Interestingly, the boiler located on the wrecksite measured 16 feet 4 inches in length. The historical record indicated that *Monohansett* carried only a single boiler, but early photographs of the vessel depict her carrying two boiler stacks. In light of this archaeological evidence, it appears that *Monohansett* had a change in its boiler system at some point in its career. The Principal Investigator pointed out that the boiler had a corrugated combustion chamber, a feature that appeared in 1870. He also stated that the boiler had an attachment for a second boiler. It is probable, although not historically documented, that the boilers were fabricated with attachment flanges and could be banked or connected should the need arise in larger vessels (Bradley A. Rodgers 2005, pers. comm.).

It was undetermined if the capstan belonged to *Monohansett*. The capstan rested approximately 20 feet from the forward starboard section of the vessel. This particular capstan is of a light build, possibly a net capstan from a fishing tug rather than *Monohansett* (Rodgers 2005, pers. comm.).

The investigations revealed a light scatter of iron fastenings and unidentifiable metallic objects within the designated site limits. The surveyors also noted a moderate scatter of coal along the shore of Thunder Bay Island adjacent to the wrecksite.

Site Formation Processes

As outlined by Keith Muckelroy in *Maritime Archaeology* (1978:158-159), the site formation processes of *Monohansett* falls under two main categories: pre-depositional and post-depositional. The pre-depositional process was revealed in the historical investigation of *Monohansett.* The historical record demonstrates that after the vessel caught fire, the tug *Ralph* towed it towards shallow water near the shore of Thunder Bay Island to run it aground. The Thunder Bay Island lifesavers doused the hull with water from a hose. Their intention was that if the vessel inadvertently sank, they could more easily recover it as opposed to if it sank in deeper water. Despite the effort, the vessel burned to the waterline, making the hull unviable for further use. After burning, the vessel sank several feet to the bottom of the lakebed.

Many of the post-depositional site formation processes are not as clear as the pre-depositional process. Large scours in the limestone lakebed were present near the vessel. During the winter months, the lake frequently freezes over, and ice heaving occurs. Ice can penetrate into the lake several feet, and its affect on submerged cultural resources has not been studied on the Great Lakes. Ice may have played a significant role in the site formation process and may have broken and carried the bow away from the main site area and displaced the boiler.

Still, the relocation of the bow and the boiler position astern of the vessel may be attributed to natural or cultural processes. The boiler was most likely located on a partial second deck, or a 'tween deck'. When the vessel sank, the bow may have broken off, while the boiler, retaining some buoyancy, floated free of the vessel.

Still another possibility is that the position of the boiler and the bow may be attributed to the cultural intrusion of salvagers. The boiler, engine, and *Monohansett*'s cargo of coal could have attracted salvagers. It is possible, but not historically documented, that in a salvage attempt salvagers knocked over the boiler, or pulled it out of the way, and, in the meantime, broke off the bow. The engine, which was connected to the boiler, is also broken up, rendering any of these possibilities plausible.

The cold, fresh water of Lake Huron acts as an excellent preserve for wooden vessels. The remaining timbers exhibit excellent preservation. Burn scars near the turn of the bilge were still present on the vessel remains. The keel of the vessel lays flat on the lakebed, but the hull remains have twisted towards starboard.

Conclusion

Monohansett is significant to understanding the construction details of Great Lakes single-decked wooden bulk carriers. Its investigation contributes to a small number of nineteenth-century bulk carriers that have been studied in detail. This Phase II pre-disturbance survey revealed information concerning how these transitional vessels were constructed.

Historically, *Monohansett*'s external design characteristics resemble that of other wooden bulk carriers. These records indicate that the vessel was built along the same lines as *R.J. Hackett*. Her deck was constructed in the fore and aft layout, and she had 24-foot centered hatches matching the specifications of the pocket docks. As indicated by the historical record, this exterior deck layout was typical of wooden bulk carriers of her time.

The archaeological investigation of *Monohansett*, however, provides a window into viewing internal construction characteristics of single-decked wooden bulk carriers, a subject that has previously received little attention. The investigations revealed that Linn & Craig constructed *Monohansett* with an exceptionally heavy flooring system, providing protection against hogging and sagging stresses. The builders outfitted the interior hold with a keelson, a rider keelson, and two sister keelsons. They also placed four floor keelsons atop the frames running parallel to the keelson assembly to act as a base for athwartship ceiling planking. Finally, four thick strakes were placed near the turn of the bilge to guard the 90 degree chine turn against failure. Double layer athwartship ceiling planking was laid atop of the floor keelsons ending at the turn of the bilge. It is likely that Linn & Craig intended the layer as sacrificial, allowing for easy replacement of the ceiling if damaged by the rapid, yet relatively violent, loading technologies (Rodgers 2003:34).

