"A FORMIDABLE LOOKING PILE OF IRON BOILERS AND MACHINERY": RECONSTRUCTING THE CIVIL WAR GUNBOAT USS *WESTFIELD*

A Dissertation

by

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ABSTRACT

This dissertation reconstructs the former Union Navy Gunboat USS *Westfield*. *Westfield* belonged to an unusual class of civilian vessels that the Navy converted during wartime to serve in the Union's blockade of Confederate southern ports. Originally built and operated as a double-ended ferryboat, the vessel was purchased by the Navy from the New York Staten Island ferry service. *Westfield* served in operations on the Mississippi River as part of a mortar flotilla before leading another flotilla of ships from the West Gulf Blockading Squadron to interdict Confederate shipping along the Texas Coast. The vessel last saw action in 1863 at the Battle of Galveston where it ran aground and was blown up by its crew to keep the vessel out of Confederate hands. In 2009, the U.S. Army Corps of Engineers (USACE) orchestrated *Westfield*'s recovery in advance of their operations to deepen the Texas City Channel. Archaeologists recovered approximately 8000 artifacts during the salvage operation. The USACE sent these artifacts to the Conservation Research Laboratory at Texas A&M University where the artifacts underwent conservation and study.

Westfield's wooden hull completely disintegrated over the last one hundred and forty-six years leaving little evidence of the vessel's design. Therefore, this dissertation reconstructs *Westfield*'s plan using other methods. The document first introduces *Westfield* with a brief history of the vessel before investigating the vessel's design using historical documentation. The discussion continues with an analyses of artifacts recovered from the wreck site and focuses on *Westfield*'s construction and steam

machinery. The resulting reconstruction proves that even the most scant archaeological remains can be a resource if properly utilized. The collection presents a unique opportunity to examine a rare vessel class, early American steam machinery, and to answer questions about how the components individually operated.

DEDICATION

To my Aggie darlin' and my little gremlin Tyler.

ACKNOWLEDGEMENTS

The USS *Westfield* Conservation Project has been a long road from its origins in 2010 to completion in 2015. When my committee chair Donny Hamilton gave me the project, I was at first horrified knowing the collection was a blown up pile of scrap at best. Yet over time I fell in love with the story of the vessel and the many unique discoveries that came out of the collection. My involvement in the project allowed me to network with other professionals in the field and this in turn opened many doors for me. Therefore, I would like to first thank Donny for the wonderful opportunity to manage this significant piece of U.S. and Texas' history.

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CHAPTER I

INTRODUCTION

This dissertation reconstructs the former Union Navy Gunboat USS *Westfield*. *Westfield* belonged to a rare class of civilian vessels that the U.S. Navy converted during wartime to serve in the Union's blockade of Confederate southern ports. The Navy purchased hundreds of civilian vessels for naval use during the American Civil War, but *Westfield* was unusual for its original function as a double-ended steam driven ferryboat. It was one of only twenty ferryboats converted in this manner by the U.S. Navy, all of which are poorly documented both historically and archaeologically (Minick 1962:436). The U.S. Army Corps of Engineers (USACE) orchestrated *Westfield*'s recovery in 2009, a project that has offered a unique opportunity to study and understand numerous aspects of this little-known class of vessel. This dissertation will focus on *Westfield*'s construction before and after naval conversion, and the vessel's steam machinery. Ceramics, glassware, and personal effects, are left out of the discussion since these artifacts were previously examined in a thesis written by Jessica Stika (2013). Military ordnance will be studied in a thesis in preparation by Andrew Thomson.

In 1861, the Union Navy purchased *Westfield* from the New York Staten Island Ferry Line (Heyl 1965:335). The vessel served in operations on the Mississippi River as part of a mortar fleet, before leading a flotilla of ships from the West Gulf Blockading Squadron to interdict Confederate shipping along the Texas Coast. *Westfield* last saw action in 1863 at the Battle of Galveston when the vessel ran aground during a

Confederate attack to retake the island. The crew attempted to scuttle the vessel with a deliberately set explosion, but the charge went off prematurely, killing *Westfield*'s commander William B. Renshaw and twelve members of the crew (Cotham 1998:129; 2006:130). Due to the force of the explosion and the Confederate salvage attempts that followed, the wreck site eventually became disarticulated and scattered. For nearly 150 years, *Westfield*'s wreck site lay near ship traffic traveling to and from the ports of Galveston, Texas City, and Houston. In 2009, the USACE initiated operations to deepen the Texas City Channel. To remain in compliance with Section 106 of the National Historic Preservation Act of 1966, the remains of *Westfield* were located and removed to ensure their preservation. The physical survey and recovery were contracted to Atkins Global, formerly PBS&J. Because this was a Texas shipwreck site and a former naval vessel, both the Texas Historical Commission (THC) and the U.S. Naval History and Heritage Command (NHHC) issued permits for the project. During the salvage operation, Atkins recovered approximately 8000 artifacts. Upon the completion of the recovery, the artifact assemblage was sent to the Conservation Research Laboratory (CRL) at Texas A&M University where the artifacts underwent conservation and study.

Westfield's wooden hull completely disintegrated between 1863 and 2009, leaving debris that consisted mainly of the ship's metal components. Therefore, understanding *Westfield*'s construction was accomplished using other forms of evidence. One of these was data derived from comparable archaeological sites. Only two New York ferryboats have been the subject of archaeological investigations. These were USS *Clifton* and USS *Southfield* (Spirek 1993; Hoyt et al. 1994). Like *Westfield*, both vessels

served as Staten Island ferries and were originally owned by the famous railroad tycoon Cornelius Vanderbilt. Historical accounts suggest the vessels followed plans similar to *Westfield* (*Richmond County Gazette* 1861). The term "suggest" is used, since to date the only surviving plans come from a successor ferryboat, *Southfield* II, which was constructed twenty years later (Cowles 1886).

In 1994, USS *Clifton* was located in Sabine Pass, Texas, and underwent brief archaeological investigations by Espey, Huston & Associates, Inc. Unfortunately, the site lay mostly covered in a low lying marsh land that prevented a detailed study of the wreck (Hoyt et al. 1994). For this reason, *Clifton* was of limited benefit to this study. The wreck site of USS *Southfield* offered more information. In 1991, East Carolina University partially excavated *Southfield*'s remains in North Carolina's Roanoke River (Spirek 1993). The excavations uncovered one half of the vessel, which consisted of a well-preserved hull, lower supporting sponsons, and part of the main deck.

In 2006, prior to *Westfield*'s excavation, Atkins Global sent researchers to the National Archives in Washington, D.C. and to numerous repositories in New York City. The result of this research provided general documentation of New York ferryboats, and more importantly, proposals on how some of these vessels should be altered for naval use. While no photographs of *Westfield* were found, the vessel's hull measurements were located in naval enrollment papers. Recovered photographs of similar ferryboats offered a general idea of how *Westfield* might have appeared prior to conversion. Regrettably, most of those photographs dated from the 1880s and 1890s after most of these ferries underwent extensive refits that likely altered their original appearance.

At the time this dissertation research began, eight years had passed since Atkins' researchers searched for information on *Westfield*. While the archives in Washington D.C. were extensively explored, other repositories in New York required a second visit due to the likelihood of unexamined materials. In 2014, a second trip was undertaken by Justin Parkoff and Jessica Stika from Texas A&M University to locate photographs of *Westfield*. Rather than searching solely for images of *Westfield* and other sister ships, the search was expanded to any photographs of waterfront scenes or New York vessels in the hope that *Westfield* was unintentionally captured in a photo. The photographic and historical evidence recovered during that trip has provided a considerable amount of information for this study.

Westfield's recovered artifact assemblage forms the principal source of clues about the vessel's steam machinery. Most of the approximately 8000 artifacts recovered from the site consist of fragments from *Westfield*'s walking beam engine and boiler system. The contribution of these artifacts was crucial for an understanding of the machinery's design and function which would be impossible to determine from the historical data alone.

This study reconstructs *Westfield* primarily using the above-mentioned sources. Following the introductory chapter, Chapter II presents a brief history of *Westfield*. This history starts in New York, follows the vessel through the most significant naval engagements in which the vessel participated, and terminates with the vessel's destruction and recovery at Galveston, Texas. For a more detailed historical study of the day to day events of *Westfield*'s naval career, see Jessica Stika's 2013 thesis.

Chapter III investigates *Westfield*'s construction, relying mainly on historical documentation gathered during both Atkins' and Texas A&M's research trips to the National Archives in Washington D.C. and repositories in New York City. By combining the previously-mentioned contemporary *Southfield* II plan, the evidence contained in the *Southfield* (I) archaeological report, and the details recovered during recent archival research, hypothetical reconstructions were created that show *Westfield* first as a ferryboat and then as a converted Union gunboat.

Chapter IV is a continued analysis of *Westfield*'s construction, but with a focus on artifacts recovered from the wreck site that assist in determining the finer details of the design. These details mainly include evidence of naval armor, an anti-boarding system, internal stowage, the naval conversion of *Westfield*'s windows to portholes, and the fastener/sheathing elements from the vessel's lower hull.

Chapter V takes the ferryboat plan drawing introduced in Chapter III and reconstructs *Westfield*'s walking beam engine and dual boiler system using available evidence from the artifact collection. Discussion of every artifact conserved would be redundant and impractical for the purposes of this study. However, many of the more instructive artifacts have been selected for illustration to accompany the discussions.

Chapter VI concludes this study with a review of the main points. An appendix contains copies of both the historical letters that explain *Westfield*'s naval conversion and the original naval enrollment documents. The reconstructions of *Westfield* proves that even fragmentary archaeological remains can be a resource if properly conserved and studied. While *Westfield* is only 150 years old, its design is largely forgotten or

misunderstood. The recovery of the artifact collection presented a unique opportunity to examine a rare vessel class, early American steam machinery, and to answer questions about how individual components operated.

Measurements are listed in this document in imperial units (feet and inches) to correspond with the scale employed by *Westfield*'s builders and crew in the 1860s; their metric equivalents are provided as well. While archaeological photography generally uses the metric system, the scales on *Westfield*'s photography vary between the imperial and metric system due to the preferences of numerous photographers over the long course of the project. To prevent confusion, photos that contain scales other than centimeters (cm.) are tagged with the corresponding measurement that should be followed. This includes scales with both centimeters and decimeters as "cm./dm.", decimeters as "dm.", and imperial units as “scale inches”. All artifact photos are given courtesy of the CRL unless otherwise noted.

CHAPTER II

A SHORT HISTORY OF *WESTFIELD*

> I took a look at the position of the blockading fleet and the narrow channel through which we had passed in coming in, and I resolved, if possible to make a thorough survey of the small channels before we sailed. We then got into the boat and started up the bay towards the town of Galveston. My attention was first directed to the wreck of the *Westfield*, a formidable looking pile of iron boilers and machinery sticking out of the water, which marked the spot where this ill-fated vessel came to her tragical end with some of her officers and crew a short time previously. - William Watson, captain of *Rob Roy*, reflecting on his surroundings upon successfully passing through the Union Blockade during the American Civil War on 2 June 1864 (Watson 1892:171).

During the American Civil War, the U.S. Navy purchased hundreds of civilian vessels to serve in the Union's blockade of Confederate southern ports. Out of the large number of converted vessels, only twenty, including *Westfield* were designed as double-ended steam driven ferryboats (Minick 1962:436). This made *Westfield* and other vessels of this type an unusual class in the broader Union fleet.

Westfield was originally commissioned for the famous businessman Cornelius Vanderbilt to expand his Staten Island ferry service. Construction of the vessel's hull commenced on 1 June 1860 at the Jeremiah Simonson Shipyard in Brooklyn, New York

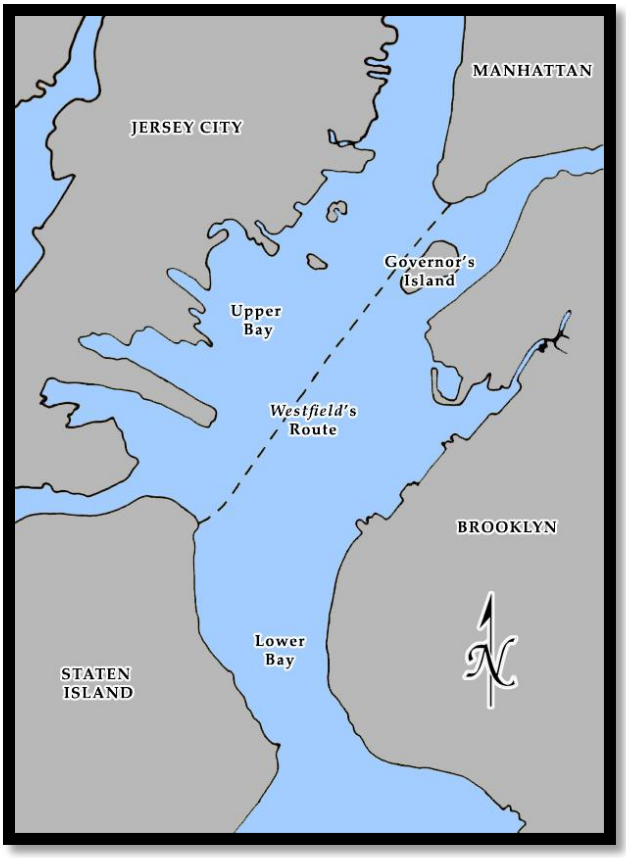

Figure 1. *Westfield*'s ferry route; modified from Hilton (1964: inside cover).

(Stiles 2009:337). The vessel's steam machinery was constructed by Morgan Iron Works in Manhattan, New York (Heyl 1965:335). *Westfield* was launched on 2 July 1861, and joined the Staten Island route on 19 July between Whitehall Street in Manhattan, and Tottenville and Vanderbilt's Landing on Staten Island (Figure 1)(Borgens et al. 2010:7). The Civil War started on 12 April 1861 before *Westfield* was completed. Seeking ships to form a blockade of all Confederate southern ports, *Westfield* was purchased by the Union Navy after only four months of civilian service (late November). During a three month period, *Westfield* underwent significant alterations by the New York shipbuilder Jacob A. Westervelt to turn the vessel into a proper naval gunboat (to be discussed in

Chapter III). Upon completion, the newly designated USS *Westfield* was commissioned into the U.S. Navy on 13 February 1862 (Stika 2013:13). The vessel's new armament consisted of a 100 lb. (45.5 kg.) Parrott rifle on the bow, a 9 in. (22.9 cm.) smoothbore Dahlgren at the stern, and four 8 in. (20.3 cm.) smoothbore Columbiads broadside guns. Under the command of Commodore William B. Renshaw, *Westfield* and a full crew of 130 men (including Renshaw) left New York on 22 February and steamed south to join the Union's blockade of the Confederacy's coastline (Borgens et al. 2010:14, 24, 27; Cotham 2006:43).

As a shallow draft vessel, *Westfield* was able to travel into rivers and tributaries that larger ships in the blockading fleet could not reach to deliver troops and to assist in offensive operations. *Westfield* was used extensively as a towing ship to pull other ships over the sandbars leading into the Mississippi River and to position mortar schooners in range of their targets at the Battle of Forts Jackson and St. Philips and an assault on Vicksburg. When Confederate troops sent fire rafts down the Mississippi River, *Westfield*'s crew used fire hoses retained from the vessel's time as a ferry to extinguish the fires, allowing the rafts to harmlessly pass through the fleet (Cotham 2006:22; Hearn 1995:178-181; Perry 1957:148-151).

Most of what historians know about *Westfield*'s naval history comes from a notebook written by the U.S. Navy Marine Henry O. Gusley, who was stationed onboard throughout the vessel's military career (Cotham 2006). Gusley’s notebook begins with an account summarizing events leading up to his first entry on 3 May 1862, five days after the successful Union capture of New Orleans. The entries recounted the events that took

place from Gusley's departure from New York Harbor on *Westfield* to the Battle of Forts Jackson and St. Philip on 18-28 April 1862. After 3 May, his entries flowed like a diary, only occasionally retracing events to record days on which he was too busy to write [Entries: 3-6 May 1862](Cotham 2006:35-55).

Following the capture of New Orleans, Gusley recorded that *Westfield*, its sister ship *Clifton*, and numerous other vessels from the Union fleet's West Gulf Blockading Squadron established a base at a location known as Ship Island, Louisiana (Figure 2). From that base, *Westfield* patrolled the lower portions of the Mississippi River and branched off into other locations such as the Pearl River and Lake Pontchartrain [Entries: 7-21 May 1862](Cotham 2006:54-62).

The Union blockade of Southern ports required that *Westfield* and other vessels regularly and rapidly moved to different locations. From the Mississippi River, *Westfield* traveled to Pensacola, Florida [Entries: 1-5 June 1862], before being recalled back to New Orleans [Entries: 9-12 June 1862](Cotham 2006:63-72). The vessel then patrolled the Mississippi River in preparation for the Union assault on Vicksburg. At Vicksburg, *Westfield* and *Clifton* were damaged during the assault, but remained in the battle, until the fleet retreated back to Ship Island [Entries: 19 June - 3 August 1862](Cotham 2006:73-86). A battle at Baton Rouge and skirmishes at Plaquemine and Donaldsonville, required Gusley to occasionally leave the ship to directly engage Confederate forces [Entries: 7-12 August 1862](Cotham 2006:87-91). Following these fights on the Mississippi River, *Westfield* returned to the blockade at Pensacola until relieved. Leaving Pensacola, the vessel rejoined the fleet at Ship Island [Entries: 14 August- 1

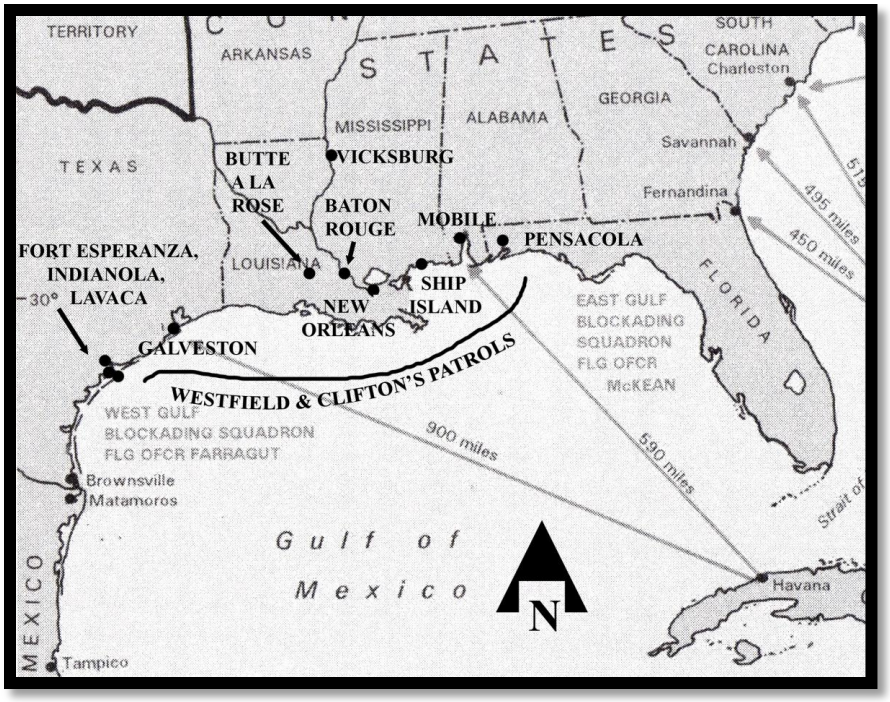

Figure 2. Range of *Westfield* and *Clifton*'s patrols; modified from Symonds (2009:39).

October 1862](Cotham 2006:92-103).

Due to new naval objectives on both the Mississippi River and the blockade along the Southern Gulf Coast, Fleet Commodore David Farragut ordered *Westfield* to Texas, where the vessel acted as the Union's flagship, leading a squadron of three additional steamers and one mortar schooner. The ships were employed in extending the blockade and assisting in the capture of important Texas ports. Capturing Galveston without a fight [Entries: 9-21 October 1862], *Westfield* and *Clifton* proceeded down to Matagorda Bay, where the vessels temporarily took possession of Indianola, before proceeding north in the bay to bombard the Confederate-held town of Lavaca [Entries: 23 October- 6 November 1862](Cotham 2006:104-116).

Upon returning to Galveston on 12 November, the crews aboard the Union ships saw a lull in naval activity, until the catastrophic Battle of Galveston. In the early morning hours of New Year's Day 1863, Confederate forces under the command of General John B. Magruder launched a well-staged covert attack on Union forces occupying the city and the harbor. During the fighting *Westfield* ran aground in the shallow waters of Galveston Bay and Commodore Renshaw decided to scuttle the vessel to prevent capture [Entries: 12 November 1862-10 January 1863](Cotham 2006:117-130). The charges laid to explode the vessel's ammunition magazines went off prematurely, killing Renshaw and twelve members of the crew (Cotham 1998:129; 2006:128-130). A Confederate eyewitness described the event in detail:

> The decks were saturated with turpentine, and the last of the crew, with Commodore Renshaw, were just about to leave the ship. The gig was ready and the Commodore was the last to descend. The torch was applied – a bright flash ran along the deck – the Commodore turned his face to look at the vessel for the last time. The sailors rested a moment on their oars; all eyes were turned in the direction of the *Westfield,* attracted by the vivid flame. It was a moment of surprise and of perfect silence, and it was only a moment; then there was a flash of blue smoke and a fearful explosion. The shells of the magazine, rising in the air, burst far up. There was a plunging noise in the water, such as is occasioned by the falling of a heavy body, and then for a radius of four or five hundred feet there was a shower of fragments which sounded like falling rain. The *Westfield* was seen to part or burst out forward, like a chestnut burr, and when the smoke

Figure 3. Destruction of USS *Westfield* from *Frank Leslie's Illustrated Newspaper* (Image courtesy of the New York Public Library; reference digital ID: 1708826).

was cleared away there was no sign of life about her. Forward she was blown into fragments down to the water; but the machinery had not been destroyed, as the singing of the steam was distinctly heard after the explosion. The Commodore's boat and all in it were annihilated in the terrible catastrophe – scattered through the air in fragments. The smoke-stacks and the after part of the ship lay in a black mass in the water for ten minutes, when there was another flash, and she was speedily wrapped in flames (Figure 3)(Scharf 1887:507–508).

The second flash presumably originated from *Westfield*'s over pressurized boilers exploding. Newspapers accounts from the time state that Renshaw ordered the boiler

safety valves chained down to ensure their destruction (Bosson 1886:112; *Boston Journal* 1863; *New York Times* 1863).

Westfield ran aground traveling stern first onto a sandbar approximately -7 ft. (-2.13 m.) deep (Borgens et al. 2010:1). After the explosion in *Westfield*'s bow, the stern and amidships areas burned to the waterline and sank at an incline into deeper water. This caused portions of *Westfield*'s machinery to remain visible above the bay (Bell 1863; Watson 1892:171). Confederate General Magruder ordered his troops to commence salvaging *Westfield*'s wreckage in the days following Galveston's capture. During these operations, the salvors recovered a considerable amount of iron, cupreous material from the hull sheathing, ordnance shells, and six out of the seven guns that *Westfield* was carrying (Confederate Prize Commission Records 1863; Borgens et al. 2010:44, 46, 197). The unrecovered seventh gun was a 9 in. (22.9 cm.) smoothbore Dahlgren, and its presence was possibly unknown to the Confederates since *Westfield*'s armaments had been changed twice in the month prior to the battle [Gusley entries: 11 and 28 December 1862](Cotham 2006:124, 127).

Westfield's wreck site was again disturbed in 1906 when the Office of the Chief of Engineers (USACE's predecessor) sought to remove more of the vessel's wreckage which had become a nuisance to local shipping. The U.S. snag boat *General S.M. Mansfield* was sent to the site to conduct this work and found that most of *Westfield*'s hull had rotted away, but the engine cylinder still remained standing and lay only 4 ft. (1.22 m.) beneath the surface. Portions of the wreck were dynamited, and the engine

cylinder was recovered, as was a large quantity of cupreous material (*Galveston Daily News* 1906; Borgens et al. 2010:48).