This single-decked wooden bulk carrier exemplifies how economics influenced technology, which in turn directly influenced vessel form. *Monohansett*'s design allowed it to take advantage of the efficient gravity fed pocket docks and mechanized unloading techniques of her time. The heavy, yet cheap, flooring system made it ideal for transporting heavy ore cargo, and its shape, a rectangular cross-section, allowed it to fit through the Sault Ste. Marie locks with a maximum cargo capacity.

5

Steambarge, Single-Decked Wooden Bulk Carrier, or Double-Decked Wooden Bulk Carrier: A Comparison Study

Introduction

Examining Great Lakes wooden bulk carrier construction techniques through the historical record can be a daunting task because very few vessel plans survive in the historical record. To generate a typical definition of construction techniques for wooden bulk carriers, several specimens necessitate comparison. Rather than relying solely on a small number of historic vessel plans, this comparison uses archaeological evidence. The archaeological investigations of *Monohansett* and similar archaeologically studied vessels provide an overall view into the design characteristics of single-decked and double-decked wooden bulk carriers.

This chapter compares several archaeologically investigated vessels, including the single-decked wooden bulk carriers *R.J. Hackett*, *Mary Jarecki*, and *Monohansett* (presented in Chapter 4) and the double-decked wooden bulk carriers *Sitka*, *City of Glasgow*, *Fedora*, *Frank O' Conner*, and *Pretoria*. It also includes a typical steambarge, *C.H. Coffinberry*, allowing this chapter to set apart wooden bulk carriers from steambarges. In this way, key features of each of these vessels open the locked door to wooden bulk carrier construction techniques during the nineteenth century.

Archaeological site plans and site reports provide an important primary source for this comparative investigation. The site reports, though few in number, afford invaluable elucidation and analysis of site plans. Likewise, "The Great Lakes Vessel Index" located in the Great Lakes Historical Collection at Bowling Green State University, Ohio, provides brief histories and basic schematics of each vessel.

Rodgers's *The Bones of a Bulk Carrier* (2003) served as a framework for this comparative study. In his report, Rodgers presents several of these vessels as precursor studies to the investigations of *City of Glasgow*. He deduces several features and design characteristics of *City of Glasgow* by comparing the vessel to *H.D. Coffinberry*, *Frank O' Conner*, *Pretoria*, and *Fedora*. This chapter reiterates several of his conclusions about the design characteristics of wooden bulk carriers while contributing a few others.

For comparison sake, each vessel is given a synopsis of its archaeological investigation. The vessels are presented in chronological order to their construction dates, a particularly crucial way to examine the data. Archaeological site plans are also included for each vessel. Based on these site plans and documentary evidence, conclusions on design characteristics of steambarges, single-decked wooden bulk carriers, and double-decked wooden bulk carriers follows the presentation of vessels.

Presentation of Vessels

R.J. Hackett. Elihu E. Peck constructed *R.J. Hackett* in 1869 at Cleveland, Ohio. *Hackett*, considered the prototype for Great Lakes wooden bulk carriers, measured 208.1 feet in length, 32.5 feet in beam, and had a 14 foot depth of hold. He built the *Hackett* with a single deck, but in 1881, a second deck was added, giving it a new depth of hold of 19.2 feet, allowing the vessel to take advantage of the newly opened Wetzel Lock at Sault Ste. Marie. On 12 November 1905, *Hackett* was upbound on the lakes for Marinette, Wisconsin, with a load of coal. The vessel caught fire at Whaleback Shoal near Green Bay, Wisconsin, burned to the waterline, and sank (GLVI 2005).

In 1998, the State Historical Society of Wisconsin (SHSW) and ECU students conducted an underwater archaeological investigation of *Hackett*'s remains. Much of the starboard side was covered with sand. The site plan and accompanying field notes indicate *Hackett* was double framed, carried a single thick strake at the turn of the bilge, and had at least five floor keelsons per side measuring 10 inches square. It was athwartship ceiling planked, and its ceiling extended over the keelson, providing an unobstructed hold (SHSW 1998).

Mary Jarecki. *Mary Jarecki* was built in 1871 by the Bailey Brothers of Toledo, Michigan. The vessel was single-decked with a raised poop deck. *Jarecki*'s dimensions measured 179.6 feet in length, 32.7 feet in beam, and it had a 13.2 foot depth of hold. The vessel carried a single-cylinder non-condensing high-pressure steam engine powered by a tubular marine boiler. In 1879, the vessel was rebuilt and given a second deck. In the summer of 1883, *Jarecki* was downbound on the lakes from Marquette with a load of iron ore. The captain had unintentionally veered the vessel from its intended course, and it ran aground west of Au Sable Point, Michigan. *Jarecki* remains rest in 6 feet of water (Labadie 1989:95-98).

As part of the Pictured Rocks Shipwreck Survey, the National Park Service Submerged Cultural Resource Unit (NPS-SCRU) conducted archaeological investigations on the suspected *Mary Jarecki* wrecksite in 1988. They found that approximately 75% of the length of the bottom hold was preserved. The vessel was double-framed and had a keelson with a single rider and two sister keelsons with double riders. Eight longitudinal floor keelsons, varying in cross-sectional sizes and lengths, were staggered in an indiscernible pattern. Three thick strakes rested at the turn of the bilge. No ceiling planking was present, but *Jarecki* would have had athwatship ceiling planking, as indicated by the multiple floor keelsons (Labadie 1989:111-115).

H.D. Coffinberry. Thomas Arnold, a shipbuilder from East Saginaw, Michigan, constructed the steambarge H.D. Coffinberry in 1874 (GLVI 2005). Coffinberry was built for the Rust, King & Company firm of Cleveland, Ohio, and carried coal, lumber, corn, and iron ore (Cooper 1996:85). Coffinberry was slightly larger than Monohansett, as it measured 191.3 feet in length, 33.4 feet in beam, and had a 13.3 foot depth of hold (GLVI 2005). The vessel was abandoned at Ashland in 1912, and, subsequently towed to Red Cliff Bay, where it rests today (Cooper 1996:92).

Archaeological investigations, conducted by SHSW and ECU, revealed *Coffinberry* was constructed with double frames sandwiched between a keel and a keelson assembly. The keelson assembly consisted of a centerline keelson, two sister keelsons, and two rider keelsons. The rider keelsons sat on top of the sister keelsons, leaving a centerline groove above the keelson. This space likely supported deck stanchions. Ceiling planking, running fore-and-aft, was still preserved inside the hold. Four thick strakes provided extra support near the turn of the bilge (Cooper 1996:92-97).

Sitka. Frank W. Wheeler of West Bay City, Michigan constructed *Sitka* in 1887. *Sitka* was a double-decked wooden bulk carrier that measured 272.55 feet in length, 40.50 feet in beam, and had a 19.4 foot depth of hold. The vessel carried a triple-expansion engine with two Scotch boilers. In October 1904, the vessel was loaded with iron ore bound from Marquette to Toledo. *Sitka* met a storm with heavy fog and winds and grounded near Au Sable Point, Lake Superior. Pounding surf broke apart the vessel, and it was deemed unsalvageable (Labadie 1989:108-111).

The NPS-SCRU examined *Sitka* during the 1988 field season as part of the Pictured Rocks Shipwreck Survey. The investigators found a large debris scatter with large sections of hull strewn across the reef. A large portion of the bottom hold was still intact and characterized by a centerline keelson, two sister keelsons, and seven floor keelsons per side. Vessel plans, which survived in the historical record, indicate that two more layers of rider keelsons would have rested atop the keelson assembly while one more layer would have lain atop the longitudinal floor keelsons, but these were not present in the archaeological record. The turn of the bilge was reinforced with six thick strakes. Although not preserved at the time of investigation, double layer athwartship planking would have rested atop the floor keelsons and terminated at the turn of the bilge. The ceiling was longitudinally planked above the turn of the bilge, as indicated in the vessel plans. Wheeler constructed *Sitka* with diagonal steel reinforcing straps. The straps extended a short distance under the turn of the bilge, indicating that they were intended to provide side support rather than bottom support (Labadie 1989:111-118).

Fedora. Frank W. Wheeler of West Bay City, Michigan, built *Fedora*, a double-decked wooden bulk carrier, in 1889. The vessel boasted a 20.1 foot depth of hold, a 282.2 foot length, and a 41.4 foot beam. It was powered by a 900 horsepower, triple-expansion engine and two Scotch boilers. In 1901, the vessel was headed towards Ashland light from Duluth when it caught fire (GLVI 2005). The captain set the engines at full speed and beached the vessel near Red Cliff, Wisconsin, where flames consumed the vessel to the waterline (Cooper 1996:81).

In 1990, the SHSW, in conjunction with ECU, conducted archaeological investigations on *Fedora*, ultimately producing a scaled representation of the wrecksite. The investigators found that *Fedora* boasted double-frames, except near the stern and amidships, where the frames were fitted without space. These tightly fitted frames provided support for stress-prone areas. The vessel was constructed with seven floor keelsons on either side of a massive centerline keelson and a rider keelson. The rider keelson was fitted with protective iron plates. The iron plates protected the keelson from damaging loading and unloading techniques. Double-layer athwartship ceiling planking rested atop the floor keelsons, but above the turn of the bilge the ceiling planking was longitudinally attached. Iron cross-bracing straps were mortised into the exterior face of the futtocks, providing additional protection against hogging and sagging stresses (Cooper 1996:32-38).