In 2009, the majority of *Westfield*'s surviving wreckage was recovered from what has become the Texas City Channel. This large operation was orchestrated by the USACE as part of the Texas City Channel Improvement Project. Due to *Westfield*'s historical significance, location, and previous naval purpose, the wreck site fell under several modern protective statutes. These statutes included the National Historic Preservation Act of 1966 (NHPA), the Texas Antiquities Code of 1969, and the Sunken Military Craft Act of 2005. This required the USACE to initiate a Section 106 investigation and recovery under the NHPA, and to further coordinate efforts with the State of Texas (Texas Historical Commission), and the U.S. Navy (U.S. Navy History and Heritage Command). *Westfield*'s recovery resulted in the largest marine archaeological salvage project that has ever been conducted in Texas' state waters. At the completion of the project, approximately 8000 artifacts were recovered and sent to Texas A&M University where the artifacts underwent conservation and analysis at the Conservation Research Laboratory (Figures 4 and 5).

In closing, *Westfield*'s time as both a Staten Island ferryboat and as a Union gunboat were short lived. Yet, the vessel's career was anything but uneventful. Following *Westfield*'s purchase and conversion for use in the Union war effort, the vessel proved both adaptable and highly functional, indicating that the ferryboat design was well suited to combat in Southern waters. As a double-ended vessel designed to carry heavy loads, the vessel was able to travel into confined spaces along Mississippi

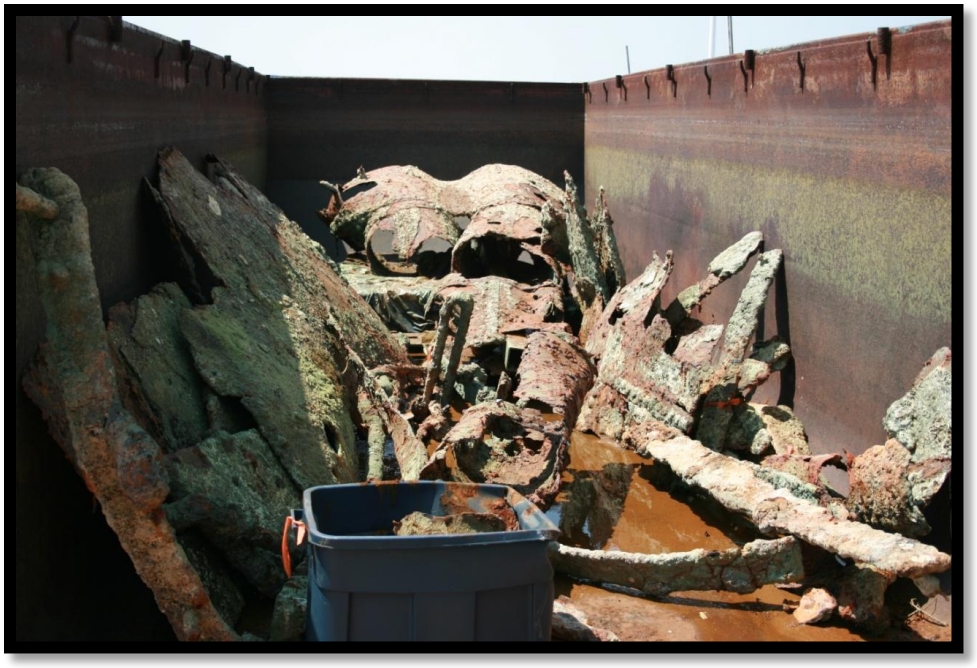

Figure 4. Recovered boiler artifacts from *Westfield*'s wreck site (Image courtesy of Atkins Global).

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Figure 5. Recovered fire grate artifacts from *Westfield*'s wreck site (Image courtesy of Atkins Global).

River tributaries and provide heavy artillery in locations that deeper draft Navy vessels could not reach. *Westfield* proved the usefulness of the vessel class at the Battle of Forts Jackson and St. Philips, as well as an attack on Vicksburg where the vessel served diverse purposes including a gunboat, tugboat, and fireboat.

Westfield met an untimely end during the Battle of Galveston on New Year's Day, 1863. Confederate forces recaptured Galveston from Union forces and *Westfield* was destroyed during the battle. *Westfield*'s recovery in 2009 by the USACE, and subsequent conservation by Texas A&M University, has offered a unique opportunity to study a rare vessel from U.S. and Texas' maritime history, the loss of which contributed to the Union's failure to retain control of a naval base in Texas during the American Civil War.

CHAPTER III

RECONSTRUCTING *WESTFIELD* THROUGH HISTORICAL DOCUMENTATION

Introduction

During the American Civil War, the Federal government purchased hundreds of civilian vessels to rapidly enlarge the Union Navy so that a blockade could be enforced against Southern maritime commerce. In order to serve their naval purpose, many of these purchased vessels required extensive overhauls that often left them significantly altered from their previous design and appearance. The former ferryboat *Westfield* was one of these vessels. While *Westfield* still retained the general appearance of a ferry, the vessel was so highly modified and armored that Confederate forces at times mistook the vessel for a purpose-built ironclad (Scharf 1887:506). Unfortunately, *Westfield*'s wreck site was too highly degraded to precisely determine how the entire vessel appeared before and after its naval conversion. The wooden hull completely disintegrated over the last one hundred and forty-six years, leaving mostly metal ship components. Therefore, understanding *Westfield*'s initial ferryboat design and construction and its later reconfigured naval appearance must be accomplished by studying the historical record as well as archaeological evidence.

Some archaeological information on *Westfield*'s vessel class does exist. The most important material evidence for *Westfield*'s design was found on a sister ship vessel called *Southfield*. *Southfield* underwent archaeological investigations in 1991 and

revealed that this vessel had a more or less intact wooden hull (Spirek 1993). The information recovered from *Southfield* serves as a good starting point for understanding *Westfield*'s basic layout and construction.

While no official construction plans have been discovered during archival research, a generalized plan of *Southfield*'s successor, *Southfield* II, was published in an engineering journal in 1886. The first *Southfield* was constructed in 1856 and *Southfield* II was constructed in 1882. Despite that this plan was made decades after *Westfield*'s and *Southfield*'s construction, an expert on these ferries stated that, "Except for the change from wood hulls to steel hulls, our ferry boats remain to-day practically the same as they were thirty years ago..." (Cowles 1886:191). This assessment by Cowles and the existence of the later plan allows for some comparison to be made between *Southfield* and *Southfield* II.

Determining *Westfield*'s design through the study of historic photographs is problematic since after the vessel was sold to the Navy, Cornelius Vanderbilt quickly built a replacement vessel (*Westfield* II) to keep his ferry line in service. Successor vessels did not include a number in the name painted on the ferrys' side. Thus, photographs of vessels that bear the name *Westfield* cannot be easily correlated back to the original vessel. While the two *Westfield*s were likely similar, newer vessels commonly incorporated improvements that altered the design. Additionally, recorded measurements state that the successor vessel was quite smaller. To help determine how *Westfield* and *Westfield* II might have differed, comparisons can be made from other sister ships that were progressively modified and photographed throughout their careers.

Examining the Staten Island Ferryboat

In the early years of the Staten Island ferry service, Vanderbilt purchased a variety of different vessel types to transport passengers. In the late 1850s, Vanderbilt started to transition his fleet to follow a single plan. These vessels included *Hunchback*, *Southfield*, *Westfield*, *Clifton*, *Westfield II*, *Clifton II*, *Northfield*, *Middletown*, and *Southfield* II (see Table 1). His new vessels featured a doubled-ended design with two rudders (one on each end) that allowed the ferry to travel in either direction (Hilton 1964:20). To turn one end into a bow, a crewman dropped a pin through the deck and into a metal swing arm attachment, effectively locking the rudder in place. This design prevented the need for the vessels to turn around in New York Harbor's heavily congested waters. Each landing contained a berth that matched the shape of the vessels' double-ended bow and stern. Upon reaching a designated berth, the matching shape facilitated easy docking to ensure the quick unloading and loading of passengers (Figure 6). The trip between Staten Island and Manhattan covered a long distance that generally took about thirty minutes each way. For this reason, there were fewer trips back and forth than on other ferry lines. This generally caused the Staten Island ferries to be filled to capacity on each trip. To alleviate overcrowding in the 1850s, Vanderbilt's ferry plan began to incorporate a second passenger deck or saloon deck above the main cabin. *Hunchback* was the first double-ended ferryboat in New York to incorporate a saloon deck (Cudahy 1990:49). Historic photographs of several sister ships (to be discussed) suggest the early saloon deck appeared almost as an afterthought in the ferryboat design. Yet, as decades progressed, the upper deck became an elaborately integrated and

Vessel	Shipyard	Year Built	Tons	Hull Dimensions w/o Guards	Engine Maker	Engine Cyinder	Disposition	Source
Hunchback	Simonson	1852	517	179' x 29' x 10'6"	unknown	40" x 10'	Sold to U.S. Govt. 1861; redocumented 1866; abandoned 1880	Cudahy 1990:402; Heyl 1965:145
Southfield	John Englis	1857	751	200' x 34' x 11'	Murphy Iron Works	44" x 10'	Sold to U.S. Govt. 1861; lost in combat 1864	Cudahy 1990:402; Spirek 1993:49
Clifton	Simonson	1861	892	210' x 40' x 13'6"	Allaire Iron Works	50" x 10'	Sold to U.S. Govt. 1861; lost in combat 1863	Cotham 2006: 173; Heyl 1965:47
Westfield	Simonson	1861	891	213'4" x 34' x 12'11"	Morgan Iron Works	50" x 10'	Sold to U.S. Govt. 1861; lost in combat 1863	Cotham 2006:130; Heyl 1965:335
Clifton II	Simonson	1862	709	181' x 32' x 13'6"	Allaire Iron Works	43" x 10'	Sold to U.S. Govt. 1863; redocumented 1865; lost 1868	Cudahy 1990:403; Silverston 2001:71
Westfield II	Simonson	1862	609	202' x 32' x 13'	unknown	50" x 10'	Sold to City of New York 1906; out of documentation 1912	Cudahy 1990:403
Northfield	Simonson	1863	600	202' x 34' x 13'	unknown	50" x 10'	Sank after collision 1901; broken up 1902	Cudahy 1990:157, 403
Middletown	Simonson	1864	641	201' x 33' x 14'	unknown	50" x 10'	Sold to City of New York 1906; abandoned, 1912	Cudahy 1990:403
Southfield II	Lawler	1882	758	212'8" x 34' x 13'	unknown	50" x 10'	Sold to City of New York 1906; out of documentation 1912	Cowles 1886:198-199; Cudahy 1990:403

Table 1. Double-ended ferryboats from the Staten Island Line.

Figure 6. Unidentified Staten Island ferry docked a in berth that matched the shape of the double-ended bow and stern (Image courtesy of Historic Richmond Town, Staten Island, NY.; reference # 50.15.6033).

recognizable feature on Staten Island ferries. One of the more unusual characteristics of Vanderbilt's ferryboats was a unique hump on the saloon deck created as part of the paddlewheel housing. While other ferryboat designs tried to hide or lower the profile of the paddlewheels, this prominent feature in the Vanderbilt plan required passengers to walk up and over the hump when traveling on the upper saloon deck.

Constructed in 1856, *Southfield* was the second double-ended vessel to serve in Vanderbilt's new ferryboat fleet. Like *Westfield*, this vessel was later purchased by the Navy and used during the American Civil War. *Southfield* was excavated by James

Spirek from East Carolina University in 1991. The excavations uncovered the stern of the vessel, which according to double-ended ferryboat tradition was the part of the vessel furthest from the boilers and stack. Excavations stopped at the paddlewheel house near amidships and revealed that the main deck was shaped as an elongated oval (Figure 7). To facilitate the paddlewheels on the sides of the vessel, the main deck overhung a smaller lower hull that contained a similar shape. Diagonal supporting stanchions or sponsons were mounted just above the copper-sheathed waterline to ensure that the overhanging deck did not hog down over the sides. These sponsons extended outwards until they reached the fenders, or guards that surrounded the main deck (Spirek 1993:128). The sponsons projected out in a manner that followed the curvature of the hull. While the superstructure above *Southfield*'s main deck did not survive, numerous deck features such as the lower cabin timbers and rail stanchions indicated how the plan originally appeared. Spirek discovered an overexposed prewar photograph of *Southfield* that helped identify many of the excavated deck features (Figure 8). When docked in a ferry berth, passengers and horse teams entered from the tip of the stern oval. After crossing above the rudder, a series of fence-like internal railings divided horse teams from foot passengers (Spirek 1993:152). The horse teams were corralled towards the center of the vessel into two longitudinal corridors within the main cabin, one on each side of a central machinery compartment. Passengers were guided away from the center of the deck into side cabins adjacent to the two corridors. The passenger cabins contained deck planks that ran longitudinally with the length of the ship, slightly curving

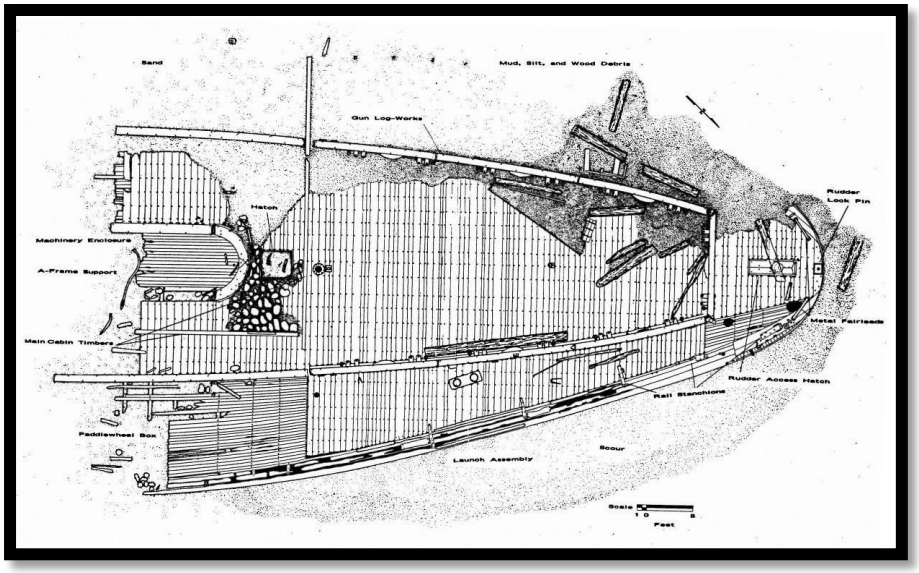

Figure 7. *Southfield* site plan (Spirek 1993:120).

Figure 8. Prewar photo of *Southfield* (Image courtesy of the Staten Island Museum; reference #K2014).

with the oval shape of the deck. Based on images of the later sister ships *Middletown* and *Southfield* II, these cabins were originally spacious and finished with paneled woodwork. Benches lined the walls and steep staircases to the saloon deck led up and over narrow connecting hallways behind the paddlewheel boxes (Figure 9 and 10). The horse team corridors and areas exposed to the elements received a second layer of deck planking that ran transversely across the lower planking without any curve. The machinery compartment had a rounded after end where it divided the horse teams into the two side corridors.

Spirek concluded that *Southfield* underwent only minimal modifications during the vessel's conversion to naval use. The main changes consisted of converting the inner stanchions and rails into gun bulwarks and placing cannon into those locations (Spirek 1993:152-154). Spirek also suspected that the double deck planking was part of the Union's refit to reinforce the gun deck (Spirek 1993:157), however, recently located photographs of *Northfield* and *Southfield* II support that this feature was common to the initial design (Figures 11 and 12). Additionally, a square opening just abaft the machinery compartment was identified by Spirek as a possible hatch that led down to the powder room (Spirek 1993:137). Spirek may be correct if this feature was repurposed by the Navy, yet in original use, the opening was for a hollow box column through which the rudder chains reached the upper pilot house. Since the Navy’s modifications on the vessel were not extensive, the *Southfield* wreck still represents a good example of an early double-ended Staten Island ferryboat.

Figure 9. Passenger cabin on *Middletown* reutilized as a children's school (Image courtesy of the Museum of the City of New York; reference # X2010.7.1.11184).

Figure 10. Passenger cabin on *Southfield* II reutilized as a children's school (Ayres 1910:61).

Figure 11. Transverse decking on the outside deck of *Northfield* (Image courtesy of Historic Richmond Town, Staten Island, NY.; not yet cataloged, reference: Ferry *Northfield,* Tompkinsville Landing [man wearing top hat], August 16, 1892).

Figure 12. Transverse decking on the outside deck of *Southfield* II (Allen 1909:202).

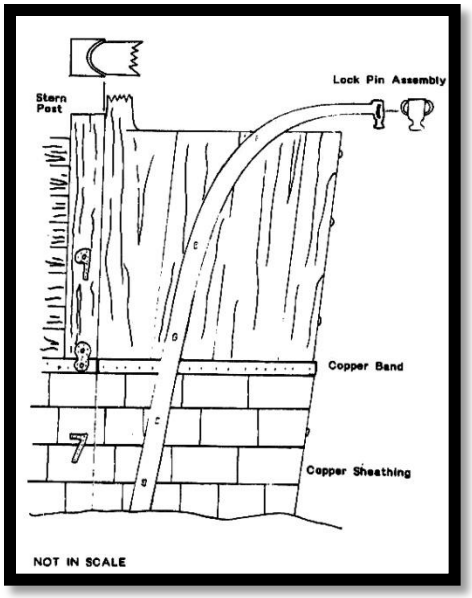

Figure 13. *Southfield*'s stern rudder with swing arm and lock pin assembly (Spirek 1993:131).

Southfield's stern rudder was still attached and relatively undamaged. Spirek remarked that the metal swing arm and lock pin assembly was wishbone shaped in appearance or forked, with the rudder placed between the wishbone apparatus (Figure 13). After dropping a pin into the lock pin assembly, the stern was able to act as the bow (Spirek 1993:133). Based on the design, the bow rudder if uncovered, would have been identical to allow the transformation of the bow into a stern.

Spirek's excavations did not penetrate into *Southfield*'s hull. Thus, our knowledge of *Southfield*'s internal construction is limited. New York ferries in general were built to carry extremely heavy loads. The construction supported not only the thousands of passengers who used these vessels daily, but the added weight of material goods that were brought on board by horse teams. To counteract this weight, these vessels required

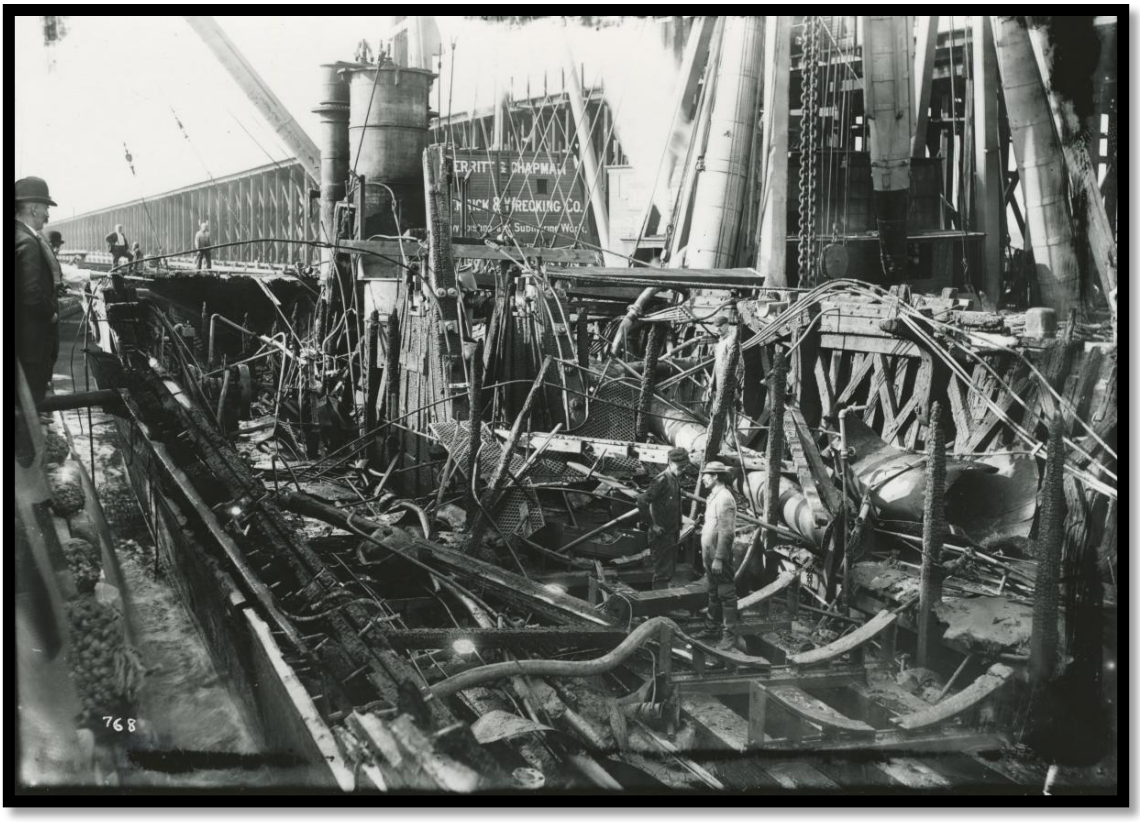

Figure 14. Burned out hulk of *Plainfield* (Image courtesy of Mystic Seaport; reference #1964.660.128).

heavy bracing to support their hulls and main deck. An example of this construction can be seen in the ferryboat *Plainfield* from the Jersey Central Line (Figure 14). *Plainfield* was constructed in 1869 and burned near Ellis Island in 1900 (Baxter and Adams 1999:46-47). A photo of the burned out hulk offers an internal view of the heavy framing that these ferryboats utilized. *Plainfield* contained closely set frames reinforced by "X" shaped cross braces that extended over every four frames. The main beams that supported *Plainfield*'s deck did not survive the fire, however, some of the large knees that assisted in that support are still present in the photo. A heavy central keelson and

side sister keelsons can be seen underneath both the curved boiler mounts and the massive bed timbers that supported the walking beam engine.

In the 1880s, marine engineers were exploring ways to improve the Staten Island ferries. Marine engineer and architect William Cowles published a generalized yet complete lines drawing plan of *Southfield* II with proposed modifications (1886). His plan explored modernizing future vessels of the same class by transitioning to steel hull construction. Cowles' plan drawing was split down the middle illustrating *Southfield* II with the already existent larger wood hull on the left and the proposed smaller steel hull on the right (Figure 15). Comparing the *Southfield* II plan to the excavation site map of the first *Southfield* revealed that with the exception of *Southfield* II being larger and more modernized, the plans were almost identical (Figure 16).

Using the *Southfield* II plan, surviving measurements of *Westfield* can be applied, and the drawing scaled to meet those parameters. While this method of reconstruction will never exactly replicate the original plan of *Westfield*, it allows for an interpretative model to be created that can assist in studying *Westfield*'s design.

Westfield and the sister ship *Clifton* were built together and completed in 1861 at the Simonson shipyard in Greenpoint, Brooklyn. They were said to be "equal in every respect" (*Richmond County Gazette* 1861). A British naval engineer described the two vessels in considerable detail: "They were 224 ft. [68.3 m.] long, 34-1/2 ft. [10.5 m.] beam and 13 ft. [3.96 m.] deep, tonnage 977 tons [886.319 mt.]. They had a single beam engine, cylinder 50 in. [1.27 m.] diam. by 10 ft. [3.05 m.] stroke, paddle wheels 22 ft. [6.71 m.] diam. by 9 ft. [2.74 m.] face; two return flue boilers, grate surface 97 sq. ft.

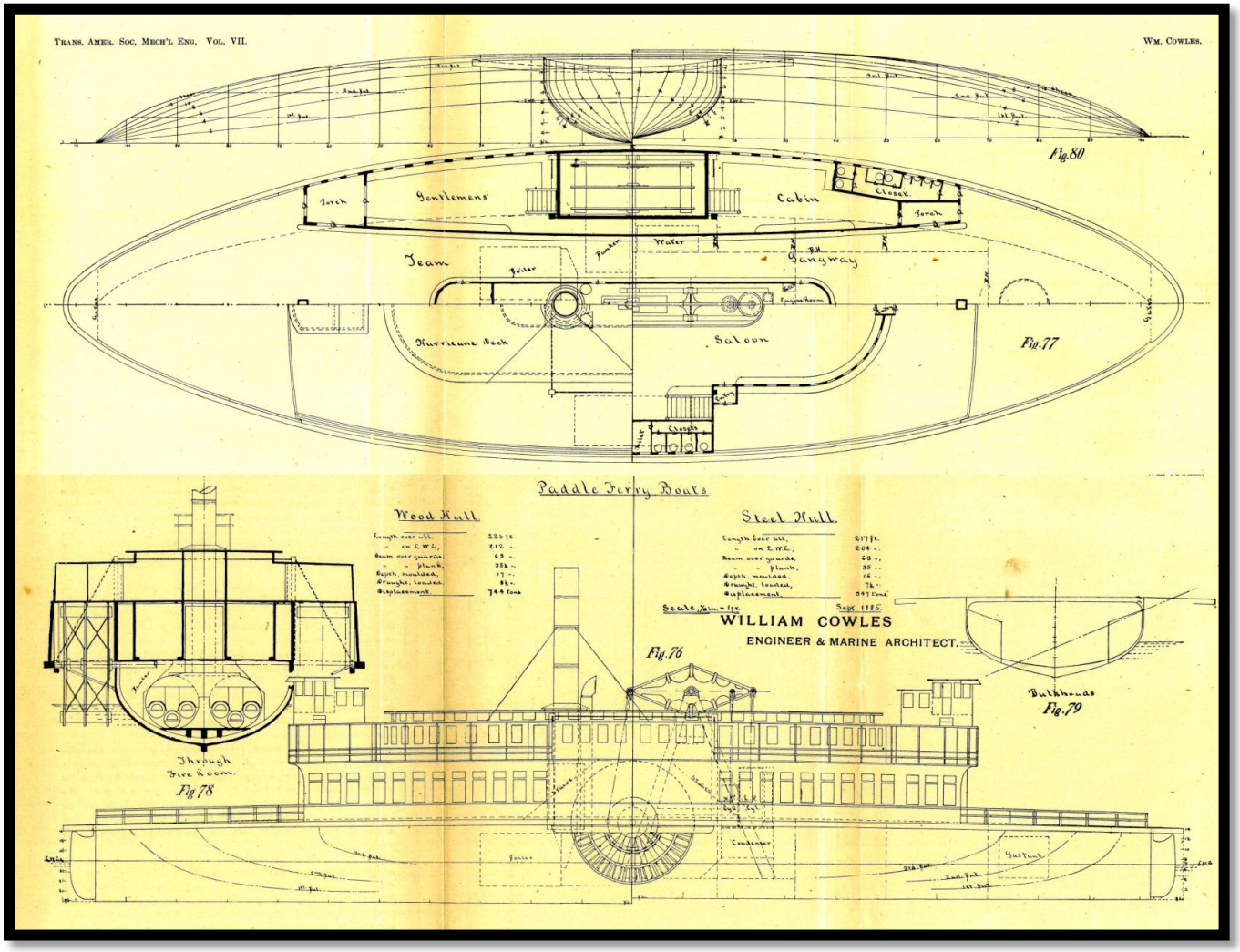

Figure 15. Generalized *Southfield* II plan depicting a wooden hull on the left and a steel hull on the right (Cowles 1886).

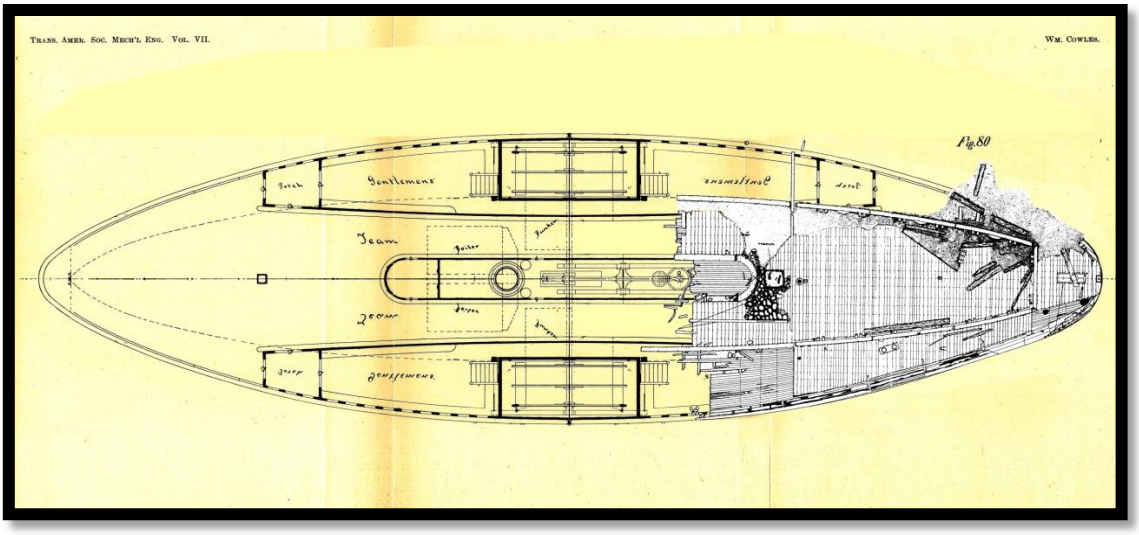

Figure 16. *Southfield* site map overlaid on generalized *Southfield* II plan; modified from Cowles (1886) and Spirek (1993).

[9.01 sm.], heating surface 2706 sq. ft. [251.4 sm.], steam pressure 30 lbs. [13.61 kg.], cutoff at half stroke, revo. 26 per min., speed 16 miles an hour" (Main 1893:133). Information recovered from the archived Navy enrollment papers offered that *Westfield* measured 213 ft. 4 in. (65 m.) in length, 34 ft. (10.4 m.) in breadth, and with a 12 ft. 11 in. (3.94 m.) depth of hold, at 891 tons (808.302 mt.)(Williams 1861; Borgens et al. 2010: Appendix A-1).

Main's measurements were tested on the *Southfield* II plan and created a ferryboat that was awkwardly long and narrow. The measurements from the Navy enrollment papers created a design that was also too narrow and could never account for both the paddlewheels and all of the interior cabin spaces. These problems were resolved after careful study of the *Southfield* II plan determined that Main's total beam measurement did not include the guards that enclosed the paddlewheels, and the Navy enrollment papers only accounted for measurements of the lower hull. Combining the

measurements from both sources and resizing the *Southfield* II plan created a ferryboat design that was 225 ft. (68.6 m.) length over all, 213 ft. 4 in. (65 m.) loaded water line, 63 ft. (19.2 m.) beam over guards (approximate), 34 ft. (10.4 m.) lower hull beam (internal measurement), 12 ft. 11 in. (3.94 m.) depth of hold (measured from the underside of main deck to the boiler room flooring), and a 8-1/2 ft. (2.59 m.) loaded draft (approximate). These final measurements created a conjectural scale working plan of how *Westfield* was designed (Figure 17). The Navy enrollment numbers proved to be the most reliable source of information. The Navy's lower hull beam and depth of hold measurements seem to have been taken from inside the hull and did not account for the hull's thickness. The length of 213 ft. 4 in. (65 m.) only properly fits in the reconstruction if measured from rudder post to rudder post. Measuring from these locations elongated Main's stated overall length of 224 ft. to 225 ft. (68.3 to 68.6 m.), but allowed the majority of the other measurements to comfortably fall into place.

Photographs of *Westfield*'s sister ferries offered an abundance of information to indicate how the boat appeared prior to U.S. Navy service. The most photographed of Vanderbilt's ferries were *Westfield* II (1862), *Northfield* (1863), *Middletown* (1864), and *Southfield* II (1882). While most of the photographs date to later decades, after the vessels underwent numerous refits (1880s-1890s), some earlier photographs do exist that helped determine how these vessels were modified throughout their careers. As previously shown, Spirek's research turned up an overexposed prewar photograph of *Southfield*. A second photo of the first *Southfield* was discovered in 2014 in the photo archives of the George Eastman House in Rochester, New York (Figure 18). The

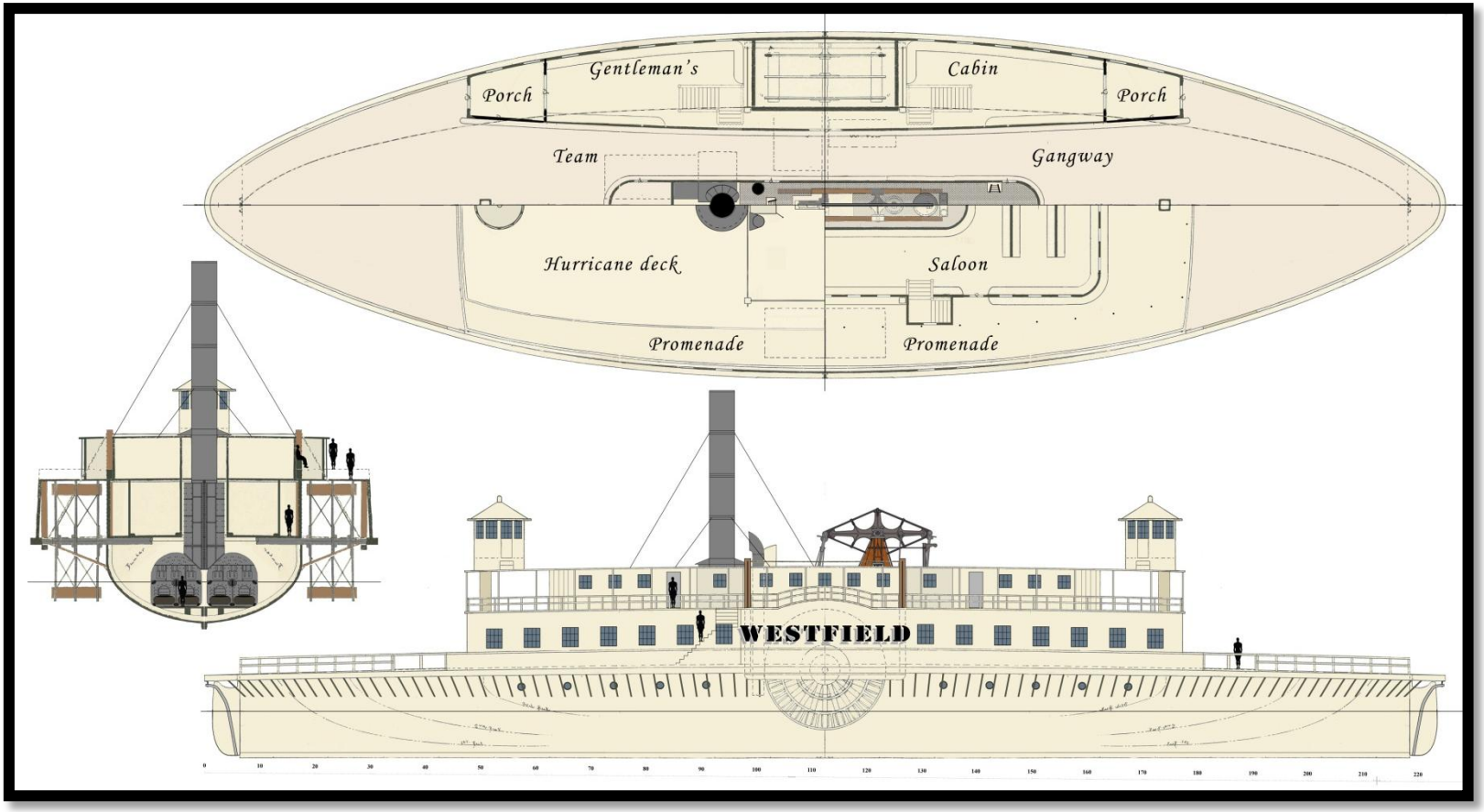

Figure 17. Theoretical reconstruction of *Westfield*'s plan (by author).

Figure 18. *Southfield* stereoview photo (Image courtesy of the George Eastman House; reference #1979:1483:0002).

stereoview photo was marked as an unidentified ferry from 1857, yet based on the background features, the vessel was traveling on a path that led past Governor's Island and towards Staten Island. The vessel's main deck and lower cabin appeared similar to other Vanderbilt ferries. The hurricane deck/roof was rather unremarkable with the exception of the smoke stack and a vented box that housed the walking beam engine. After placing the stereoview under a high powered microscope, the letters "*SO*..." were visible on the starboard side of the vessel. With no other vessels in the Vanderbilt fleet beginning with those letters, the image was conclusively identified as *Southfield*. The image served as a good starting point to determine through photography how Vanderbilt's double-ended ferries evolved over time.

A second important stereoview was discovered in the New York Public Library that dated from 1863 (Figure 19). The vessel in the stereoview was also listed as

Figure 19. Unknown *Westfield* stereoview photo (Image courtesy of the New York Public Library; reference MFY Dennis Coll. 91-F196).

unknown, but was clearly one of Vanderbilt's ferries photographed while passing Governor's Island. Under a microscope, the letters "*WE*..." were visible on the vessel's starboard side, suggesting the name *Westfield* (Figures 20 and 21). Which *Westfield* was portrayed in the image is questionable. The image may represent the first *Westfield* that was built in 1861, sold to the Navy in the same year, and was simply not published until 1863. The *Westfield* in the image contained saloon deck architecture that differed from all other *Westfield* II photographs that have been found. On the other hand, those differences may be due to the numerous refits that *Westfield* II underwent during its long career. The unknown *Westfield* in Figure 19 appeared to be an updated version of the plan that *Southfield* followed. The main deck and cabin remained the same as *Southfield*, with the exception that the fence-like railings that divided the passenger foot traffic from

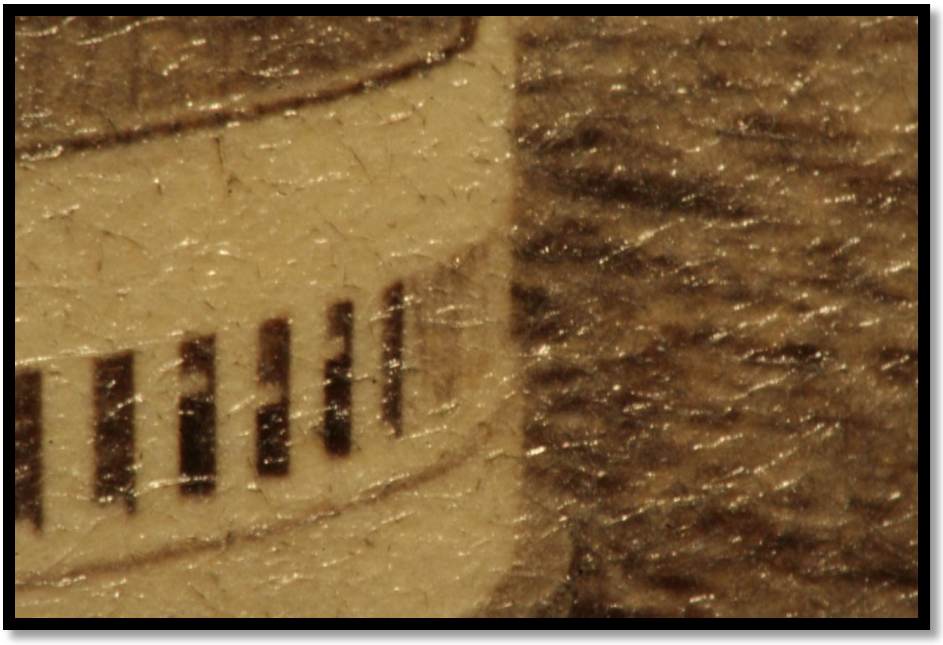

Figure 20. Close up of lettering on the unknown *Westfield* stereoview (Photo by Jessica Stika).

Figure 21. Close up of outlined lettering on the unknown *Westfield* stereoview (modified by author).

the horse teams were no longer present. The saloon deck was still more or less rectangular, but now incorporated slightly rounded corners. Above this, the hurricane deck/roof had undergone significant changes. On *Southfield*, the pilothouses were part of the saloon cabin, projecting slightly forward and aft of the structure. To provide better visibility on the unknown *Westfield*, the pilothouses were raised as independent round structures seated at the forwardmost and aftermost sections of the hurricane deck. Conical roofs topped these houses and extended outwards to shield the pilot from the sun. The vented box over the engine was absent and the walking beam became exposed to the elements. Canvas awnings were replaced by extending the hurricane deck out halfway towards the sides of the vessel, leaving a partially covered promenade. Due to the paddlewheel box hump, this extension of the hurricane deck is puzzling since tall passengers walking over the hump would have to bend down slightly to avoid hitting their heads on the roof. Like the early saloon deck on *Southfield*, this extension of the hurricane deck appeared almost as an afterthought in the vessel's design.

Known and dated photographs of *Westfield* II display the vessel after numerous decades of service and refits, but early illustrations of the vessel do exist from newspapers. In 1871, *Westfield* II became one of the most famous vessels in New York history after the ferry suffered a catastrophic boiler explosion that killed sixty-six people and injured around two hundred (Hilton 1964:20). The incident made headlines immediately after the event and remained in the news due to the investigation and the numerous safety inquires that followed. The vessel was eventually repaired and returned to service the following year. *Harper's Weekly* and *Frank Leslie's Illustrated*

Newspapers each made detailed drawings of the incident. Newspaper illustrations should always be regarded with caution when it comes to accuracy. Artists were paid to quickly present an image to the public of what happened. Sometimes those artists were not present for the event, rather the artist depended on commentary brought to them from eye-witnesses. The *Harper's Weekly* illustration may be one of those image types, despite that the image states it was drawn from the hurricane deck of *Northfield* (Figure 22). The drawing details the chaos and suffering aboard *Westfield* II and *Northfield* immediately following the explosion. The round pilothouse with the conical roof on the damaged vessel is interesting since it resembles the one seen in the unknown *Westfield* stereoview. But, other than that one detail, the illustration is generic. The drawing from *Frank Leslie's Illustrated Newspaper* is considerably more detailed and likely represents an image sketched by an artist physically on site (Figure 23). Some of the more specific details include three men pointing towards the narrow hallway behind the paddlewheel housing that linked the stern and bow passenger cabins. Above their heads, the hump that formed the paddlewheel house roof is prominently displayed. More men walk through the starboard horse team corridor next to the normally concealed boiler steam drum. The artist took the time to depict the heads of the massive staybolts that attached the outer steam drum onto the boiler. Inspection covers on the fallen smokestack housing have slid open due to the stack having collapsed into a downward position. This type of detail would not have been present for the everyday public to view. Thus, this image is likely a trustworthy representation of what the artist actually witnessed. This leads to the most important detail. Above the saloon deck, the hurricane deck extends out a short

Figure 22. *Westfield* II following a boiler explosion; detail from *Harper's Weekly Newspaper* (12 August, 1871).

Figure 23. *Westfield* II following a boiler explosion; detail from *Frank Leslie's Illustrated Newspaper* (12 August, 1871).

distance over the promenade, covering the benches along the upper cabin, and leaving little headroom for passengers walking over the paddlewheel box hump. This unique architectural feature matches the design seen in the unknown *Westfield* stereoview (Figure 19), meaning the unknown *Westfield* might be *Westfield* II.

Early undated photographs of the sister ships *Northfield* and *Middletown* show further evolutions of the hurricane deck that appear to have resolved the problem of passengers possibly having to lower their heads before crossing the paddlewheel box humps (Figures 24 and 25). A new version of the hurricane deck left exposed roof openings above the paddlewheel box humps so that passengers could safely walk up and over the humps without hitting their heads. This modification included extending the hurricane deck completely to the sides of the vessel. The resulting construction likely made the saloon cabin darker inside. To provide light to the inner cabin, clerestory windows in an upper skylight roof were added above the hurricane deck. Also, above the hurricane deck, the pilot houses were elongated with an inboard addition that provided more interior space for the crew. Below the hurricane deck, the saloon cabin was redesigned with completely rounded ends as opposed to rounded corners. This likely provided more ease when traveling around the promenade.

Photographs of *Westfield* II, *Northfield*, and *Middletown* from the 1880s and 1890s show the final evolution of Vanderbilt's ferry plan (Figure 26). At this stage, the hurricane deck was completely redesigned as a fully functioning deck complete with railings, boat davits, and new pilot houses. These improved pilot houses abandoned the conical roofs for a flat top and visor that faced the intended direction of travel. The

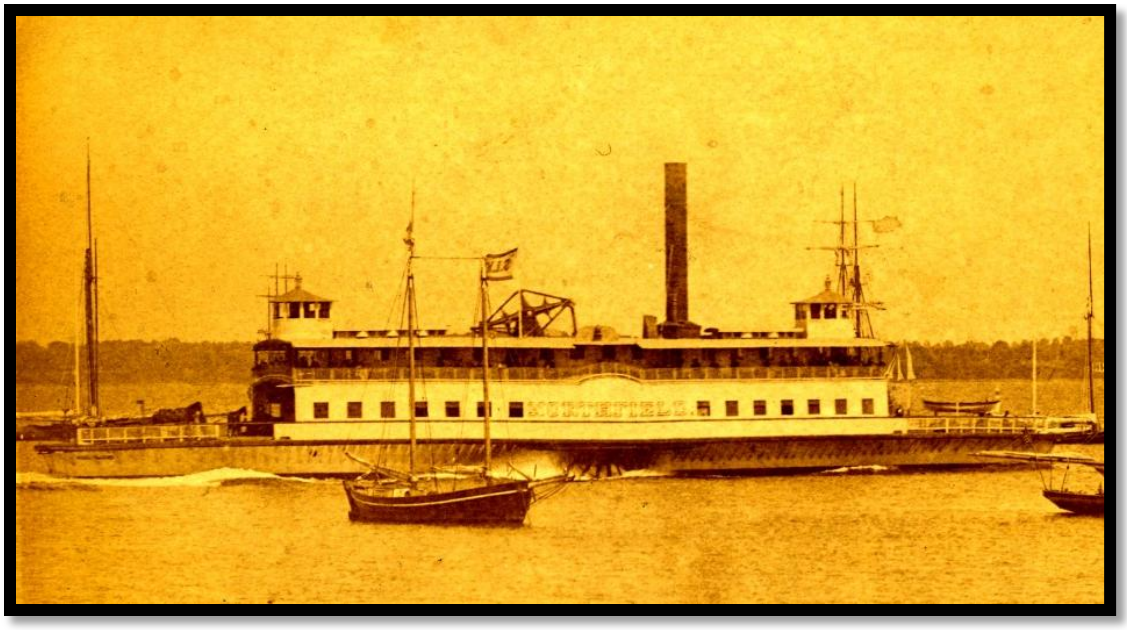

Figure 24. *Northfield* with a section of the hurricane deck missing above the paddlewheel (Image courtesy of the Staten Island Museum; reference # K938A).

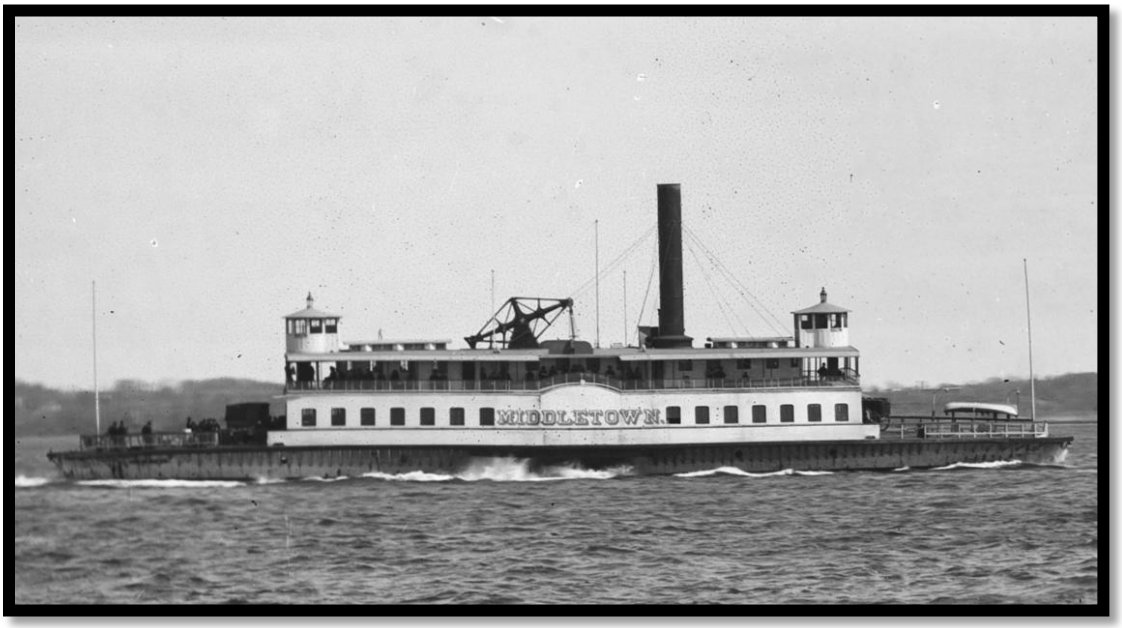

Figure 25. *Middletown* with a section of the hurricane deck missing above the paddlewheel (Image courtesy of the George Eastman House; reference # 1977:0703:0005).