City of Glasgow. James Davidson, a shipbuilder from West Bay City, Michigan, constructed *City of Glasgow* in 1891. The *City of Glasgow* was one of the largest wooden bulk carriers ever built on the Great Lakes, measuring 297.0 feet long, 41.0 feet wide, and had a 20.42 foot depth of hold. The vessel was also double-decked. In 1907, the vessel ran aground and caught fire in Green Gay, Wisconsin. A year later, the Leatham and Smith Quarry raised the vessel and converted it to a stone barge. The company put the converted barge back into service, and it carried limestone for the company until 1911, when it met a fierce storm. The barge broke its towline, eventually beaching itself in Lilly Bay (Rodgers 2003:1, 8).

In the fall of 2000, ECU's Program in Maritime Studies and SHSW conducted archaeological investigations of the wrecksite. The site report, *The Bones of a Bulk Carrier*, indicates that Davidson built the vessel with six floor keelsons on either side of the main keelson. The floor keelsons signify that the vessel would have been athwartship planked. The absence of a rider keelson allowed the vessel a relatively unobstructed hold, allowing for easier unloading with mechanized techniques (Rodgers 2003:17-26, 29).

Rodgers indicates that *City of Glasgow* was unique in that Davidson constructed the vessel with an iron basket truss, similar to that of *Sitka*. This basket structure would have provided extra support against hogging and sagging stresses commonly associated with cargo vessels exhibiting a large length to beam ratio. Davidson apparently borrowed the basket truss concept from clipper ships because it provided an "ideal way to improve the strength of his bulk carriers while integrating the flexibility for the chief materials, iron and wood. The basket truss was able to flex with the wood, loaning it support from beneath while it did no harm to the relatively soft material that made up the ship's hull" (Rodgers 2003:32).

Frank O'Conner. *Frank O'Conner*, originally named *City of Naples*, was one of the first wooden vessels on the Great Lakes to extend beyond the 300 foot mark. James Davidson constructed *Frank O'Conner* in 1892. It was built with a 301 foot length, 42.5-foot breadth, and a 21.25 depth of hold. A triple expansion engine powered *Frank O'Conner*. In October 1919, the vessel was upbound on the lakes with a load of anthracite coal from Buffalo to Milwaukee when a crewmember discovered fire in the forward part of the hold. The vessel burned and sank in 60 feet of water near Cana Island, Wisconsin (Cooper and Jensen 1995:32-36).

SHSW with students from ECU conducted a pre-disturbance survey on *Frank O'Conner* in 1991. The surveyors found that the vessel contained many similarities to that of *City of Glasgow* and *Pretoria*. The floors were triple-timbered on the bottom of the hold, but devolved into double-timbered frames above the chine. A centerline keelson provided longitudinal support along with multiple floor keelsons placed out to the turn of the bilge. The keelsons supported double layer athwartship planking, which was still preserved in the inner hold. Like Davidson's other vessels, *Frank O'Conner* exhibited iron cross-bracing or basket trussing (Cooper and Jensen 1995:38-46).

Pretoria. *Pretoria,* the largest wooden bulk carrier to operate on the Great Lakes, was constructed by James Davidson of West Bay City, Michigan, in 1900. The vessel measured 338.4 feet in length, 44 feet in beam, and had a 23 foot depth of hold. The vessel serviced the Davidson Steamship Company for 5 years. In 1905, downbound on the lakes with a load of iron ore, the *Pretoria* foundered in Lake Superior near Outer Island, Wisconsin (Cooper and Jensen 1995:49).

In 1990, the SHSW located *Pretoria* during a reconnaissance survey of the Apostle Islands. Subsequently, in 1991, SHSW divers conducted a small-scale survey in order to plan a full-scale investigation the following year. In 1992, *Pretoria*'s wrecksite was documented in detail (See Figure 30) (Cooper and Jensen 1995:55). The investigations revealed *Pretoria* was constructed on very similar construction schematics as that of *City of Glasgow* (Cooper and Jensen 1995:56; Rodgers 2003:18). The massive keelson was sandwiched with sections of steel plates, and Cooper and Jensen state that these plated sections probably corresponded with the hatchways (Cooper and Jensen 1995:56). The plates served to protect the keelson from abrasion caused by mechanized unloading equipment and damage inflicted by falling ore from loading docks (Desmond 1984 [1919]:92-95). The vessel exhibited triple-frames at the bottom of the hold, but above the turn of the bilge, the frames devolved into double-frames. Four flour keelson on either side of the large keelson supported double-layered athwartship ceiling planking. At the turn of the bilge, three thick strakes provide extra support for this stress-prone area. Longitudinal ceiling planking replaced the transverse ceiling planking at the chine. *Pretoria*'s hull was reinforced with a steel basket truss, like that exhibited on *City of Glasgow* (Cooper and Jensen 1995:56-62).