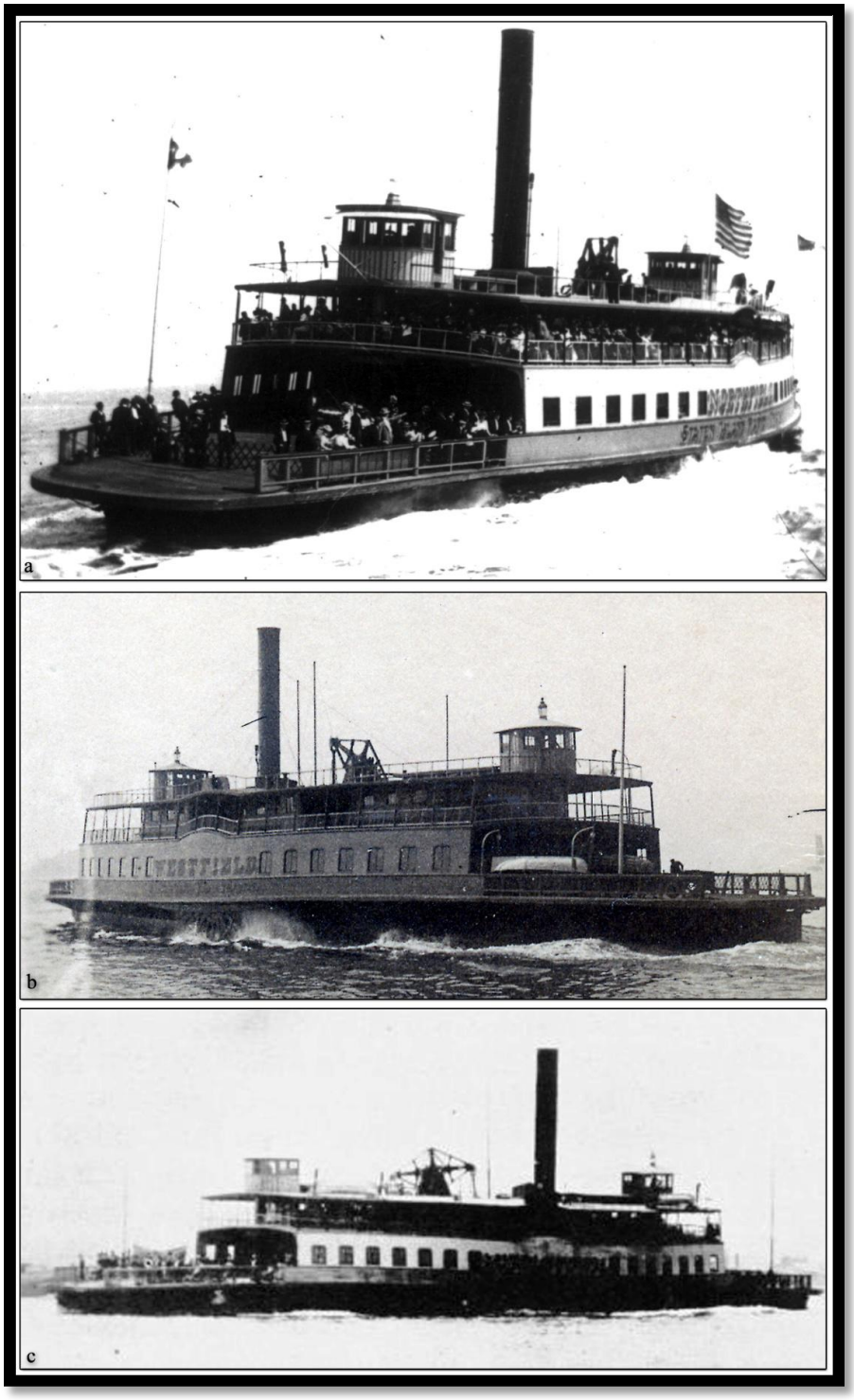

Figure 26. A) *Northfield*, B) *Westfield* II, and C) *Middletown* (Borgens et al. 2010:9).

openings above the paddlewheel box humps were covered with rounded roof sections that expanded the curvature of the lower humps. This modification ensured that passengers traveling over the humps were covered from the elements at all times.

Returning to the unknown *Westfield* stereoview (Figure 19), the image clearly represents a transitional phase between *Southfield*'s construction and the refits that took place on the later sister ships. The first *Westfield* served only four months in the ferry fleet before being purchased by the Navy in 1861. This short amount of time does not leave much room for refits and improvements. Even if the vessel in the image was actually *Westfield* II, the image portrays the first *Westfield*'s successor before significant alterations took place. *Westfield* II was supposed to be an immediate replacement for the first *Westfield* and was put into service in 1862. Separated by roughly only a year in construction, the vessels were likely almost identical in appearance if not size. This suggests that the unknown *Westfield* stereoview represents the best example of how the first *Westfield* was likely originally constructed.

Naval Conversion to a Ferry Gunboat

A considerable number of historic photographs survive that detail converted ferry gunboats during the Civil War. Unfortunately, none of these photographed vessels came from the Staten Island Line. This makes it difficult to reverse engineer the photos to determine what changes were made to *Westfield*. Additionally, *Westfield* was considerably larger than the vessels that appear in wartime photographs. Thus internally

and externally, there were likely many more alterations that cannot be determined from wartime photographs alone.

The most important clue to *Westfield*'s post naval conversion appearance survives as an eyewitness sketch of the vessel that was found by the Civil War historian Edward Cotham in the Memphis Public Library (Figure 27). This sketch, popularly known by the *Westfield* excavation team as the "Memphis drawing" contains the date 16 December 1862. This dates the image to after *Westfield*'s naval conversion and two weeks prior to the vessel's destruction. While the name of the illustrator is not known, one other drawing found in the collection had a note with the same handwriting that explains that the vantage point was taken from the side wheeler USS *Harriet Lane*. *Harriet Lane* was stationed in Galveston at the time of *Westfield*'s loss. While any illustration or iconography should be reviewed with caution due to stylization issues brought on by an artist's interpretation, the artist in this case included a detailed scale that runs the length of the vessel, a scale that has been repeatedly confirmed to be mostly accurate by artifacts recovered from the wreck site. The main inaccuracy is in the length of the vessel. The artist portrayed *Westfield* as 214 ft. (65.2 m.) long as opposed to a longer 224 ft. or 225 ft. (68.3 m. or 68.6 m.) as discussed previously in the civilian ferryboat section. The artist was likely trying to follow the Navy enrollment length of 213 ft. 4 in. (65 m.). In the profile drawing, the stern shows carefully illustrated features (although it is not fully inked), while the bow appears to be compressed as though the artist was running out of drawing space on his preset scale compared to what he actually saw in

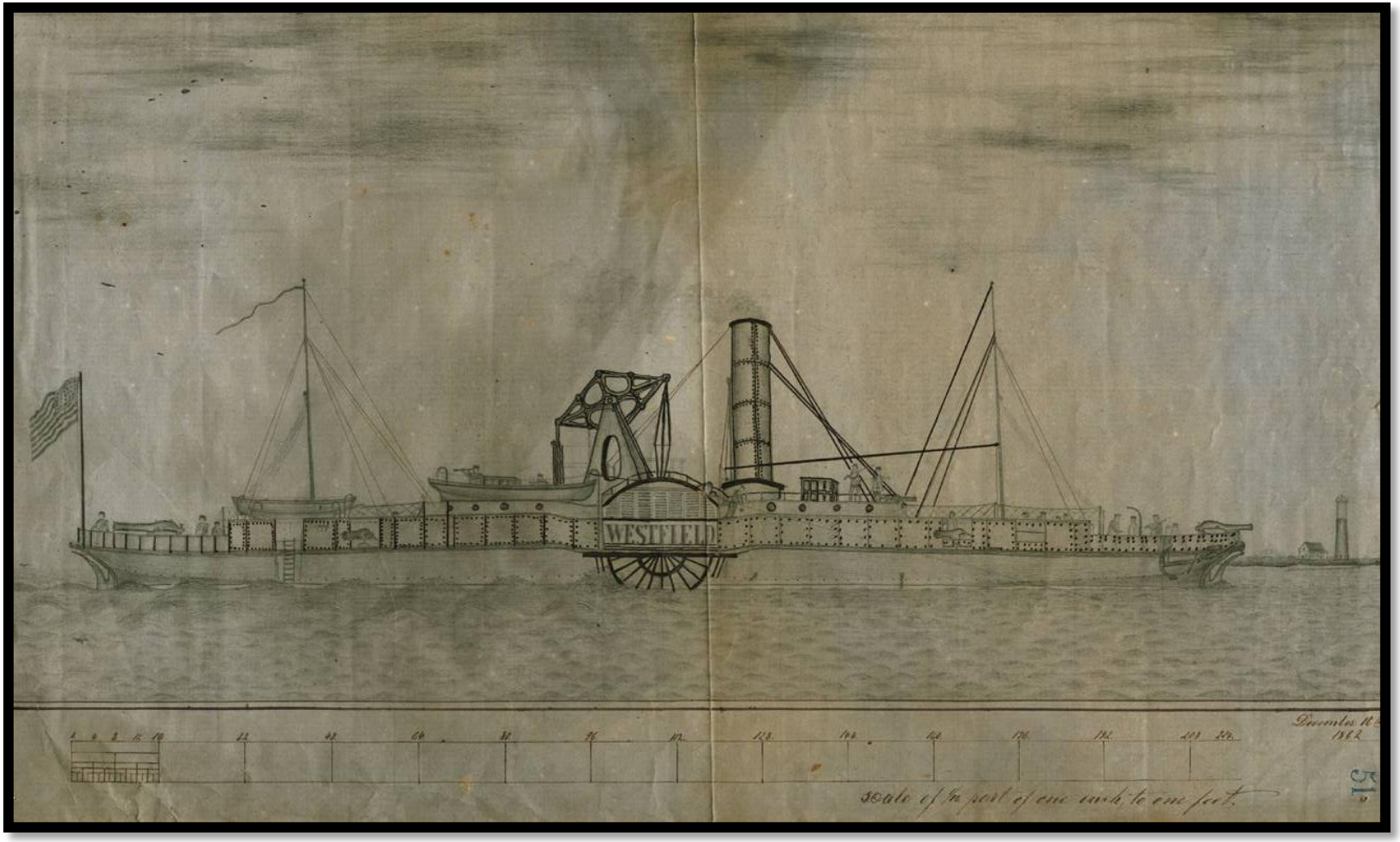

Figure 27. Ferry gunboat USS *Westfield* by an unknown artist (Image courtesy of the Memphis and Shelby County Room, Memphis Public Library and Information Center).

front of him.

Comparing the photographs of civilian Vanderbilt ferryboats to the depiction of *Westfield* in the Memphis drawing shows how heavily the Navy Department altered *Westfield* for naval use. The upper saloon deck was removed, the height of the main cabin was lowered, and new pilots houses constructed at each end. The former passenger windows were replaced and decreased in number with smaller portholes. To protect the main cabin and gun decks, 5 ft. (1.52 m.) tall iron bulwarks were added to the structure at amidships and hinged plating was constructed at the bow and stern (Borgens et al. 2010:16). Prior to the height reduction, *Westfield* contained covered foyers just forward and aft of the main cabin. When the cabin was lowered, the roof over the foyers was removed, exposing these areas, and creating more space for the gun decks. Rather than rebuilding the ends of the paddlewheel boxes, which would have become open following the cabin height reduction, the shipyard instead left the original boxes intact. This required leaving small portions of the original deck height. The artist depicts these portions as a small step on either side of the box.

The Memphis drawing suggests at first glance that *Westfield*'s paddlewheel box after conversion projected outward from the vessel, indicating a reduction in the vessel's guards. However, upon closer examination of the drawing, this does not appear to be the case. Instead, the artist may have misunderstood what he was seeing and drew the paddlewheels as he understood them to be on *Harriet Lane*, a vessel without guards. On oceangoing side wheelers with overhanging guards, it was very common to enclose the sponsons with planks to prevent them from being ripped from the vessel while traveling

in rough waters (Whittier 1983:27). The artist drew two types of hull planking. On the lowest portion of the drawing, the planks follow the keel, as would be expected. But above this, a series of dots marks where the diagonal sponsons should be that supported the upper deck. A second type of planking follows these dots and curves upward at the bow and stern, leaving a distinct line between the two types of planking. At the paddlewheel box, the planking curves sharply inwards, where four sponsons are still exposed, two on each side of the box. Rather than heavily altering the guards, *Westfield*'s sponsons were instead planked over, creating large hull blisters on each side of the paddlewheels. This modification is also evident on the converted ferryboats USS *Commodore Perry* and USS *Commodore McDonough* (Figures 28 and 29).

Fellow *Westfield* researcher Mark Cowan from the Texas Historical Commission speculated that by enclosing the sponsons, *Westfield*'s tall rectangular rudders lost the ability to completely turn without hitting the newly created blisters on each side of the hull. To counteract this problem, the rudders were cut down in height to the waterline, leaving the rudder post intact and the metal swing arm that supported the lock pin assembly. After the modification, the surviving lower part of the rudder regained maneuverability allowing the swing arm to pass just beyond the range of the two hull blisters (Mark Cowan, personal communication 2014). This alteration is apparent when comparing the *Southfield* II plan to the Memphis drawing. On the Memphis drawing, the rudder posts on both ends of the vessel are partially hidden between the enclosed sponsons, while the swing arms reach up from the waterline and curve out towards the rudder pins. Similar configurations are shown in Figures 28 and 29.

Figure 28. USS *Commodore Perry* (Image courtesy of the Library of Congress; reference # LC-B811- 2684 [P&P] LOT 4182).

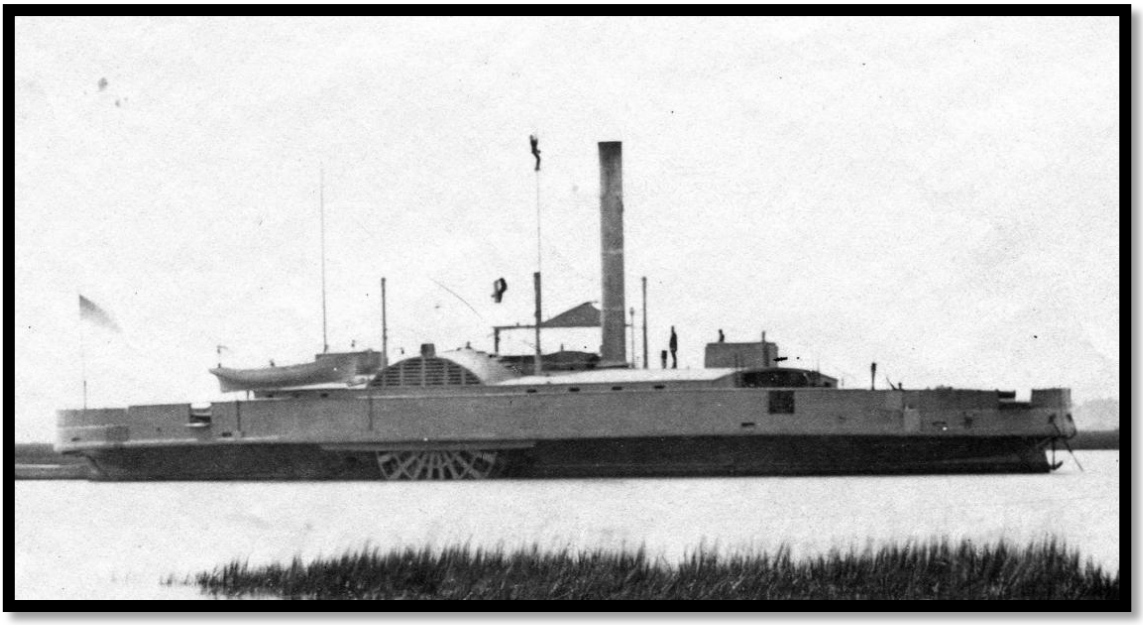

Figure 29. USS *Commodore McDonough* (Image courtesy of the Hagley Museum and Archives; reference # 1971.MSS.918).

During Atkins' research prior to *Westfield*'s excavation, three important documents were found relating to *Westfield*'s naval conversion. They consisted of correspondence from the shipyard owners Charles Copeland and James Howe bidding to conduct the conversion work on *Westfield* with the Assistant Secretary of the U.S. Navy Gustavus V. Fox. Although the final work was contracted out to shipbuilder Jacob A. Westervelt, his proposal has not been located. The proposals were likely similar though, since many of the proposed Copeland and Howe changes are displayed in the Memphis drawing (Figure 27)(Borgens et al. 2010:16). The first letter discussed changes that took place on other converted ferry gunboats (Copeland 1861a). The second letter proposed how to armor ferryboat bulwarks (Copeland 1861b). The third letter listed out a summary of the final changes that should take place specifically on *Westfield* (Copeland and Howe 1861).

Using the Copeland and Howe documents, many of the differences between ferryboat photographs and the Memphis drawing are clarified. To start with, *Westfield* retained the functionality of a double-ended ferry; a significant design feature that could not have changed easily. The first letter detailed that any changes to the vessel should permit the vessel to "remain efficient for the purposes designed" (Copeland 1861a). As previously described, the Memphis drawing portrays a lower profile vessel. This created the illusion of a considerably higher walking-beam engine. Additionally, the pilot houses at each end of the main cabin appear to have moved inward towards the walking-beam engine and smoke stack. The first letter explains these changes very clearly and is repeated almost word for word by the third letter: "The promenade deck to be dropped

down to about 7 or 8 ft. [2.13 or 2.44 m.] from the main deck" (Copeland 1861a; Copeland and Howe 1861). As evidenced by the Memphis drawing, these height alterations were clearly adopted from the proposal. The main cabin as seen on the civilian ferry boats is drastically lowered on the Memphis drawing. This lowering was achieved by removing the entire promenade deck, and cutting down the height of the main cabin. By removing the promenade deck, the A-frame supporting the walking beam became exposed which in turn made the engine assembly seem taller and more pronounced. The smoke stack was also lowered by one segment furthering this illusion. In reality, the height of the A-frame never changed. Originally the pilot houses were situated on the portions of the hurricane deck that sat directly over the main deck foyers. When the promenade deck was removed, the lower main deck foyers became exposed, thus shortening the length of the main cabin. The pilot houses not only needed to be lowered, but also moved inwards above the machinery compartment, where the new hurricane deck could support them. This alteration is confirmed in the third letter: "New pilot houses and steering arrangements" (Copeland and Howe 1861).

The main feature that separates the Memphis drawing of *Westfield* from the original ferryboats is the addition of iron plates that wrap around the vessel's entire bulwarks. The artist took great care to emphasis these plates by inking the bolts that secured the plates to the bulwarks. Large 5 by 5 ft. (1.52 by 1.52 m.) plates protected the main cabin as well as several gun ports that were placed just past the cabin's limits. Beyond these large plates, shorter plates, approximately 3 by 2-1/2 ft. (91.4 by 76.2 cm.), are seen at the bow and stern of the vessel. These armored plates are detailed

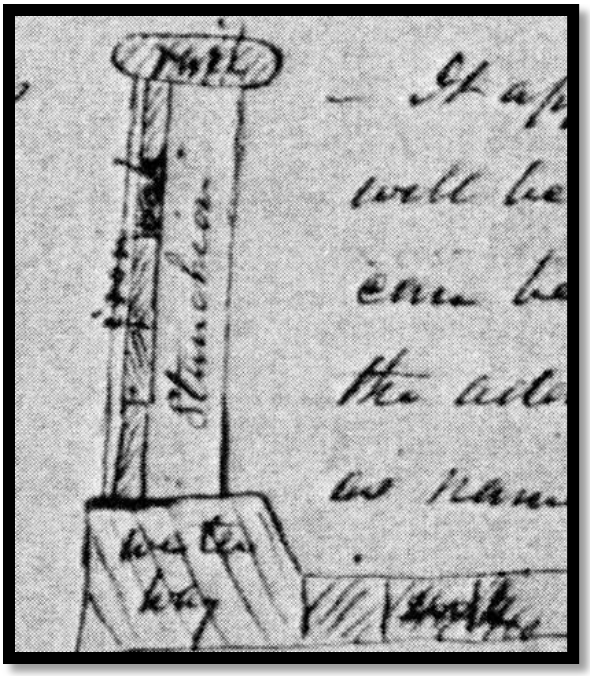

Figure 30. Plan of the bulwarks with affixed boiler plating (Copeland 1861b).

extensively in all three letters: "Bulwarks with water way... [illegible] all around the boat, with either three or five ports at each end: -- the bulwarks to be attached... [illegible] double, that is faced outside and inside as protection from musket balls; bulwarks to be about 5-1/2 ft. [1.68 m.] high... should be deemed advisable to face the bulwarks with boiler iron" (Copeland 1861a). The second letter explains in more detail how to mount the boiler iron to the bulwarks: "In a conversation with Mr. Delano in regard to the best mode of constructing the bulwarks, he is decidedly in favor of sheathing them on the outside with boiler iron as suggested in my letter of the 11th... [illegible] to protect from musket balls -- Mr. D proposes to put oak bulwarks 2 in. [5.08 cm.] thick and iron plating on that" (Copeland 1861b). Accompanying this explanation is a detailed drawing of the proposed bulwarks (Figure. 30). The third letter continues this

discussion of armored bulwarks and further explains why the plates at the bow and stern of the vessel appear shorter on the Memphis drawing: "...put up bulwarks 5 ft. [1.52 m.] in height, four broadside ports on each side, the iron bulwarks at ends to drop down for the range of pivot guns... We also propose to cover the bulwarks with iron plating the whole length of the boat with hinges and fastening complete" (Copeland and Howe 1861). The illustrated plates in the Memphis drawing are not shorter, but rather are hinged plates that were folded down at the time *Westfield* was sketched. The presence of these folding plates as well as the 5 by 5 ft. (1.52 by 1.52 m.) plates was confirmed by the archaeological remains and will be discussed in the next chapter.

Westfield's former plan divided the main deck cabin structure into four passenger cabins, two open horse team corridors, and a central machinery compartment. Following conversion, construction closed off the team corridors with new doors on each end. Examples of this reconfiguration can be seen on the converted ferry gunboats USS *Commodore Perry* and USS *Commodore Barney* (Figures 31 and 32). This modification created internal hallways. With the exception of adding ladder access to reach the new upper pilothouses, the machinery compartment was left relatively unaltered. New construction heavily modified the former passenger cabins. Following conversion, the staircases and benches were removed from these large cabins and the interior space was divided into smaller cabins that would serve the new naval officers stationed onboard.