Conclusion

Collectively, this group of vessels was very similar on the exterior. Rodgers points out that all wooden bulk carriers were constructed with a plumb bow and fantail stern. Their cross-section profile exhibited a rectangular shape, allowing them to fit through the Sault Ste. Marie canal with a maximum cargo capacity (Rodgers, 2003: 34). Their deck plans conformed to the fore and aft configuration, established by Peck's construction of *R.J. Hackett*. This deck plan consisted of a pilothouse and cabins forward and the engine house with cabins aft. A series of hatches, set on 24-foot centers matching the specifications of Marquette's pocket docks, lined the deck. All of the vessels, including the steambarge *H.D. Coffinberry*, exhibit these external design characteristics. Thus, the steambarge, the single-decked wooden bulk carrier, and the double-decked wooden bulk carrier were very similar on the exterior, making it difficult to differentiate between the three vessel types.

The internal construction characteristics, however, differed greatly between steambarges and both single-decked and double-decked wooden bulk carriers. Rodgers states, "The two laid deck arrangement seems to be the main evolutionary change between steambarges (predecessors to the bulk carriers) and wooden bulk carriers." This is true, but, as exemplified by *H.D. Coffinberry*, steambarges were different in their flooring system from wooden bulk carriers.

H.D. Coffinberry contained a centerline keelson assembly set on double frames. The frames directly supported a single layer of longitudinal ceiling planking. This sort of internal layout resembles that of a typical nineteenth-century schooner, with a centerline keelson assembly, double-frames, and longitudinally planked ceiling planking. Wooden bulk carriers, on the other hand, exhibited a much more complex system of flooring.

Rodgers states that the high length to beam ratio dictated the use of a heavy frame and flooring system in wooden bulk carriers. This system consisted of a series of longitudinal floor keelsons in addition to the centerline keelson structure. These keelson structures were intended to add to the longitudinal strength of the vessels, combating hogging and sagging stresses. The floor keelsons supported athwartship ceiling planking, usually consisting of two layers. The short, athwartship planks, especially when compared to those used for longitudinally planked vessels, cost less and were likely easier to install. The top layer was likely sacrificial, as it could easily be replaced when damaged from the quick, yet relatively violent, unloading activities (Rodgers 2003:34-35). At the turn of the bilge, this double layered ceiling planking rested on several thick strakes. Above this point, the ceiling planking was longitudinally planked as a single layer. As Rodgers states, "The ceiling planks were not expected to contribute to the ship's longitudinal strength which was carried by the multitude of floor keelsons" (Desmond 1999 [1919]:55; Rodgers 2003:34).

A difference between single-decked wooden bulk carriers and double-decked wooden bulk carriers lies in the addition of a second deck, or deck beams. The deck beams provided extra stiffness to the sides in addition to supporting deck planks, but as Rodgers states, the second deck was probably not planked (Rodgers 2003:34).

> The lack of planking allowed freer access in the hold for loading and unloading. Loading a ship on the lakes at the time involved

> positioning it under the spillways of a hopper loader, also known as a pocket dock, so the bulk cargo could simply cascade from the elevated hopper into the hold. Unobstructed access in the hold was critical to this operation so no bulkheads or decking could be permitted (Rodgers 2003:8).

R.J. Hackett, *Mary Jarecki*, and *Monohansett* were all constructed with a single deck. Interestingly, *Monohansett* remained a single-decked vessel during its entire career on the lakes, while both *R.J. Hackett* and *Mary Jarecki* had a second deck, or at least a set of second deck beams, added later in their careers.

Double-decked wooden bulk carriers were also different from single-decked wooden bulk carriers in that many of them were constructed with iron plating protecting the centerline keelsons from loading and unloading damage (Cooper 1986:85; Desmond 1984 [1919]:92-95; Rodgers 2003:36). Many wooden bulk carriers were also built with iron cross bracing, or basket trusses. This basket truss was found in several of Davidson's vessels, including *City of Glasgow*, *Frank O'Conner*, and *Pretoria*. Interestingly, Wheeler's *Sitka* exhibited iron cross bracing only on the sides and down to the turn of the bilge while, the Davidson vessels were built with iron strap cross bracing supporting the entire structure.

6

Conclusion

Oaken Whale with a Cast Iron Tail demonstrates how the nineteenth-century Great Lakes wooden bulk carrier transitions from a steambarge to its modern steel form. The development of the wooden bulk carrier was intricately linked to its function and environment. They were designed to carry heavy bulk cargoes, particularly iron ore. Epitomized by the *R.J. Hackett*, these vessels capitalized on the advantages of both steambarges and sailing vessels. Their design facilitated technological innovations associated with the iron ore industry, such as loading and unloading mechanisms. Likewise, their deck plan, conforming to the fore and aft configuration, and their shape, having a rectangular cross-section, allowed these vessels to operate with maximum efficiency in the Great Lakes canal and lock environment. Their main design restriction was limited to shape of the locks at Sault Ste. Marie.