As mentioned, no wartime photographs have been discovered to help determine how *Westfield*'s interior spaces were modified. Instead, a rather remarkable illustration

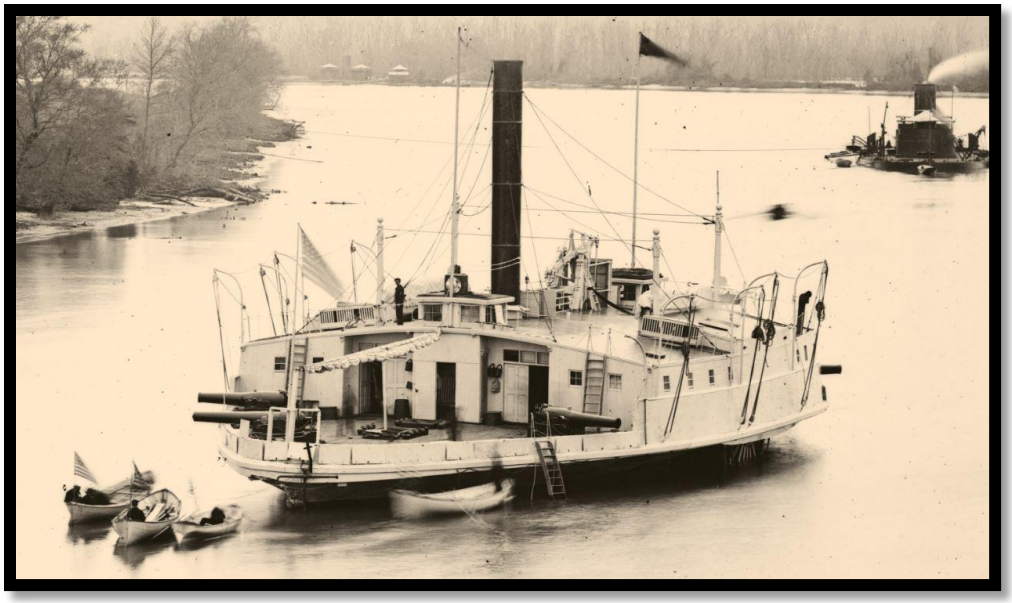

Figure 31. Horse team corridors on USS *Commodore Perry* closed off with doors (Image courtesy of the Library of Congress; reference # LC-DIG-cwpb-02181).

Figure 32. Horse team corridors on USS *Commodore Barney* closed off with doors (Image courtesy of the Nation Archives and Records Administration; reference Mathew Brady Collection, archive # 526380).

was found detailing the complete deck plan of *Westfield*'s sister ship, USS *Clifton* (Figure 33). The drawing was created by *Clifton*'s shipboard physician, Dr. Daniel Nestell. The plan marked each cabin with a number and below the drawing listed out what the cabin was used for or which officer occupied it. Nestell even illustrated the porthole locations in relation to the newly added bulkheads that divided up the former passenger cabins. Spirek surmised that a hatch located just aft of the machinery compartment on *Southfield* was used for accessing the powder magazine (Spirek 1993:137). Yet based on the *Southfield* II plan, this hatch was originally an opening through which the rudder chains led up to the pilot house. The *Clifton* drawing suggests that Spirek was correct that the opening was reutilized as a hatch, for Nestell drew the former rudder chain boxes as hatches into the lower hull. After the pilot houses were moved inwards, the two holes would have been left in the deck, one fore and one aft of the machinery compartment. The location made these holes suitable access points into the lower hull.

As civilian ferryboats, *Westfield* and *Clifton* were said to be nearly identical to one another (*Richmond County Gazette* 1861). When the Civil War broke out, the vessels were purchased by the Navy at the same time, refit in the same yard, and then steamed south to serve together. Thus, it is likely that the Navy modified both vessels in an identical manner. Using the porthole locations on the Nestell drawing enabled dividing bulkheads to be added to a second reconstructed plan depicting *Westfield* as a naval ship (Figure 34). The plan was further modified to incorporate the changes found in both the Memphis drawing and the Copeland and Howe documents.

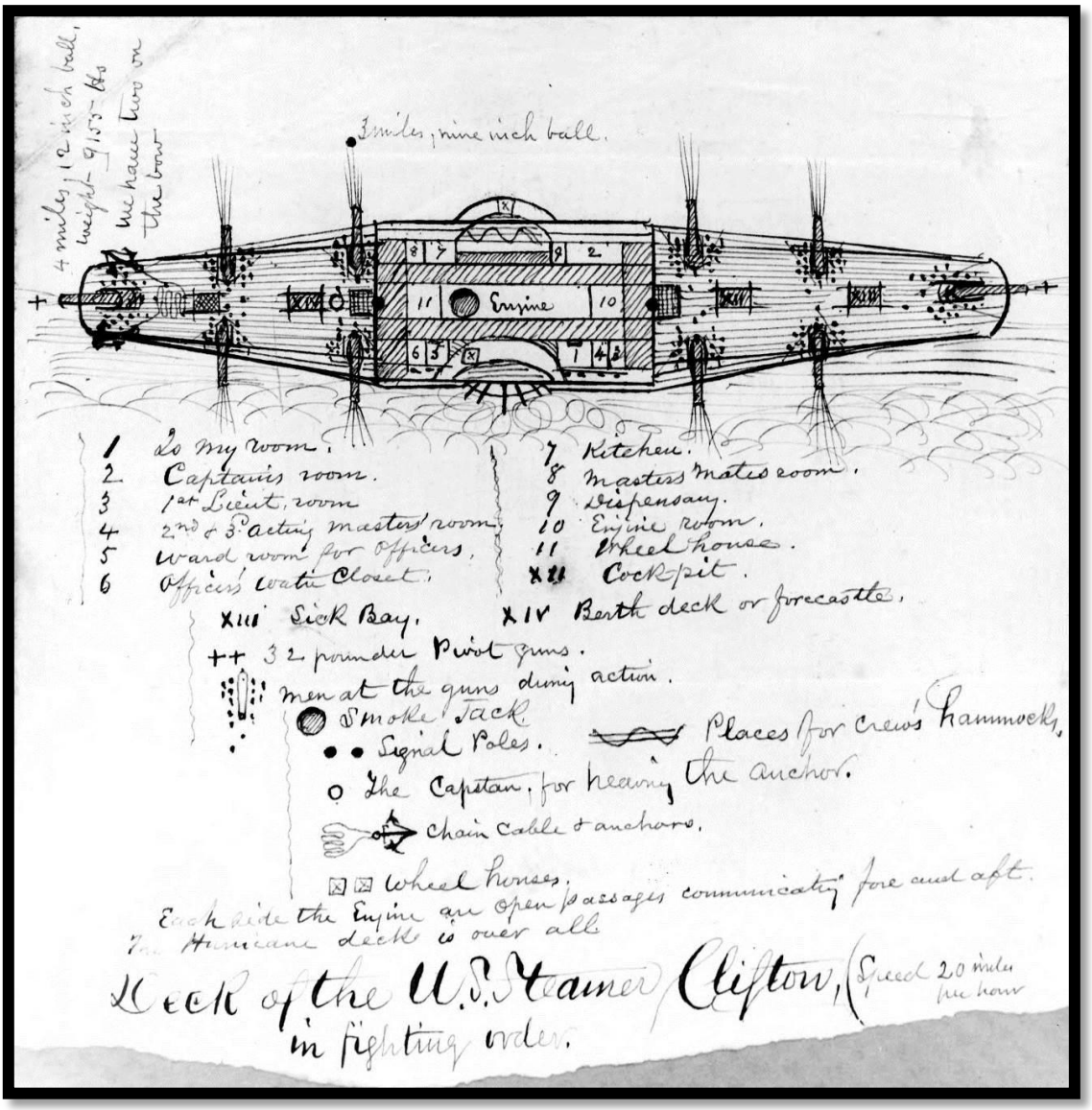

Figure 33. Deck of USS *Clifton* in fighting order by Dr. Daniel Nestell (Image courtesy of the Nestell Collection, Nimitz Library, U.S. Naval Academy, Annapolis, Maryland; reference # Nestell 2-075, MS. 310).

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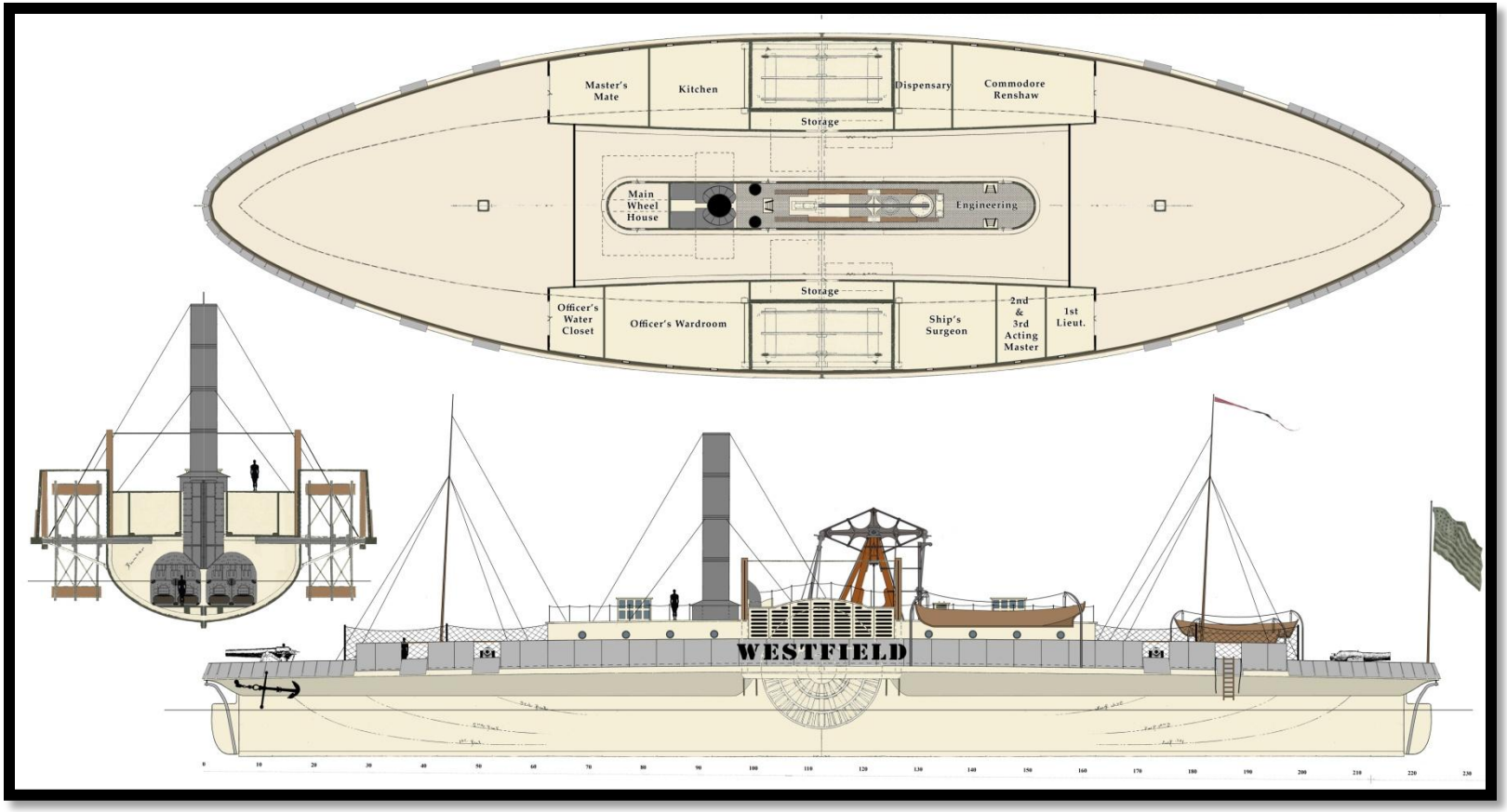

Figure 34. Theoretical reconstruction of USS *Westfield*'s plan (by author).

Conclusion

This chapter examined the historical information that was available to assist in determining *Westfield*'s former construction. To understand *Westfield* as a Staten Island ferryboat, this information included archaeological information recovered from *Westfield*'s sister ship, *Southfield*, historical photographs of similar later vessels, recorded measurements of *Westfield*, and a generalized lines drawing of *Southfield* II. Based on the photographs, *Westfield*'s construction was an evolutionary step between Vanderbilt's *Southfield* and the later sister ferries. Using this information, a reconstruction of *Westfield* was prepared. The result created a ferryboat design that was 225 ft. (68.6 m.) length over all, 213 ft. 4 in. (65 m.) loaded water line, 63 ft. (19.2 m.) beam over guards (approximate), 34 ft. (10.4 m.) lower hull beam (internal measurement), 12 ft. 11 in. (3.94 m.) depth of hold (measured from the underside of main deck to the boiler room flooring), and a 8-1/2 ft. (2.59 m.) loaded draft (approximate).

A second reconstruction plan of *Westfield* was created depicting the vessel as Navy gunboat. The information was based on two eyewitness sketches, correspondence from ship yard contractors, and historic photographs of other converted ferry gunboats. The most useful sketch came from an unknown eyewitness who drew a profile of *Westfield* two weeks prior to vessel's destruction. The second contemporary sketch, drawn by a ship's surgeon, portrayed the interior layout of *Westfield*'s sister ship and naval companion USS *Clifton*. After comparing information relating to this naval conversion to the information gathered from *Westfield*'s time as a ferry, the eyewitness

Memphis sketch of *Westfield* was reverse engineered to determine how the changes affected the original ferryboat plan. This created a new plan of a heavily modified boat. *Westfield*'s upper saloon deck was removed, the main cabin and smoke stack lowered, portholes added, and new pilot houses constructed. New bulkheads were added to the former passenger cabins. These bulkheads divided up the interior space and created new smaller cabins to accommodate *Westfield*'s officers. To protect the vessel in the open ocean, *Westfield*'s supporting sponsons were enclosed with planks which required the rudders to be cut down to retain maneuverability. One of the most visually-significant modifications consisted of the Navy's addition of iron plates that wrapped around the vessel's entire bulwarks. This included 5 by 5 ft. (1.52 by 1.52 m.) plates around the main cabin and side gun ports, as well as 3 by 2-1/2 ft. (91.4 by 76.2 cm.) folding plates situated at the bow and stern to facilitate the use of long range pivot guns. Upon the completion of *Westfield*'s naval conversion, the former ferryboat was almost unrecognizable. While the general appearance of a ferryboat remained due to the vessel retaining its double-ended design, from the sponsons up, *Westfield* was essentially a new vessel (Figure 35).

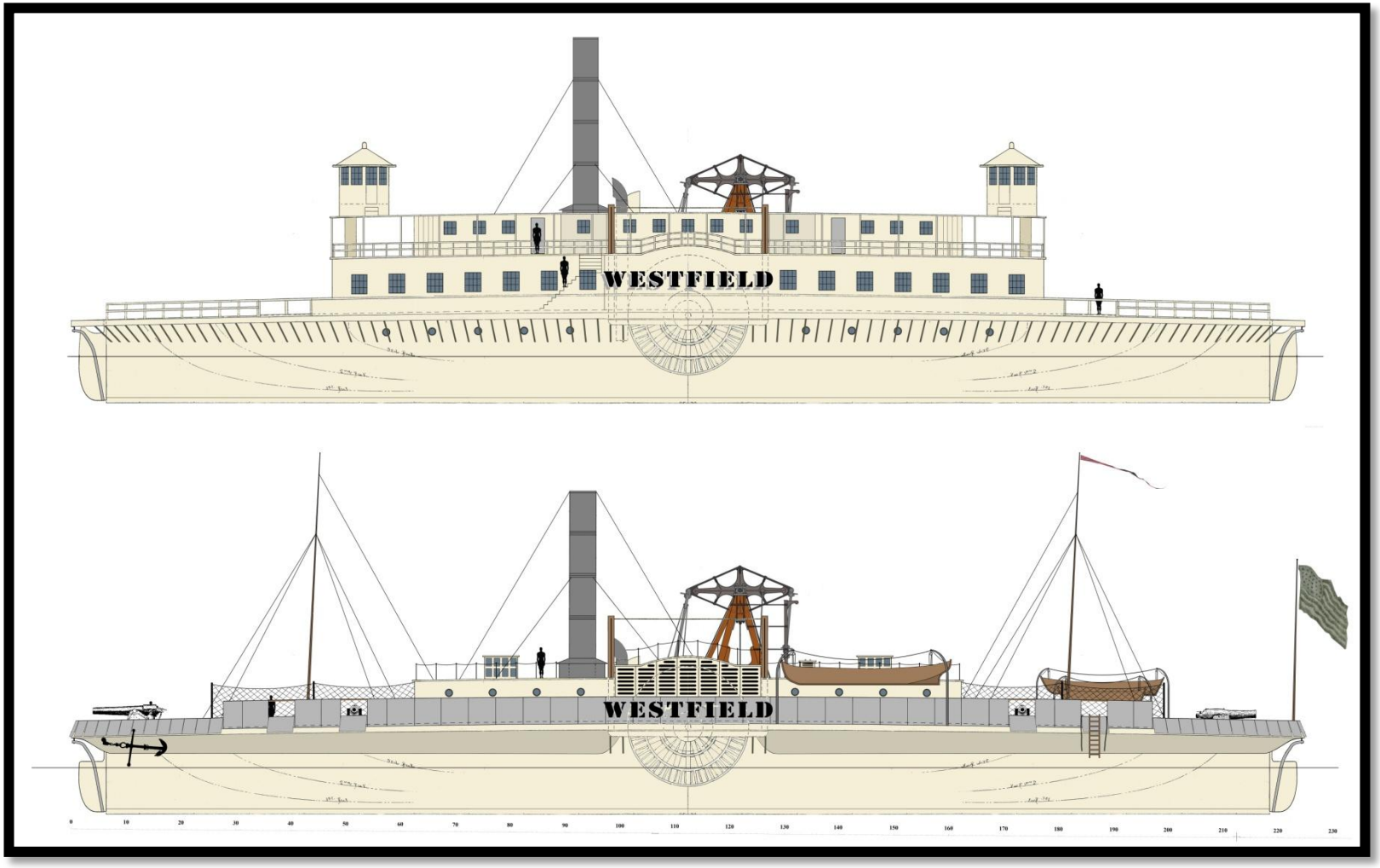

Figure 35. Profile comparison of *Westfield* prior to and after naval conversion (by author).

CHAPTER IV

ARTIFACT ANALYSIS PART I: SHIP CONSTRUCTION

Introduction

In 2009, an assemblage of at least 7,800 artifacts were recovered from *Westfield*'s wreck site. The conservation process discovered additional artifacts as concretions that were disassembled into component pieces, resulting in a final tally of 8,380 items. Artifacts recovered from the site represent a variety of materials including iron (4,948), cupreous (2,134), organic (544 [385 wood, 41 coal, 69 bone/shell, 12 paper including 11 fuse wicks and a burned book fragment, 11 rubber, 9 rope/cordage, 7 fabric, 6 leather pieces]), glass (299), lead (229), rock (150), brick (32), ceramic (26), silver (1), and a small number of unidentifiable material or concretion fragments. Of these numbers, 1,990 artifacts were conserved. Discussion of every artifact that was conserved would be redundant and impractical for the purposes of this dissertation. However, many of the more instructive artifacts have been selected for illustration to accompany the following discussions. By far, the largest category was iron artifacts. The largest objects recovered from the site included a 9 in. (22.9 cm.) smoothbore Dahlgren cannon, a boiler firebox, boiler flues, and a bearing block from the walking beam engine (Figure 36).

This chapter discusses the few artifacts that survived from *Westfield*'s construction. The limited quantity was caused by the combined destructive forces of the magazine explosion, boiler explosions, fire, salvage, demolition, and years of erosion and exposure to the sea environment that eliminated *Westfield*'s former hull and

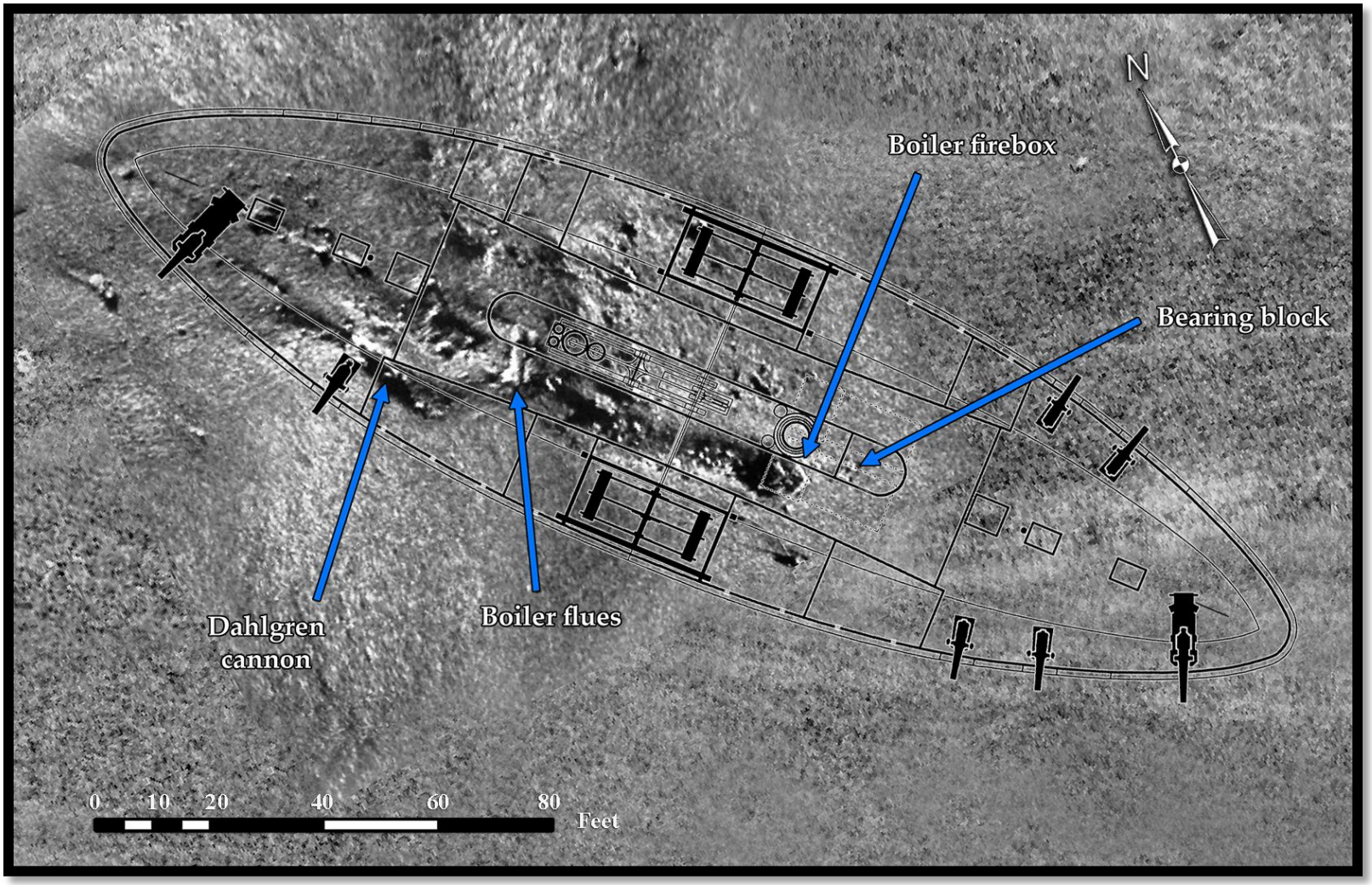

Figure 36. Side scan sonar view of *Westfield*'s wreck site with ship plan overlay (Sonar image provided courtesy of Atkins Global; modified by author with ship plan based on deposition of artifacts).

superstructure. Based on what survived, these construction-related artifacts can be divided into eight categories consisting of armor, an anti-boarding system, windows and portholes, interior cabin components, deck items, rudder chains, hull sheathing, and fasteners.

Ship Construction

An outer protective armor of iron boilerplate was a defining attribute of *Westfield* in its naval configuration. The vessel's low profile and iron plating gave the impression that *Westfield* was an ironclad (Scharf 1887:506). The depiction of *Westfield* in the 1862 Memphis sketch (see Figure 27) suggests the gunboat was plated with armor for most of its 225 ft. (68.6 m.) length. Iron boilerplates, like those depicted in the 1862 drawing and described in the Copeland and Howe proposals (see Chapter III), were recovered during the later Confederate salvage of the wreck site in May 1863. The Engineer Department of the Confederacy recovered 3,300 lbs. (1497 kg.) of iron boilerplates, valued at 60 cents a ton (Borgens et al. 2010:196).