As the locks underwent a series of subsequent enlargements during the later part of the nineteenth century, shipbuilders pushed the limits of wooden ship construction as they attempted to maximize their designs. In order to combat hogging and sagging stresses caused by the high length to beam ratio, shipbuilders added a second deck. Although this second deck was probably not planked, the deck beams stiffened the sides and spread the strain of heavy cargo across the entire vessel.

Ultimately, shippers and shipbuilders realized that wooden vessel construction could not greatly exceed 300 feet in length without loosing integrity. This length restriction, combined with dwindling timber supplies and high insurance rates, pushed the bulk cargo trade to rely on a new construction material for its transportation needs. Despite the apparent downfalls in wooden construction, the wooden bulk carrier proved so effective that its form and function was carried over into iron and steel bulk carrier construction.

This study also distinguished the single-decked wooden bulk carrier in both a historical and archaeological context, as exemplified by *Monohansett*, and explored one of the reasons for the switch from wood to iron and steel-hulled vessels: fire. The history of *Monohansett* reflects several dangers in operating wooden vessels on the Great Lakes, but, like many other wooden steam vessels on the lakes, the *Monohansett* finally succumbed to fire. Ultimately, shippers realized that in the changing times of the twentieth century, steam navigation was not compatible with wooden hulls.

This single-decked wooden bulk carrier exemplifies how economics influenced technology, which in turn directly influenced vessel form. *Monohansett*'s design allowed it to take advantage of the efficient gravity fed pocket docks and mechanized unloading techniques of her time. The heavy, yet cheap, flooring system made it ideal for transporting heavy ore cargo, and its shape, a rectangular cross-section, allowed it to fit through the Sault Ste. Marie locks with a maximum cargo capacity.

The archaeological investigations of *Monohansett* provided insight into the transitional phase of Great Lakes wooden bulk carrier construction, a phase that previously received little attention. Overall, these investigations revealed that *Monohansett* contained a complex keelson support system. This system was intended to provide longitudinal support, countering its high length to beam ratio. It also provided the vessel with a solid flooring system, providing support and protection against the new, fast, yet destructive, loading and unloading technologies.

The location and excellent preservation of *Monohansett*'s remains make it an ideal dive site for recreational divers, and the vessel's approximate coordinates appear in several diver guides. The remains lie in clear water, and artifacts that have not already been removed could prove to be an enticement to future sport divers.

The wrecksite lies within the protected waters of TBNMS, providing management and juridical protection of the site. Current management plans for *Monohansett* include continued monitoring and management by the TBNMS staff. The TBNMS prohibits "recovering, altering, destroying, possessing or attempting to recover, alter, destroy, or possess an underwater cultural resource (shipwrecks, prehistoric sites, piers and other structures)" (TBNMS 2005). TBNMS's continual monitoring of this wrecksite is crucial to its preservation. ECU's Phase II pre-disturbance survey provides a baseline for future management plans.

This study also combined the archaeological findings of the *Monohansett* with other archaeologically investigated vessels, generating a working definition for the Great Lakes steambarge, the single-decked wooden bulk carrier, and the double-decked wooden bulk carrier. All of the vessels used in this comparison study conformed to the fore and aft deck configuration. As indicated in Chapter 2, only early steambarges were constructed with an aft configuration, having both their pilothouse and engineering cabin towards the aft end of the vessel. Therefore, this study defines the steambarge as usually having the fore and aft configuration. Unfortunately, an early steambarge with the aft deck configuration has yet to be archaeologically investigated. The addition of an early steambarge to this comparative study could provide some additional conclusions about their construction techniques.

The steambarge was similar to the single-decked wooden bulk carrier in that they both boasted a single deck. Overall, the frames of a steambarge followed that of traditional nineteenth-century wooden vessel construction, except where the vessels were triple framed or where the frames were tightly fitted together, uniting the flooring system in a solid homogenous unit. The wooden bulk carrier, on the other hand, possessed a complex flooring system unique to the wooden bulk carrier class. The keelson support system allowed the wooden bulk carrier to capitalize in the heavy bulk cargo trade.

Double-decked wooden bulk carriers were different from steambarges and single-decked wooden bulk carriers in that they were double-decked. They also boasted internal iron supports, such as keelson plating and iron cross bracing, allowing shipbuilders to attain a higher length to beam ratio. Many of them were built with triple frames supporting the floor keelsons and double frames above the turn of the bilge. The triple frames provided additional rigidity for the keelson support system, allowing the vessels to transport larger loads of bulk commodities.

These design characteristics represent a general definition for steam-barges, transitional vessels, and wooden bulk carriers, but it should be recognized that the vessels did not always exactly conform to these characteristics. For example, *R.J. Hackett* and *Mary Jarecki* were constructed with a single-deck, but they had second decks added later in their life times. In this way, these single-decked vessels transitioned into the constructs of double-decked wooden bulk carriers.

Similarly, the iron basket truss appears to be a characteristic typical to double-decked wooden bulk carriers but not steambarges or single-decked wooden bulk carriers. Not every wooden bulk carrier, however, was built with a basket truss. For example, *Sitka* exhibited the iron cross bracing on her sides and the turn of the bilge, and, thus, the bracing formed a sort of band rather than a basket shape. In this way, *Sitka* may represent the experimental phase of the iron basket truss.

It should also be noted that variations between structural components exist, but this does not take away from classification of a vessel as a whole. Rather, this may reflect builder variation. For example, in the complex flooring system found in wooden bulk carriers, in general, contained anywhere from three to seven floor keelsons per side. A unique variation to this complex flooring system was seen in the case of *Mary Jarecki*, whose floor keelsons were staggered in an indiscernible pattern yet still attached, forming a single longitudinal girder. Despite these variations, the system of floor keelsons and athwartship planking served a similar purpose: they provided additional support for heavy cargo.

This investigation proves that the nineteenth-century wooden bulk carrier was unique in that its construction techniques were different from other vessel types. Within this vessel class, this study also clarified a distinction between single-decked and double-decked wooden bulk carriers. Shipbuilders constructed both the single- and double-decked wooden bulk carrier with a sturdy flooring system, ideal for transporting heavy bulk cargo. These modifications in design provided support and protection for the hull from efficient, yet somewhat damaging, loading and unloading techniques, and they allowed the vessel owners to profit during a time of economic growth. In addition to being effectively fitted for their function and being driven by the burgeoning iron ore trade, both the single-decked and double-decked wooden bulk carrier were built to operate in the unique environment of the Great Lakes. Built with a plumb bow, a short fantail stern, and a deck plan with a fore and aft configuration, the vessels were suited to operate in foul weather and tight locks and canals, specifically the Sault Ste Marie locks.

References

Primary Sources

Great Lakes Marine Historical Collection, Milwaukee Public Library, Milwaukee, Wisconsin.
Ship Information and Data Record: *Monohansett*:
Vessel Enrollment, Port Huron (Michigan), 1 August 1872;
Vessel Enrollment 43, Port of Milwaukee (Wisconsin), 10 February 1879;
Vessel Enrollment 583, Port of Milwaukee (Wisconsin), 8 April 1888.
Ship Information and Data Record: *R.J. Hackett*

Historical Collection of The Great Lakes, Bowling Green State University, Bowling Green, Ohio.
Great Lakes Vessel Index: *Fedora*, *H.D. Coffinberry*, *Jesse Linn*, *Pretoria*, *R.J. Hackett*

Michigan Historical Center, Office of the State Archaeologist, Lansing, Michigan.
Shipwreck Record: 20UH56

Maritime Studies Program, East Carolina University.
Underwater Archaeology Field Data: *City of Glasgow, Monohansett*

Thunder Bay Sanctuary Research Collection, Alpena Public Library, Alpena, Michigan.
Marine Subject File: *Monohansett*: Telegram to the Inter Ocean Transportation Company, 26 May 1883.
Subject File: Samuel F. Hodge & Co: *Helped to Make Detroit Famous: Samuel F. Hodge & Co., Proprietors of the Riverside Iron Works, Renowned for their High Type Marine Engines and Mining Machinery*.

State Historical Society of Wisconsin, Madison, Wisconsin.
Underwater Archaeology Field Data: *R.J. Hackett*
Vessel Enrollment 43, Port Huron (Michigan), 1 August 1872
Vessel Enrollment 198, Port of Milwaukee (Wisconsin), 10 February 1879
Vessel Enrollment 583, Port of Milwaukee (Wisconsin), 8 April 1888

Newspapers

Alpena Argus-Pioneer, (Alpena, Michigan), 25 November, 1907.

Chicago Inter-Ocean, (Chicago, Illinois), 25 April 1879.

Chicago Times, (Chicago, Illinois), 3 March 1872.

Door County Advocate, (Sturgeon Bay, Wisconsin), 26 October 1874.

Duluth Evening Herald, (Duluth, Minnesota), 24 August 1889.

Duluth Daily Tribune, (Duluth, Minnesota), 26 August 1889, 2 September 1889, 14 November 1892.

Erie Morning Dispatch, (Erie, Pennsylvania), 22 October 1877.