The quantity of metal plates and plate fragments constitutes one of the larger categories of artifacts recovered from the site. Over 590 plate fragments were identified, though most of these related to the boilers, which were constructed from the same type of plates. Conservators were able to distinguish between the two plates types based on how they were fastened at their edges. Plates used in boiler construction were heavily riveted at the seams. Plates used as hull armor were secured to the bulwarks with 6 to 8 bolts fastened along each edge.

Six boilerplates used as armor were recovered relatively intact (Artifacts 102-006, 108-001, 111-001, 111-002, 111-003, and 122-045). Their sizes varied by a few inches due to corrosion along the plates' edges; however, the most intact plate (Artifact 108-001), measured 5 by 5 ft. (1.52 by 1.52 m.), allowing the original standard plate size to be determined (Figure 37). This size is consistent with the size of plates covering the cabin in the Memphis drawing of *Westfield* (Figure 27). Conservators determined that the plates were originally 5/16 in. (7.94 mm.) thick, sufficient only to protect the gun crews from small arms fire and possibly small canister shot.

The cabin space fore and aft of the paddlewheels had eight broadside gun ports (four per side) designed to be opened and closed as required by the numbers and positions of guns at any given time. Each gun port was 5 ft. (1.52 m.) wide and was closed by means of a 3 ft. (0.914 m.) tall upper plate hinged to a fixed lower plate covering the 2 ft. (0.61 m.) high bulwarks. When the plate was folded down on its hinges, opening the port, a cannon's muzzle could be extended beyond the bulwarks. Similar hinged plating can be seen in the photographs of USS *Commodore Perry* and USS *Commodore McDonough* (Figures 28, 29, and 31). The dimensions of the gun ports have been substantiated by the recovery of a nearly complete 5 by 3 ft. (1.52 by 0.914 m.) hinged armor plate (Figure 38). The hinges did not survive; however, fastening holes indicate that four hinges were used. Impressions in the concretion and staining on the iron indicate that each hinge was 14 by 2-1/2 in. (35.6 by 6.35 cm.) long, affixed to the plate by three small bolt fasteners, 1/2 in. (1.27 cm.) diameter, and spaced 3-1/2 to 4-1/2 in. (8.89 to 11.4 cm.) apart.

Figure 37. Square armored plate (Artifact 108-001; scale cm./dm.).

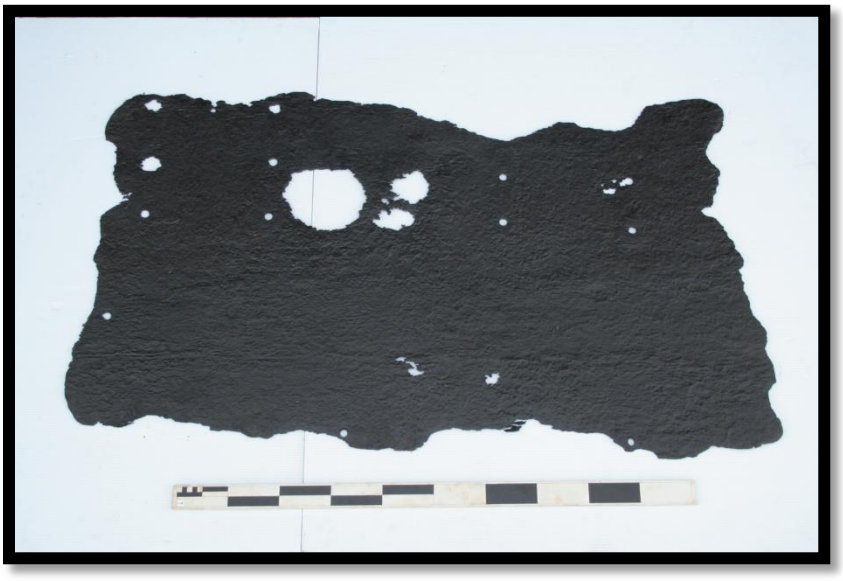

Figure 38. Hinged armored broadside gun port plate (Artifact 102-001; scale cm./dm.).

Figure 39. Armored bow or stern plate with hinges; prior to conservation (Artifact 110-002; scale cm.dm.).

The Memphis drawing (Figure 27) depicts the gun decks at the extremities of the bow and stern as protected by smaller hinged metal plates. In the drawing these are clearly shown as half the width of the 5 ft. (1.52 m.) plates protecting the cabin. These smaller plates could be raised or lowered as required when using the pivot guns. Artifacts 123-037 and 125-001 are the best preserved examples out of five that were identified conclusively as the smaller size of hinged armor plates (The others were Artifacts 103-076, 110-002, and 110-003). These plates measure approximately 3 by 2-1/2 ft. (91.4 by 76.2 cm.). Matching the broadside gun port plate, their height indicates that when folded down, 2 ft. (5.08 cm.) of the armored bulwarks stood above the deck as shown in Figure 27 for the pivot gun positions. Hinges were preserved on several of these plates. Their measurements are consistent with those used on the broadside gun port plate (Figure 38). Artifact 110-002 survived with the top portion of both hinges still attached to the plate (Figure 39).

Behind the bulwarks, *Westfield* was equipped with defensive netting to repel enemy boarding parties. The Memphis drawing (Figure 27) shows netting supported by stanchions on both the bow and stern decks. These stanchions were held by sockets fixed to the deck. One of these sockets survived intact (Artifact 103-074). The artifact is cast iron and still retains wood fragments from the original deck (Figure 40). Based on the socket size, the stanchion measured 2-1/2 by 3-3/4 in. (6.35 by 9.52 cm.) thick at the bottom of the socket. A similar stanchion (Figure 41) was recovered from the Civil War Union steamer USS *Otsego*, the difference being that the latter was cast with a cupreous metal and contained smaller dimensions (Diveley 2008:223). *Westfield* required numerous posts and sockets in order to support nets around each gun deck. A general idea of the socket arrangement can be inferred from Figure 42, in which an unknown converted ferry gunboat has all of the stanchions erected in their respective sockets.

In its ferryboat configuration, *Westfield* had seven large cabin windows on each side of the paddlewheel boxes. One or two of these windows on each end illuminated covered foyers between the cabin and the outside decks, while the others supplied light to the large passenger cabins. Cabin windows were removed when *Westfield* was converted from a ferryboat to a gunboat. The saloon deck was replaced with an open hurricane deck, and the cabin height was shortened by about 2 ft (5.08 cm.). The foyers were completely removed, creating longer fore and aft decks. The foyers windows disappeared and the remaining windows were removed, boarded up, and replaced with portholes.

Figure 40. Stanchion socket from USS *Westfield* (Artifact 103-074; scale cm.).

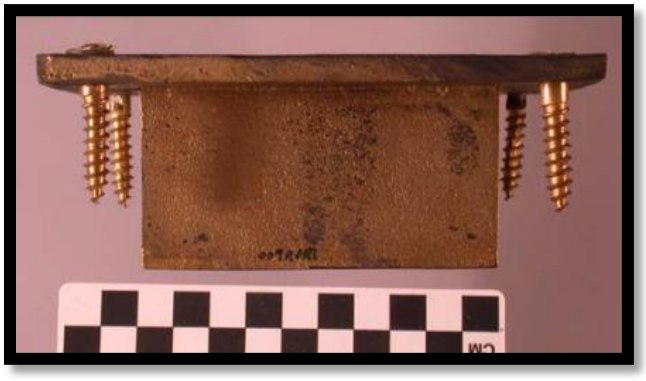

Figure 41. Stanchion socket from USS *Otsego* (Diveley 2008:223); scale cm.

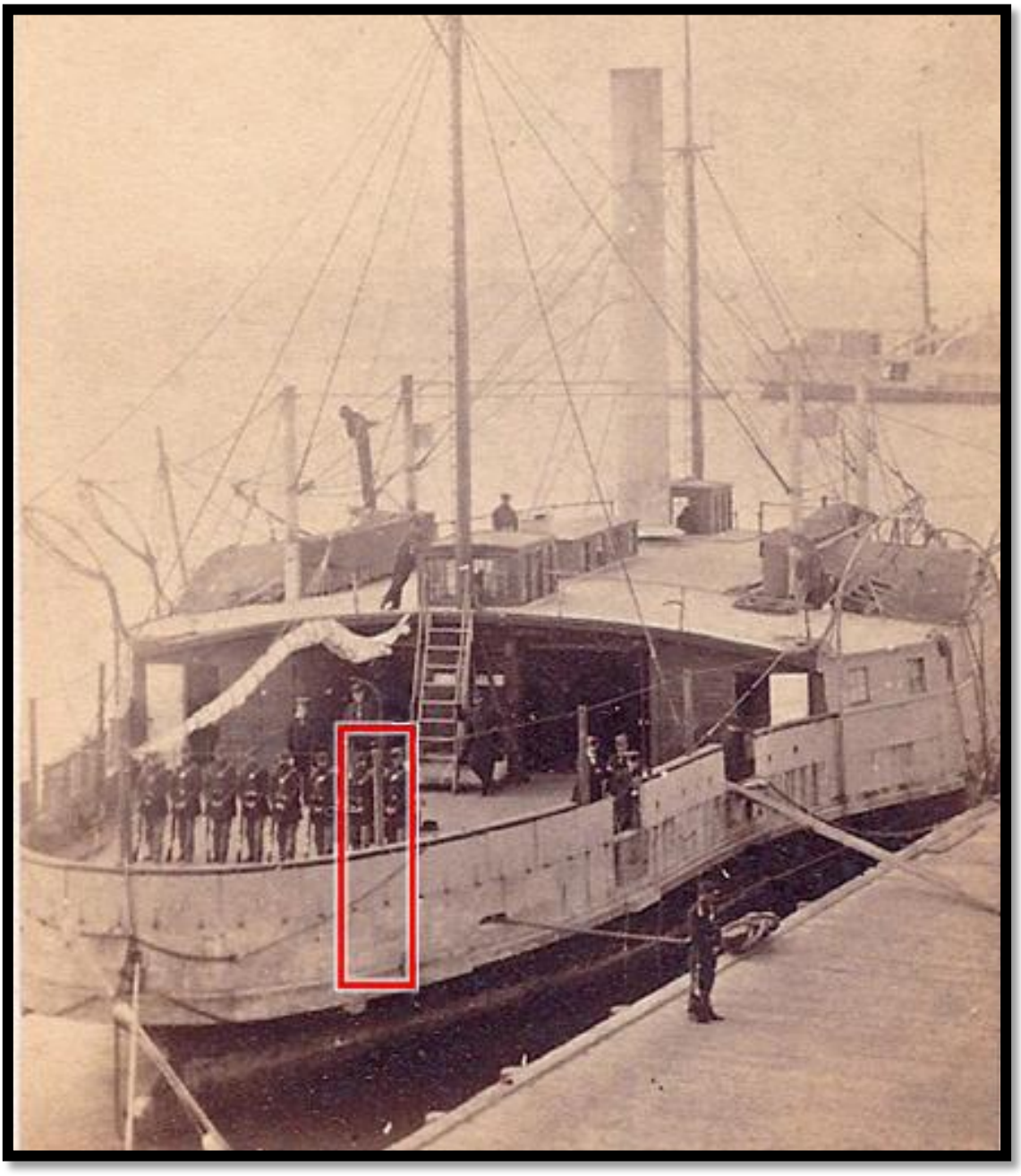

Figure 42. Stanchions for netting on an unknown ferry gunboat (Image courtesy of the Library of Congress; reference # LOT 14043-2, no. 74 [P&P]).

Figure 43. Sash weights (Artifacts 118-177, 119-171, 120-074, and 122-004; scale cm.).

During the 19th century, sash weights were commonly used to counter balance the weight of large windows. This helped keep windows open and prevented them from slamming down when being closed. Archaeologists recovered parts of four sash weights from *Westfield* (Figure 43). These weights may have been left over from when the vessel served as a ferryboat. During the rushed conversion of *Westfield*, and the removal of the large windows, many of the sash weights may have remained hidden in their interior compartments. Modern-day home renovators often find sash weights lying between wall studs of old houses even if a window frame is no longer present. People removing windows in the past simply cut the ropes and let the sash weights fall down into the wall.

Replacement of windows with portholes was a necessity due to the vessel's sides being covered to a height of 5 ft. (1.52 m.) by boilerplate armor and the need for the vessel to travel out into open water where storms were likely to be encountered.

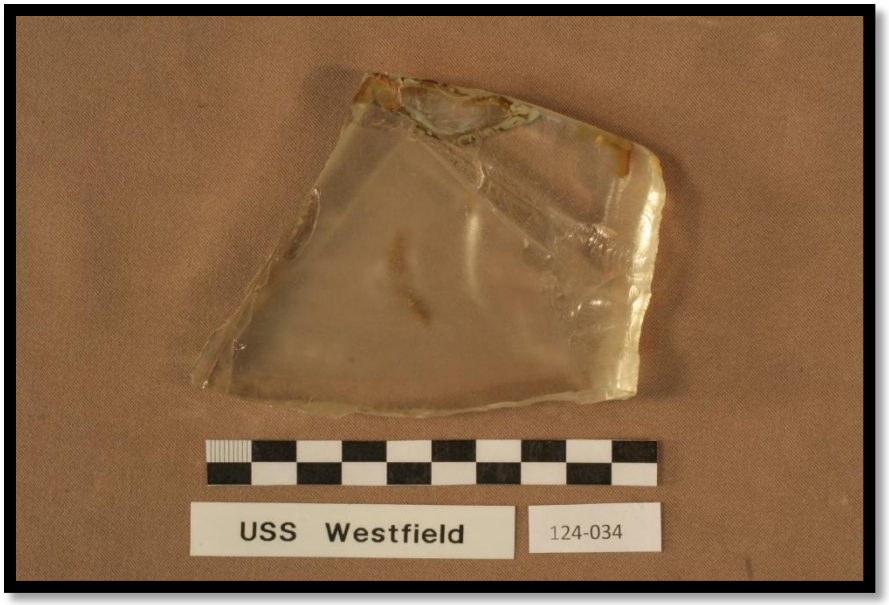

Figure 44. Glass fragment from a porthole (Artifact 124-034; scale cm.).

Portholes also allowed daylight to enter the cabin and provided more protection than large windows to the officers housed in the main deck cabin. Two porthole fragments were recovered from the site (Artifacts 124-034 and 131-024). Artifact 124-034 is a small glass fragment (Figure 44). There are four distinct diagnostic features that this artifact offers. The 5/8 in. (24 mm.) thickness of the glass is common for porthole glass from the period. According to Head Conservator Helen Dewolf, many other identifiable pieces of porthole glass have been conserved from numerous shipwreck by the TAMU Conservation Research Laboratory (personal communication 2014). One edge of the glass is curved, evidence of the object's original round shape, but is too fragmented to determine the original diameter. Curved striations on its surface might have been caused by the frame that held the glass in place. These striations suggest that the interior viewing area of the window had a diameter of at least 1 ft. (35.4 cm.) or possibly larger.

Part of the glass rim appears to have been purposefully shaped by uniform chipping, as though someone intentionally knapped the glass to achieve the desired rounded shape. This suggests that the glass originally provided did not conform to the outer frame and required modification when installed.

Artifact 131-024 is also believed to have come from a porthole but has a smaller diameter than Artifact 124-034. The object consists of a bent cupreous rim fragment with recessed fastening holes and a series of parallel ribs on the inside circumference (Figure 45). The outer diameter is about 13 in. (33 cm.). The backside of the rim is hollowed out indicating that the artifact was part of a frame. The ribs lining the margin of the interior curve might have functioned to hold a gasket in place. This object resembles the outer supporting rim of a porthole frame mounted in a vessel's side. The complete porthole likely included a hinged inner frame holding the glass that could be closed and tightened into the gasket to create a watertight seal (Figure 46).

In historical images of Staten Island ferryboats built by Simonson shipyards, the boats contain small portholes on the lower hull beneath the guards (Figure 47). These portholes allowed light to reach the lower boiler room and the machinery compartment. Based on its smaller size, similar to engine room portholes in historical images, the porthole rim fragment (Artifact 131-024) may have come from the lower hull. The Memphis drawing (Figure 27) indicates that the sponsons were boarded over, thus portholes on the lower hull would not have been visible when *Westfield* became a gunboat. The portholes, if left in place, would have been obstructed by the new

Figure 45. Cupreous porthole fragment (Artifact 131-024; scale cm.).

Figure 46. Reconstruction of porthole based on Artifact 131-024.

Figure 47. Porthole on the Staten Island ferryboat *Middletown* (Image courtesy of the Museum of the City of New York; reference # X2010.7.1.11182).

enclosing boards. The glass fragment (Artifact 124-034) appears to have come from a larger window. Since rounded skylights have not been seen in converted ferryboat images, it is probable that this glass came from a larger porthole added to the main cabin when the ship was converted to a gunboat.

Westfield's main cabin structure was divided longitudinally by a central machinery compartment. The ship's ferryboat configuration included open-ended corridors through the cabin on either side of the machine compartment allowing horse-drawn wagons to pass from one end of the ship to the other. Passenger cabins, four in all, were located outboard of the wagon corridors both fore and aft of the paddlewheel boxes. The two passenger cabins on each side of the ship were linked fore and aft by

narrow passageways inboard of the paddlewheel boxes. After the Navy purchased *Westfield*, the wagon corridors were closed off with doors to create internal passageways and a fully enclosed cabin. Based on the Nestell drawing of USS *Clifton* (Figure 33), the narrow passages connecting the passenger cabins were opened onto the larger passageways to create space for crew hammocks. New bulkheads were added inside the four passenger cabins to divide them into smaller spaces. These newly created crew spaces were utilized as officers quarters and other compartments, including a galley and dispensary, necessary additions for a naval ship.

Numerous recovered artifacts are likely associated with these repurposed cabins. Most appear to have come from a variety of lockers that possibly provided personal storage. These objects include small turning knobs (Artifacts 105-017 and 107-026), and two types of cupboard turning buttons (Artifacts 120-284, 121-078.1, and 132-128). It is unlikely that this locker hardware was retained from *Westfield*'s time as a ferry (Figure 48). The ferry's storage lockers would have been located in the saloon deck, which was removed during *Westfield*'s conversion. Based on surviving photographs of *Westfield*'s sister ships (Figure 9 and 10), the lower main passenger cabins were dedicated to passenger seating and did not have space for any type of storage. Two hooks were also recovered (Figure 49). One can be easily identified as a common coat hook fragment (Artifact 121-145), while the other is larger and contains a pinhole that pierces through the end of the object (Artifact 119-216). The exact use of the latter object and its pinhole is not clear, but the object appears to be from a fixture designed to hold personal effects.

Some cabin artifacts might have been either original hardware on the ferryboat or

Figure 48. Cupreous artifacts from cupboards (Artifacts 105-017, 107-026, 120-284, 121-078.1, and 132-128; scale cm.).

Figure 49. Cupreous cabin hooks (Artifacts 119-216 and 121-145; scale cm.).

Figure 50. Decorative doorknob frame (Artifact 125-037; scale cm.).

added (or reused) when *Westfield* was converted to a gunboat. It is difficult to determine which came from *Westfield*'s time as a ferry and which were brought on board during naval conversion. One such artifact (125-037) consists of an elegant cupreous object decorated on the front surface to resemble a cord of rope (Figure 50). The back of the object is smooth, and the center contains a rounded hole. Conservators believe this object is a decorative frame through which a doorknob turned.

Other cupreous door pieces (Figure 51) consist of a strike plate for a door lock (Artifact 108-026), a strike plate for a door knob (Artifact 109-099), and a marine door hook (Artifact 108-093). A cupreous handrail bracket (Artifact 104-058) may have been part of a railing that lined the horse corridors and was kept onboard after naval conversion (Figure 52). Again, these objects cannot be easily dated. Hand rails could

Figure 51. Cupreous door artifacts (Artifacts 108-026, 108-093, and 109-099; scale cm.).

Figure 52. Cupreous handrail bracket (Artifact 104-058; scale cm.).

have been added after naval conversion to give crewmembers something to hold onto when traveling the passageways in rough seas.

A single cast iron rolling chock (Artifact 125-068) was found near the stern area (Figure 53). This artifact was originally secured to the vessel with three bolts. Seen on ships today, rolling chocks were used to guide mooring lines when *Westfield* tied alongside another vessel or docked near land. Since the armored plates likely interfered with mooring lines, the rolling chock may have been mounted on the outer guard. On the lowest part of the bulwarks, the water way timber allowed for scupper holes that provided deck drainage, and ropes and chains that passed through hawse pipes. A lead pipe that was recovered is believed to have been used as a scupper hole (Figure 54). The object is too soft for chain, contains an internal diameter of 2 in. (5.08 cm.), which is likely too small for rope, and does not contain any of the internal wear marks that would be found on a hawse pipe. The pipe measures 14-1/2 to 15 in. (36.8 to 38.1 cm.) along the center, excluding the flanges, consistent with the original bulwark thickness through which the pipe passed. On each end, the metal has been hammered down to create a rim or flange. Along the flanges, small holes indicate that the pipe was secured to the bulwarks with nails.

The *Westfield* excavations yielded nine chain segments. The segments vary in length and preservation, but all were determined to have come from the same size/type of chain (Figure 55). Five of the segments were found across three sequential grids (102, 103, and 104), starting in what archaeologists believe was *Westfield*'s stern area, and moving east towards the former main cabin. The chain is too small for securing cannon

Figure 53. Cast iron rolling chock (Artifact 125-068; scale inches).

Figure 54. Lead scupper pipe (Artifact 107-069; scale cm.).

Figure 55. Wrought iron chain (Artifact 102-004; scale cm.).

Figure 56. Rudder chains on the steamboat *Ticonderoga* (Image courtesy of the Shelburne Museum, Shelburne, Vermont).

tackle or to be as anchor cables. The location of their recovery suggests these were rudder chains used to control *Westfield*'s stern rudder. The chains would have connected beneath the deck on both sides of the rudder, and then ran under the main cabin before being redirected on chain rollers up into the forward pilot house. A comparable arrangement of similarly sized rudder chains can be seen on the 1906 steamboat *Ticonderoga* (Figure 56).

We know from Confederate salvage accounts that *Westfield* was sheathed with copper below the waterline (Confederate Prize Commission Records 1863). The use of copper sheathing was first introduced into ship construction by the British Navy in 1761 as a method to protect wood hulls from consumption by teredo worms (Lenfestey and Lenfestey 1994:110). Copper does not form concretion (unless in contact with or in close proximity to iron) and would have been easy to identify, yet very little copper sheathing was recovered from the site during *Westfield*'s excavation. It is likely that Confederate salvors removed any sheathing accessible from the sides of *Westfield*'s hull. Substantial portions of sheathing should have remained, particularly on the bottom of the ship following their salvage efforts. When the USACE's predecessor organization dynamited the site in 1906, the hull had mostly rotted away and large quantities of cupreous materials was removed from the site (Borgens et al. 2010:62). This material was likely hull sheathing. It is possible that once wooden portions of the ship had deteriorated, storm currents might easily have carried the remaining sheathing away. Only two small fragments of sheathing were recovered (Artifact 132-001.6 and Artifact 133-114). Artifact 132-001.6 (Figure 57) was screened from sediment that was inside the

Figure 57. Copper hull sheathing (Artifact 132-001.06; scale cm.).

Figure 58. Copper sheathing tacks (Artifact 108-071; scale cm.).

firebox. Along the upper edge of the fragment are attachment holes for the sheathing tacks; these are spaced between 1-1/2 and 1-3/4 in. (3.84 and 4.44 cm.) apart and are inset about 1/2 in. (1.27 cm.).

The largest single category in the *Westfield* artifact assemblage is fasteners. Over 1,800 fasteners have been documented and include 1,565 tacks, 143 spikes, 94 bolts, and 18 screws. Though there are many different fastener types, certain examples were purpose-made for specialized uses. This includes small cupreous tacks for attaching sheathing to the hull, cupreous spikes used to nail planks to the frames and deck planks to the deck beams, and cupreous bolts used along the keel and sister keelsons. Cupreous metals are more resistant to corrosion resulting from salt in the marine environment. Thus, fasteners used below the waterline were predominately cupreous. Cupreous metal also prevented a galvanic reaction that would otherwise be created if the copper-alloy hull sheathing was secured with iron tacks. The sheathing tacks from *Westfield* are essentially small cupreous nails ranging from 1 to 1-1/2 in. (2.54 to 3.81 cm.) long, with a large diameter round head of about 1/4 in. (6.35 mm.) diameter (Figure 58). The cupreous spikes had three primary uses: single deck nails, double deck nails, and boat nails. Single deck and double deck nails fastened the deck planks to the deck beams, and boat nails attached planks to frames. Boat nails were of varying lengths, were square at the point, and generally rose-headed (McCarthy 2005:175). Deck nails from the *Westfield* site are typically 6 to 7 in. (15.2 to 17.8 cm.) long with an approximate 3/4 in. (1.90 cm.) square head (Figure 59). There are numerous cupreous through-bolts that are likely from the keel or keelson of *Westfield* (Figure 60). The larger bolts range from 10

Figure 59. Cupreous spikes (Artifact 121-154; scale cm.).

Figure 60. Cupreous through-bolts (Artifact 118-159; scale cm.).

to 19 in. (25.4 to 48.3 cm.) in length (some are broken) and have a shaft diameter of approximately 3/4 in. (1.90 cm.). Some examples, like Artifacts 107-035, 108-006, and 120-077, are through-bolts that still retain their clinch ring. The clinch ring is a round washer that was placed at either or both ends of a bolt. The act of hammering the bolt (clinching) caused the bolt head to flatten against the clinch ring and helped secure it in place (McCarthy 2005:181). The clinch rings have a diameter of approximately 1-1/4 in. (3.17 cm.).

Iron bolts and spikes made up most of the recovered concretions. For nearly every type of cupreous fastener identified from the wreck site, there is an iron counterpart, notable exceptions being copper hull tacks and a cupreous dove-tailed keel fastener. Other iron fastener types not represented by cupreous counterparts include fasteners to support large beams and flat headed deck bolts. Iron fasteners often were very poorly preserved and required molding and casting to preserve their details. Fortunately, enough examples survived to determine that the range of sizes represented are almost identical to the cupreous fasteners. Cupreous fasteners were preserved much better. While many were weathered, others clearly retained strike marks from when they were driven into *Westfield*'s hull.

A few of the fastener artifacts (118-022, 119-233, 134-037, and NP-13.2) display saw and hack marks that indicate the objects were removed intentionally by force (Figure 61). One of the most obvious displays of these marks on an artifact appears to be fastener related, but also contains decorative circles molded into the metal (Artifact 138-051.1). This artifact was sawn off at an angle, leaving distinct teeth marks in the

Figure 61. Artifacts with hack and saw marks
(Artifact 118-022, 119-233, 134-037, and NP-13.2; scale cm.).

Figure 62. Sawn rounded artifact (Artifact 138-051.1; scale cm.).

metal before the saw broke through and ripped off part of the edge (Figure 62). Two of the more recognizable sawn artifacts came from *Westfield*'s boilers (Artifacts 109-100 and 124-032). Both of the objects consist of cupreous threaded fittings with hollow interiors (Figure 63). One of the artifacts is still screwed into a piece of wrought iron plate that came from the front of a boiler. Based on a similar artifact that was recovered from the wreck of USS *Maple Leaf*, conservators believe these objects were part of boiler cock gauges used to test water levels (Cantelas 1995:133; Figure 64). All of these objects were likely removed by Confederate salvors following *Westfield*'s destruction.

Westfield's hull did not survive; however, numerous timber fragments were recovered from the site. Most of these wood fragments survived because of the iron fasteners that once passed through them. As the iron corroded, the wood became impregnated with ferrous material, which prevented the wood's cell structure from collapsing. After conservators removed concretion from the wood, the bolt holes often remained intact, preserving the diameter of the no-longer-existent fastener. These wood fragments do not reveal much information about *Westfield*'s hull construction other than fastener dimensions; however, two such artifacts are worth mentioning here.

The largest surviving wood fragment (Artifact 108-130) measures approximately 16 in. (40.6 cm.) long by 8 in. (20.3 cm.) thick (including a bracket) by 7-1/2 in. (19 cm.) wide. This artifact survived because of a large cast iron fixture attached to the wood's top surface. The fixture has heavy raised projections or ridges presumably designed to support another structure. An illegible three-digit number (possibly 082, 532 or 522) is embossed on the surface of one projection. Four bolts that did not survive once

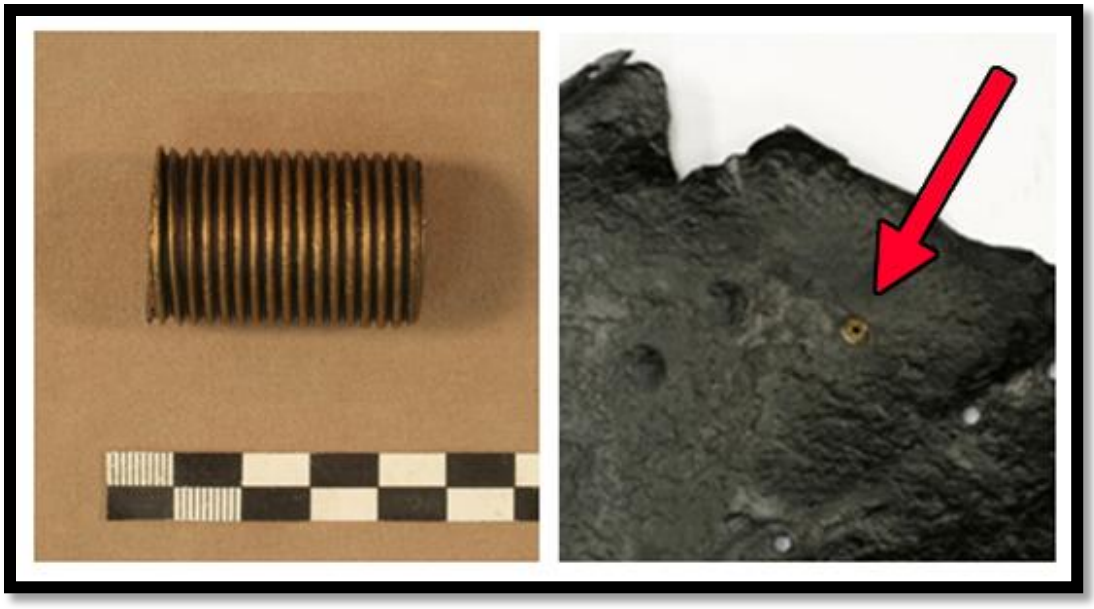

Figure 63. Sawn cupreous threaded fittings (Artifacts 109-100 and 124-032).

Figure 64. Cupreous water cock gauge from USS *Maple Leaf*
(Image courtesy of Florida Bureau of Archaeological Research).

attached the object to the wood. On the underside of the fixture, an additional ridge was received by a channel cut into the wood. This mortise and tenon-like feature prevented the fixture from sliding and placing too much lateral strain on the bolts. Although its purpose is not known, the object was reinforced to support a heavy load (Figure 65).

A second artifact (123-055) consists of a wood fragment and a cupreous bolt (Figure 66). Both the bolt and the wood have been scoured by currents and over time, worn down and polished. While the artifact does not offer much information regarding hull construction, the deep erosion marks on the wood's surface reflect the high energy currents that passed over the wreck site, contributing to the disintegration of *Westfield*'s hull.

Conclusion

Following *Westfield*'s discovery, archaeologists recognized that very few elements of the gunboat's original architecture remained intact. Despite this, certain artifacts were used to infer details about *Westfield*'s former construction. A large quantity of armor was recovered from *Westfield*'s wreck site. Conservators determined that the original thickness was 5/16 in. (7.94 mm.) thick, sufficient only to protect the gun crews from small arms fire and possibly small canister shot. Three types of armor were found. This included 5 by 5 ft. (1.52 by 1.52 m.) plates that protected the main cabin and broadside gun decks, 5 by 3 ft. (1.52 by 0.914 m.) hinged plates for the broadside guns, and 3 by 2-1/2 ft. (91.4 by 76.2 cm.) hinged plates for the bow and stern pivot guns. A recovered cast iron stanchion socket substantiated that, as depicted in the

Figure 65. Large wood fragment with iron fixture (Artifact 108-130; scale cm.).

Figure 66. Cupreous bolt and wood fragment eroded from currents (Artifact 123-055; scale cm.).

Memphis drawing, upright stanchions were placed behind the iron bulwarks to support anti-boarding nets.

Parts from four sash weights were recovered, likely from *Westfield*'s former passenger windows. Following naval conversion, the passenger windows were replaced by portholes. Recovered fragments indicate two porthole sizes. The smaller size likely came from the lower hull when *Westfield* was still a ferry, while the larger size replaced the former passenger windows.

Westfield's former passenger cabins were divided up for crew compartments. Numerous recovered cupreous locker buttons show that new storage was installed in these refurbished cabins. Some of the lockers may have been utilized as personal storage for the officers, while others were probably used for dispensaries and ship stores.

The largest quantity of recovered artifacts consisted of fasteners that came from *Westfield*'s lower hull. This included tacks, spikes, bolts, and screws. Cupreous fasteners came from areas of the vessel at or below the waterline, while iron fasteners were originally placed inside the hull or in the vessel's superstructure. Portions of small chain came from *Westfield*'s stern areas. Based on the location, the chain was likely used to steer *Westfield*'s stern rudder.

Only a few fragments of *Westfield*'s copper hull sheathing were recovered. Most of these metal plates were likely salvaged. Saw marks and hack marks on other artifacts hint that these artifacts were removed by force when *Westfield* was accessible to Confederate salvors.

CHAPTER V

ARTIFACT ANALYSIS PART II: STEAM MACHINERY

Introduction

Most of the largest recognizable iron and cupreous artifacts recovered from *Westfield* were associated with the machinery, especially the steam engine and the boilers. Considerable research into the function of these components was conducted as *Westfield*'s conservation progressed. The discussion of engine and boiler artifacts is prefaced by a summary of walking beam engines and return flue boilers. Discussion of important artifacts recovered from *Westfield*'s wreck site is then woven into that of the engine and boilers in general to understand the final reconstructions of the vessel's machinery (Figure 67).

The Walking Beam Engine

North American walking beam engines were based on the 18th-century Newcomen engine, a considerably smaller device which was utilized to extract water from English coal mines (Whittier 1983:5). In the early 19th century, variations of this low pressure engine began to appear on American side-wheel steam vessels. By the 1850s, the walking beam engine surpassed the more common crosshead engine, and became the most widely used marine engine in America. Compared to other marine engines at the time, the popularity of the walking beam engine is attributed to the engines' simplistic and inexpensive design (Sheret 2005:52). These engines proved

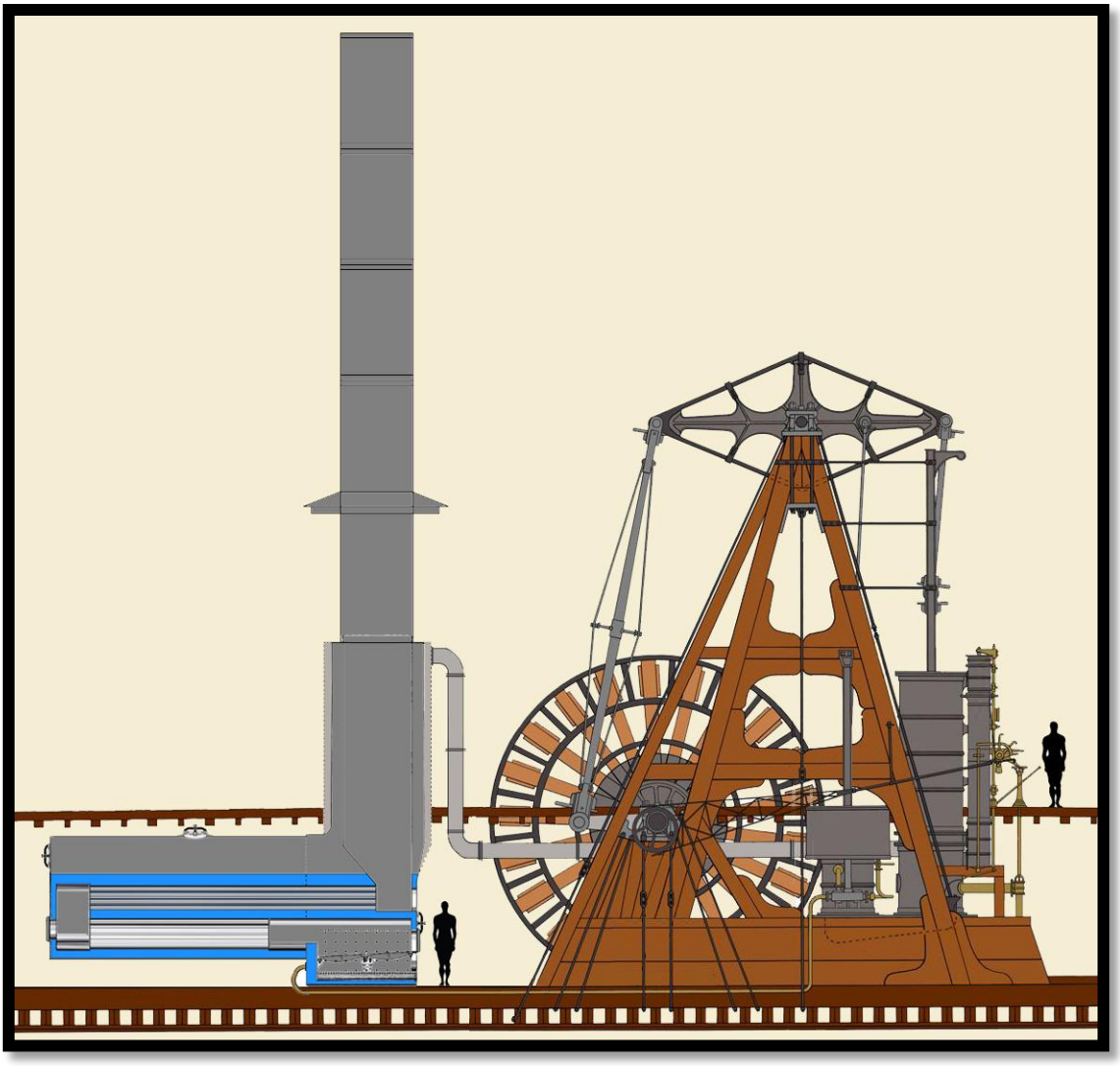

Figure 67. Reconstructed profile view of *Westfield*'s machinery (by author).

easier to maintain and repair over long periods of time. A well-maintained engine on average lasted 30 to 40 years, a service life that often surpassed the vessel on which the engine was placed. Some engines even lasted 50 to 60 years. After a vessel was retired, the walking beam engine was often removed, reconditioned, and continued in service on one or more other vessels (Whittier 1983:13).

In its general design a walking beam engine operated by utilizing a massive vertically oriented steam cylinder with an internal piston. The piston connected above the cylinder to the end of a diamond-shaped beam lever that was supported by a large wooden A-shaped frame. The beam pivoted or walked back and forth at the peak of the A-frame when the piston moved up and down. On the other side of the walking beam, a connecting rod pushed down on a crank arm attached to the paddlewheel shaft. This downward cranking motion acted much like a human leg applying pressure to a bicycle pedal, and so turned the vessel's side-mounted paddlewheels.

Engine Components

The main components of a walking beam engine are the A-frame, steam chest, cylinder, piston, condenser, air pump, hot well, walking beam, connecting rod, crankshaft, and eccentric arm (Figure 68). The unique shape of the A-frame, also known as the gallows frame, helped to evenly distribute the weight of the walking beam and the paddlewheel shaft. At the time *Westfield* was in service, this frame was built of enormous wooden beams heavily braced by knees. Underneath the A-frame, an even more massive wooden bed frame supported the weight of the entire engine and distributed the load over a long portion of the vessel's hull. To counteract the lifting forces created by the cylinder's piston, the A-frame incorporated numerous iron tie rods that locked the structure tightly down on the bed frame. These rods could be tightened through the use of turnbuckles. As part of regular maintenance, the engineer monitored the tension of these rods to ensure that the engine remained stable over long periods of

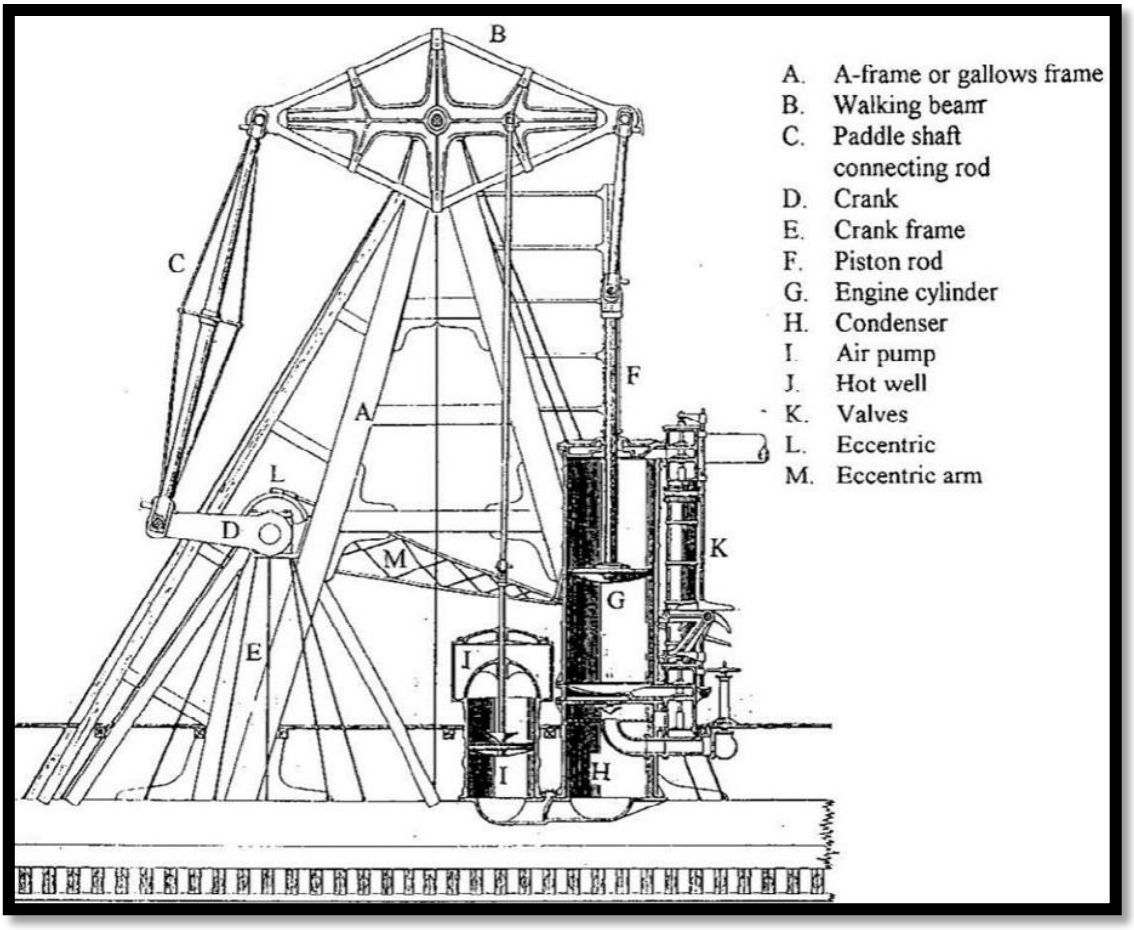

Figure 68. Components of a walking beam engine
(International Correspondence Schools 1897:64-65, fig. 329).

use (Whittier 1983:13).

Operation of this engine assembly began with the heating of water in the boilers to generate steam. From the vessel's boilers, heated steam passed through a long steam pipe, which traveled to the steam chest located in the main engineering room. The steam chest consisted of two main chambers. One chamber acted as an intermediate storage area, the intake manifold, where steam gathered before entering the engine cylinder. The second chamber, the exhaust manifold, acted as an area for exhausted steam to gather

after leaving the engine cylinder (International Correspondence Schools 1897:66).

The engine cylinder was double-acting, meaning steam was utilized alternately from both above and below the piston (International Correspondence Schools 1897:39-40). This design facilitated the piston's up and down movement. Steam was transferred to either end of the cylinder in time with the piston's position by the coordinated action of four lifting rods, each connected to dual poppet valve assemblies within the steam intake and exhaust manifolds (Figure 69). When the engine was in motion, two of the combined rod and poppet valve assemblies worked in tandem, yet alternately with the other two assemblies. When the first valve assembly lifted, releasing steam into the top of the engine cylinder, the third valve assembly simultaneously opened to exhaust used steam from below the piston. Upon completion of the transfer, the second and fourth rods performed the same task, except in reversed position. The second transfer released steam into the bottom of the cylinder and exhausted used steam out from the top of the cylinder.

To start the engine, the engineer manipulated the lifting rods through the use of a starting lever located at the control station. This lever was mounted at a 45-degree angle to a horizontal rocker arm underneath the lifting rods. The base of each rod contained a lifting toe. Attached to the rocker arm, small curved wipers rested directly underneath each toe. By pushing the starting lever up or down, the rocker arm turned which caused the wipers to lift or drop each toe rod assembly. This allowed the engineer to send small bursts of steam into the cylinder, while at the same time exhausting used steam. As the small bursts of steam expanded within the cylinder, the piston was slowly coaxed into

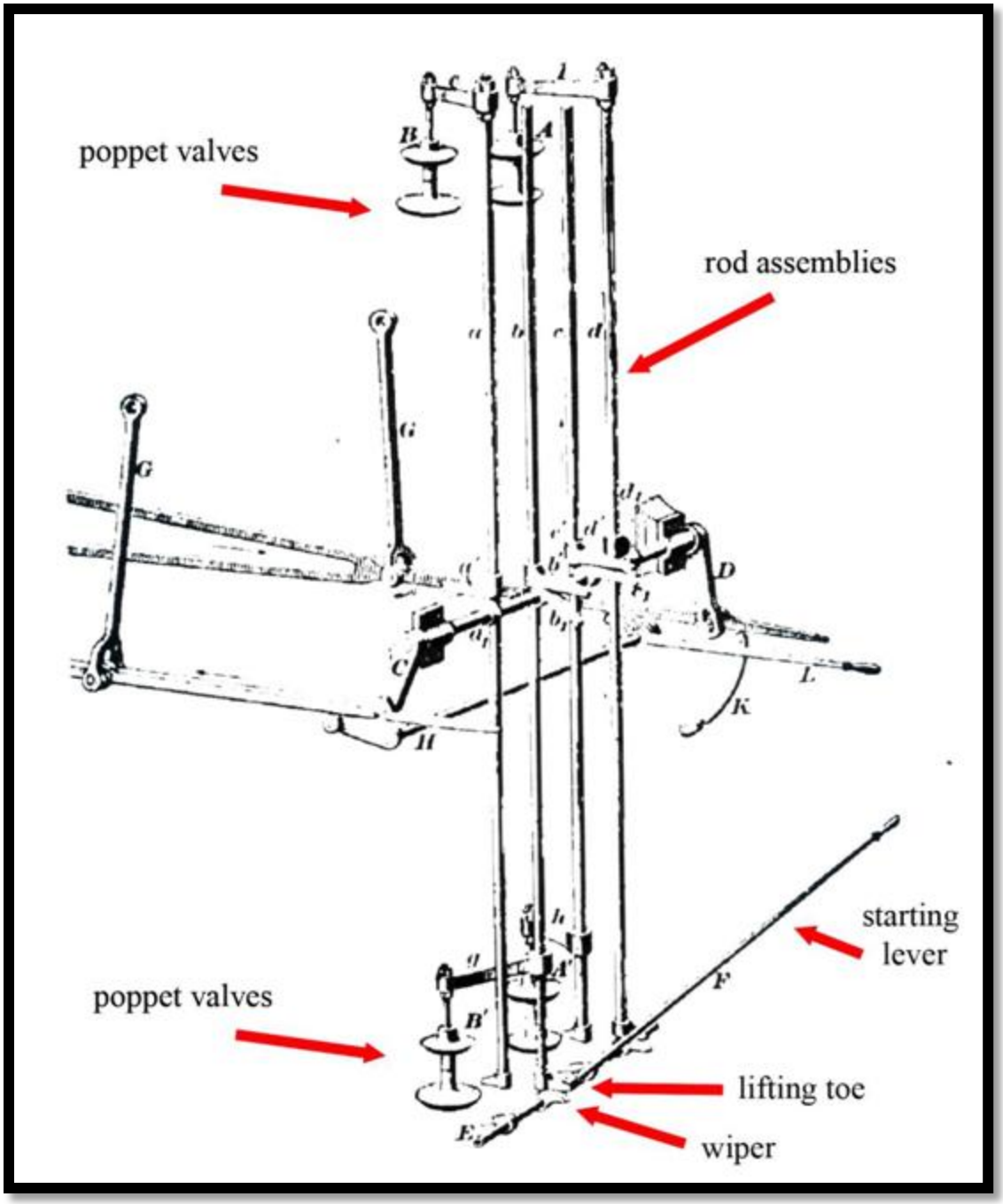

Figure 69. Lifting rod and poppet valve assemblies. The steam chest has been omitted to view the assemblies; modified from International Correspondence Schools (1897:69, fig. 331).

movement. This process was difficult and required considerable skill on the part of the engineer. The engine needed to overcome the immense drag and resistance created by the paddlewheels pushing against the water. If the engineer released too much steam into the cylinder, the pressure might cause the piston to become stuck at the end of a stroke. The stroke was the distance the piston travelled from the top to the bottom of the cylinder. Starting the piston was a balancing act. The engineer needed to release just enough steam above and then below the piston alternately and repeatedly until the crank arm tipped past the fulcrum point and the weight threw the engine into motion. In the event that the piston became stuck, the crew were required to manually push the paddlewheel. This was done through an access hatch in the side of the paddlewheel housing. Using a rod, crew members pushed down on the wheel's buckets until the wheel turned and the piston moved. This job could be quite dangerous if the cylinder was still heavily pressured. Enough pressure might cause the paddlewheel to jump into action and throw the rod and crewmembers violently (International Correspondence Schools 1897:10, 66-72; Whittier 1983:15-16, 21-22; Sheret 2005:54-56).