Marquette, (Marquette, Michigan), 20 July 1889.

Milwaukee Sentinel, (Milwaukee, Wisconsin), 18 November 1878, 20 February 1888.

Secondary Sources

Barry, James P.
1970 *Ships of the Great Lakes*. Howell-North Books, Berkeley, CA.

Cooper, David J. (editor)
1996 *By Fire, Storm and Ice: Underwater Archaeological Investigations in the Apostle Islands*. State Historical Society of Wisconsin, Madison, WI.

Cooper, David J. and John O. Jensen
1995 *Davidson's Goliaths*. State Historical Society of Wisconsin, Madison, WI.

Dean, Martin, Ben Ferrari, Ian Oxley, Mark Rednap, and Kit Wilson (editors).
2000 *The NAS Guide to Principles and Practice*. The Nautical Archaeology Society and Archetype Publications, London.

Desmond, Charles
1999 [1919] *Wooden Shipbuilding*. Vestal Press, Inc., Lanham, MD.

Devendorf, John F.
1996 *Great Lakes Bulk Carriers 1869-1985*. Apollo Printing & Graphics Center South Bend, IN.

Greenwood, John O.
1975 *Namesakes 1900-1909: A Photostory and Historical Biography of Great Lakes Vessels that Existed into the 20th Century, but Were Gone before 1910*. Freshwater Press, Inc., Cleveland, OH.

Harrington, Steve
1998 *Divers Guide to Michigan*. Maritime Press, St. Ignace, MI.

Harrison, Stuart H.
1974 *The Cleveland-Cliffs Iron Company*. University Press, Princeton, NJ.

Heinrich, Thomas R.
1997 *Ships for the Seven Seas*. The John Hopkins University Press, Baltimore, MD.

Hough, Jack L.
1958 *Geography of the Great Lakes*. University of Illinois, Urbana, IL.

Kolascz, Sarah Ann
2004 *The Career, Demise, and Wreckage of the* Monohansett*: A Nineteenth Century, Single Screw, Wooden, Bulk Freighter*. Undergraduate thesis, Kalamazoo College.

Labadie, C. Patrick
1989 *Submerged Cultural Resources Study: Pictured Rocks National Lakeshore*. Southwest Cultural Resources Center, Santa Fe, NM.

Labaree, Benjamin W. et al.
1998 *America and the Sea: A Maritime History*. Mystic Seaport, Mystic, CT.

Mansfield, J. B.
1972 [1899] *History of the Great Lakes, Vol.1*. Freshwater Press, Inc, Cleveland, OH.

Mills, Rodney H.
2002 *Wooden Steamers on the Great Lakes*. Great Lakes Historical Society, Vermillion, OH.

Muckelroy, Keith
1978 *Maritime Archaeology*. Cambridge University Press, London.

Rodgers, Bradley A.
2003 *The Bones of A Bulk Carrier*. Maritime Studies Program, East Carolina University, Greenville, NC.
1996 *Guardian of the Great Lakes: The U. S. Paddle Frigate* The University of Michigan Press, Ann Arbor, MI.

Stonehouse, Frederick
1992 *A Short Guide to Shipwrecks of Thunder Bay*. Thunder Bay Underwater Preserve, Alpena, Michigan.

Temin, Peter
1976 *Iron and Steel in Nineteenth Century America*. The M.I.T. Press, Cambridge, MS.

Thompson, Mark L.

1991 *Steamboats and Sailors of the Great Lakes*. Wayne State University Press, Detroit, MI.

1994 *Queen of the Lakes*. Wayne State University Press Detroit, MI.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration

1999 *Thunder Bay National Marine Sanctuary: A Federal/State Partnership for the Management of Underwater Cultural Resources Final Environmental Impact Statement/Management Plan*. US Government Printing Office, Washington, D.C.

Warner, Thomas D. and Donald F. Holecek

1975 *Thunder Bay Shipwreck Survey Study Report: A Summary of Findings for an Underwater Inventory of Lake Huron Shipwrecks Located off Alpena County, Michigan*. Michigan State University, East Lansing, MI.

Wright, Richard J.

1969 *Freshwater Whales: A History of the American Ship Building Company and Its Predecessors*. The Kent State University Press, Kent, OH.

Online Resources

Christer Westerdahl.

1996 *Beowulf's Ship Type and the Pivot of Denmark – Traditional Zones of Transport Geography in Relation to Vessel Types*. <http://www.abc.se/~m10354/publ/transport.htm>.

Great Lakes Vessels Index.

2005 Historical Collections of the Great Lakes, Bowling Green State University. <http://www.bgsu.edu/colleges/library/hcgl/vessel/html>.

Thunder Bay National Marine Sanctuary

2005 <http://thunderbay.noaa.gov/regulations_new.html>.