Steam passed through the exhaust chamber after leaving the cylinder and collected in the condenser beneath the main cylinder. The condenser and air pump worked in concert to cycle hot water, recaptured from steam, back to the boilers. Cold sea water was injected into the condenser through a gravity fed pipe. Water sprayed up into a cone-shaped projection placed above the pipe, cascading evenly over the entire chamber and condensing the hot steam back into water. Condensation created a natural vacuum that aided the piston's movement (International Correspondence Schools

1897:65).

The air pump cylinder (Figure 68) in *Westfield* would have been immediately forward of the main cylinder and condenser assembly. A second piston within the air pump was powered by the motion of the walking beam. When the air pump piston moved up, the suction pulled a mixture of air and water out of the condenser (International Correspondence Schools 1897:65). This mixture passed into the channel way underneath both cylinder assemblies, and then up towards the hot well, which sat on top of the air pump (Edwards 1883: xxxi, fig. 1). The end of the piston stroke lifted a domed cover above the air pump allowing water (condensed from steam) to fill the upper hot well. Excess water was diverted overboard through a spillway pipe. When the piston reversed motion and moved down, the lid quickly sealed. The trapped pressure pushed water from the hot well into two separate valve assemblies that ultimately fed back to the boilers. As the piston continued to move down, the increasing pressure closed the one-way air pump foot valve, located in the lower channel way (International Correspondence Schools 1897:65). This prevented water from flowing back into the condenser from the air pump.

The massive walking beam consisted of a diamond-shaped wrought iron band mounted around a central cast iron skeleton. Two large trunnions at the center of the skeleton (with one on each side) served as the walking beam's main cantilever (International Correspondence Schools 1897:64). The main walking beam trunnions were supported by twin cast iron bearing blocks with cupreous bushings that formed the pinnacle of the A-frame.

The piston rod exposed above the cylinder connected by way of a crosshead with two shorter rods known as connecting links. The upper end of the connecting links attached to trunnions at one end of the walking beam. The crosshead allowed the connecting rods to pivot slightly fore and aft as the end of the walking beam moved through an arc thus allowing the piston rod to remain vertical. The crosshead was guided by iron channels that ran vertically above each side of the cylinder to ensure the piston rod could not get out of alignment. These channels were secured to the A-frame with iron struts for extra stability (International Correspondence Schools 1897:64).

The opposite end of the walking beam contained trunnions that formed the mounting point for the main crank arm's connecting rod. This rod transferred the walking beam motion to the rotary crank arm on the paddlewheel shaft. To ensure that this massive rod did not bend, supplementary rods were bolted at the ends, and bore against braces fixed at the connecting rod's center point. Bearing blocks supported the enormous weight of the paddlewheel shafts at their juncture with the crank arm.

From its attachment point on the paddlewheel shaft, a long arm ran towards the steam chest before terminating above a second rocker arm at the engineer's control station. This long arm device was known as an eccentric arm. The arm contained an off center flywheel that was keyed into the paddlewheel shaft. When the engine was in motion, the off center flywheel rotated around the main shaft in an eccentric circle. This caused the eccentric arm to sway back and forth away from the second rocker arm (International Correspondence Schools 1897:64). Compared to the first rocker arm attached to the starting lever, the second rocker arm was considerably larger in scale and

contained a unique pedal that hung off to the side. Once the engine was successfully manipulated into motion, the engineer could "drop the hook" by pulling a lever. This term related to a hook built onto the end of the eccentric arm. By dropping the hook onto the rocker arm pedal, the moving eccentric arm pulled the pedal back and forth. This rocking motion took control of the lifting rods that regulated the flow of steam into the cylinder (International Correspondence Schools 1897:68-71). This arrangement functioned as a autopilot, allowing the engineer to stop personally manipulating the controls and to monitor other aspects of the engine.

Figure 70 displays an engine room from the steamboat *Cosmopolitan* similar to the engine room in *Westfield*. Like *Westfield*'s engine, the engine on this boat was also built by Morgan Iron Works in 1861. The main difference between the engine room on this boat and *Westfield* was that on *Westfield* the engine cylinder was on the same deck as the control station and thus visible to the engineer. In this boat, the engine room was placed one deck higher than the engine cylinder, and therefore all that can be seen is the piston rod leading down to the engine cylinder on the deck below.

Engine Proportions

Like most marine engines in the 19th century, each walking beam engine was designed and customized by the builder to accommodate a specific vessel. No single standardized plan existed for the engine type. Despite this, all walking beam engines followed the same principles and were similar in construction.

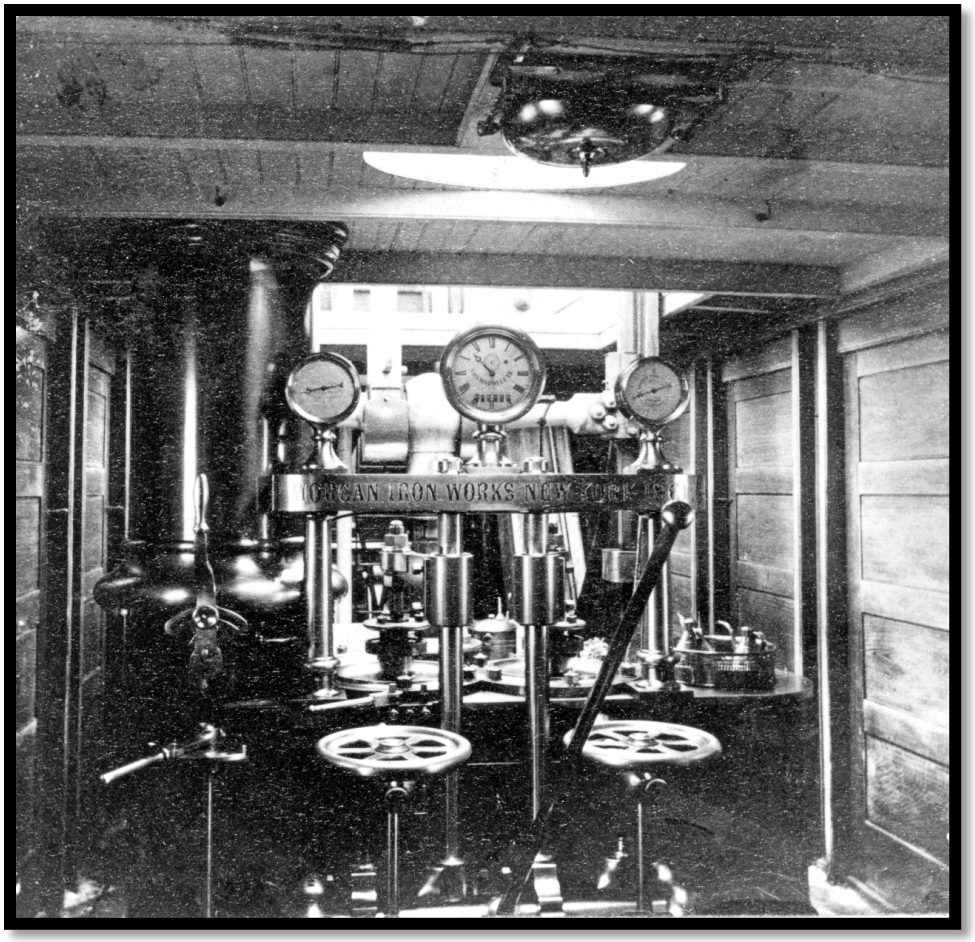

Figure 70. The steamboat *Cosmopolitan*'s engine room was similar to *Westfield*'s. Image from Davis (2000:580); archived at the Western Reserve Historical Society in Cleveland Ohio; reference # unknown.

Proportion played a significant role in designing engines for new vessels or reusing older components from previous vessels. The main issue of proportion focused on the size and stroke of a vessel's engine cylinder. This distance was proportioned to other key areas on the engine. The length of the crank arm, or the throw of the crank, measured exactly half of the piston stroke. When the walking beam lay perfectly horizontal, the piston remained at a half stroke within the cylinder. This caused the crank arm to also remain horizontal. Therefore, at the beginning of a stroke, the crank arm pointed straight down,

and at the end of a stroke, the crank arm pointed straight up (International Correspondence Schools 1897:11, 70).

The size of other engine components varied considerably. A-frame and walking beam size could be adjusted within limits as long as the proportions of the engine stroke were followed. Building an A-frame too short would have caused the walking beam to interfere with the stroke of the cylinder and building an A-frame too tall would have overstressed the connecting rods that facilitated the walking beam's movement. Fortunately, in the case of *Westfield*, numerous artifact fragments provide clues that, in conjunction with the historical record, allow many engine components to be reconstructed. Dimensions of other engine parts not represented in the artifact assemblage can be determined by examining the proportions of equivalent components found on other walking beam engines and fitting those theorized elements within the known parameters of *Westfield*'s hull.

Historical Data

Three types of historical sources assisted with a virtual reconstruction of *Westfield*'s engine. The first sources were measurements found in legal documents and period publications. For example, enrollment and licensing documents state that *Westfield*'s lower hull measured 213 ft. 4 in. (65 m.) by 34 ft. (10.4 m.) by 12 ft. 11 in. (3.94 m.) at 891 tons (808.302 mt.)(Williams 1861; Borgens et al. 2010: Appendix A-1). Later secondary accounts state that Morgan Iron Works constructed the engine with a 50 in. (1.27 m.) diameter cylinder that contained a 10 ft. (3.05 m.) piston stroke (Heyl

1965:335). Finally, the paddlewheels were 22 ft. (6.71 m.) in diameter by 9 ft. (2.74 m.) wide (Main 1893:133).

The second source was the scale drawing of *Westfield* (Figure 27) discovered by the Civil War historian Edward Cotham in the Memphis Public Library. The Memphis drawing contains details of the engine's upper half and includes a carefully illustrated scale that runs the length of the vessel.

The third and perhaps most useful source of historical information was the proposal written by the naval architect William Cowles in 1886. The proposal emphasized the need to modernize the fleet of Staten Island ferryboats. Cowles explained that the ferryboat design "remained practically the same as they were thirty years ago" (1886:191). While the points of the proposal are not relevant to this discussion, Cowles' above statement and his included architectural drawing of the Staten Island ferryboat *Southfield* II (Figure 15) allow for a comparison to be made between his plan and the Memphis drawing.

Paddlewheel Shaft, Engine Cylinder, and Condenser

The placement and scale of some of *Westfield*'s key machine components are depicted in the Memphis drawing (Figure 27). Confidence in those placements is reinforced by their general agreement with the *Southfield* II plans. *Westfield*'s paddlewheel is small in relation to the size of its walking beam and its hull in general. The paddlewheel shaft on the Memphis drawing is situated just below the level of the main deck and closer to the water than most side-wheelers to accommodate the smaller

paddlewheel. The *Southfield* II plans, likewise, show a small paddlewheel and a lower placement of the paddlewheel shaft. This characteristic was typical of ferryboats to ensure that the paddlewheel shaft did not become a barrier to passenger and horse team traffic passing through the vessel.

Westfield's cylinder and steam chest appear to have been placed at the same height and location as on *Southfield* II, as evidenced by a small box-like structure illustrated on *Westfield*'s hurricane deck (Figure 71). After the U.S. Navy purchased *Westfield*, the vessel underwent a refit that reduced the superstructure to 8 ft. (2.44 m.) above the main deck. Assuming the engine size and placement on *Westfield* matched that shown on the *Southfield* II plans, the upper 1 ft. (30.5 cm.) of *Westfield's* engine cylinder and steam chest would have extended above the upper deck after the deck was lowered for naval use. The delicate nature of the steam chest's rod and poppet valve assemblies, no doubt made a protective cover necessary. The box shown on the Memphis drawing appears to have provided that protection. The *Southfield* II plans (Figure 15) show the base for the cylinder and steam chest 2 ft. (0.61 m.) below the level of the main deck and reaching a height of 11 ft. (3.35 m.). Like *Southfield* II, *Westfield*'s engine had a stroke of 10 ft. (3.05 m.). The total height of both engines is presumed to match closely. The extra 1 ft. (30.5 cm.) of cylinder height on the *Southfield* II drawing is accounted for by the cylinder's top cover and by the lower piston bed that stopped the piston after a stroke was completed.

Westfield's lower condenser can be theoretically reconstructed, based on *Southfield* II's plans, to a height of 5 ft. (1.52 m.). Usually condensers measured

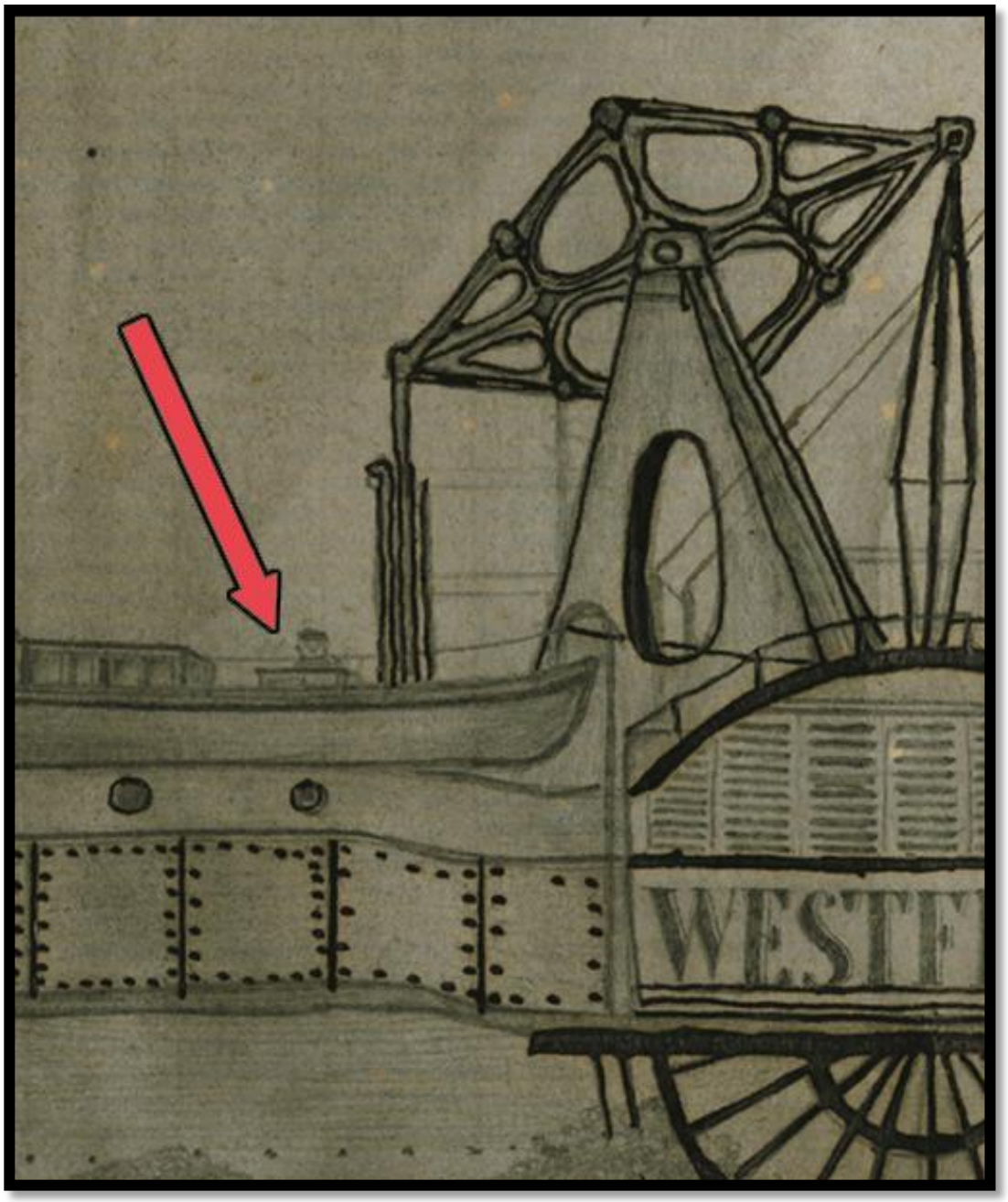

Figure 71. Small deck structure (arrow) with a crewman's head showing above it located between the stern pilot house and crosshead channels (Image modified from the 1862 sketch of *Westfield*).

approximately one third or more of the main cylinder height. Too small of a condenser might allow water to flow back into the main cylinder (Sheret 2005:138). The combined height of *Westfield*'s cylinder and condenser assembly would have been about 16 ft. (4.88 m.) including 10 ft. (3.05 m.) of cylinder stroke plus 1 ft. (30.5 cm.) for the cover and piston bed, plus 5 ft. (1.52 m.) for the condenser. Accounting for *Southfield* II's 1 ft. (30.5 cm.) thick main deck, *Westfield*'s known 12 ft. 11 in (3.94 m.). depth of hold, and the already discussed placement of the cylinder and condenser assembly, a space of 6 ft. 11 in. (2.11 m.) remained beneath the engine assembly for hull frames and the large bed timbers that supported the walking beam engine.

Numerous fragments of *Westfield*'s cylinder and condenser assembly have been identified (Figure 72). These fragments have an interior diameter of 50 in. (1.27 m.), matching the historical record. Most engine cylinders had a wall thickness of 1 to 1-1/2 in. (2.54 to 3.81 cm.) but also incorporated reinforcing rings as part of the casting, spaced evenly along the cylinder as a method of reinforcement (Whittier 1983:15). *Westfield*'s cylinder and condenser fragments are 1 in. (2.54 cm.) thick and many exhibit reinforcing rings measuring 5 in. (12.7 cm.) high and 1/2 in. (1.27 cm.) thick (in addition to the wall thickness). Four of the larger curved fragments can be identified as coming from the lower condenser. Although heavily weathered, Artifact 132-016 still contains a broken remnant of the dividing plate that separated the condenser from the upper cylinder (Figure 73). Two of the artifacts (132-006 and 138-001), are still bolted to the base plate that formed the condenser's foundation (Figures 74 and 75). In order to secure the engine cylinder and condenser together to the lower base plate, the ends of each

Figure 72. Large cylinder fragment before conservation (Artifact 134-007; scale inches).

Figure 73. Fragment from the top of the condenser, viewed upside down (Artifact 132-016; scale dm.).

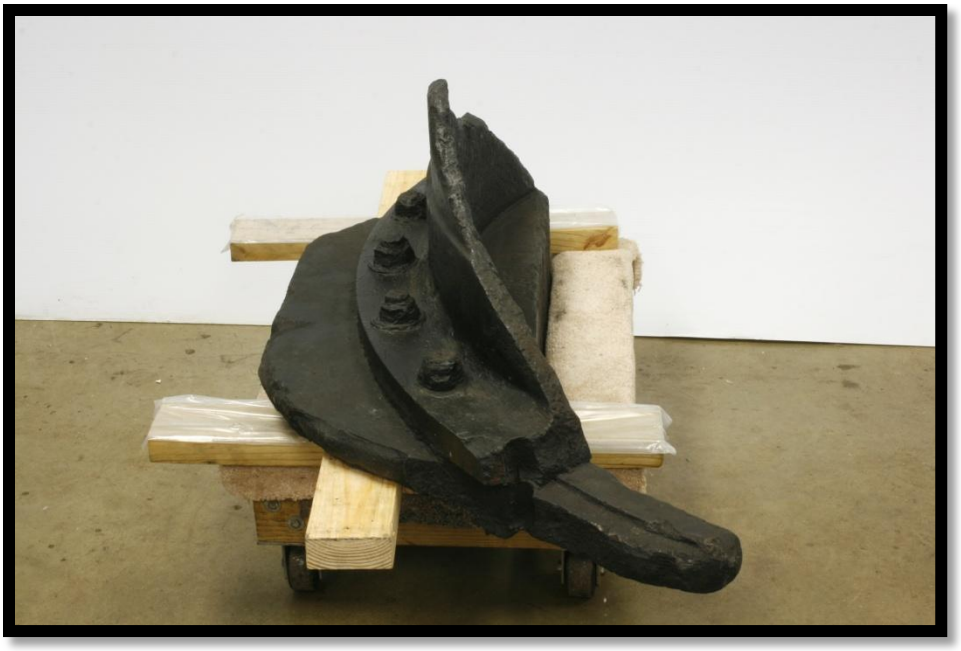

Figure 74. Fragment of cylinder on base plate I (Artifact 138-001).

Figure 75. Fragment of cylinder on base plate II (Artifact 132-006; scale cm./dm.).

cylindrical component contain a 1 in. (2.54 cm.) thick lip, 4 in. (10.2 cm.) wide. On this lip, fastening bolts are spaced 6-1/2 in. (16.5 cm.) apart. In total, four base plate fragments were recovered (132-001.91, 132-006, 138-001, and 140-004). These plates are 1-3/4 in. (4.44 cm.) thick. Conservators removing concretion noticed these plates retained wooden splinters on their undersides from the bed frame timbers that supported the engine. Artifacts 132-006 and 138-001, along with Artifact 134-007 still fit together and can be rejoined along their fracture points (Figure 76). Based on the rejoining of these artifacts and the known orientation of *Westfield*'s engine (condenser/engine cylinder aft, air pump/hot well forward), conservators were able to determine that these three artifact came from the starboard side of the vessel. Following the bolt pattern on these joined artifacts, base plate Artifact 132-001.91, which could not be rejoined, came from *Westfield*'s port side (Figure 77).

Beneath the base plate fragments, portions of the channel way leading to the air pump survived. The largest channel fragment, found on Artifact 138-001 (Figure 78), although incomplete, indicates that the port and starboard walls of the channel way were relatively flat and the chamber had a depth of at least 1 ft. (30.5 cm.). Numerous fragments from the channel way walls survived independently. These fragments, combined with the portions that remained attached to the base plates, allowed conservators to determine that the shape of the channel way was designed to facilitate the forward movement of water. One smaller fragment came from the after portion of the channel way (Artifact 133-004). This fragment shows that the shape of the condenser continued down into the channel way creating a rounded after wall that curved along the

Figure 76. Rejoined cylinder fragments (Artifacts 132-006, 138-001, and 134-007).

Figure 77: Fragment of port side base plate (Artifact 132-001.91; scale dm.).

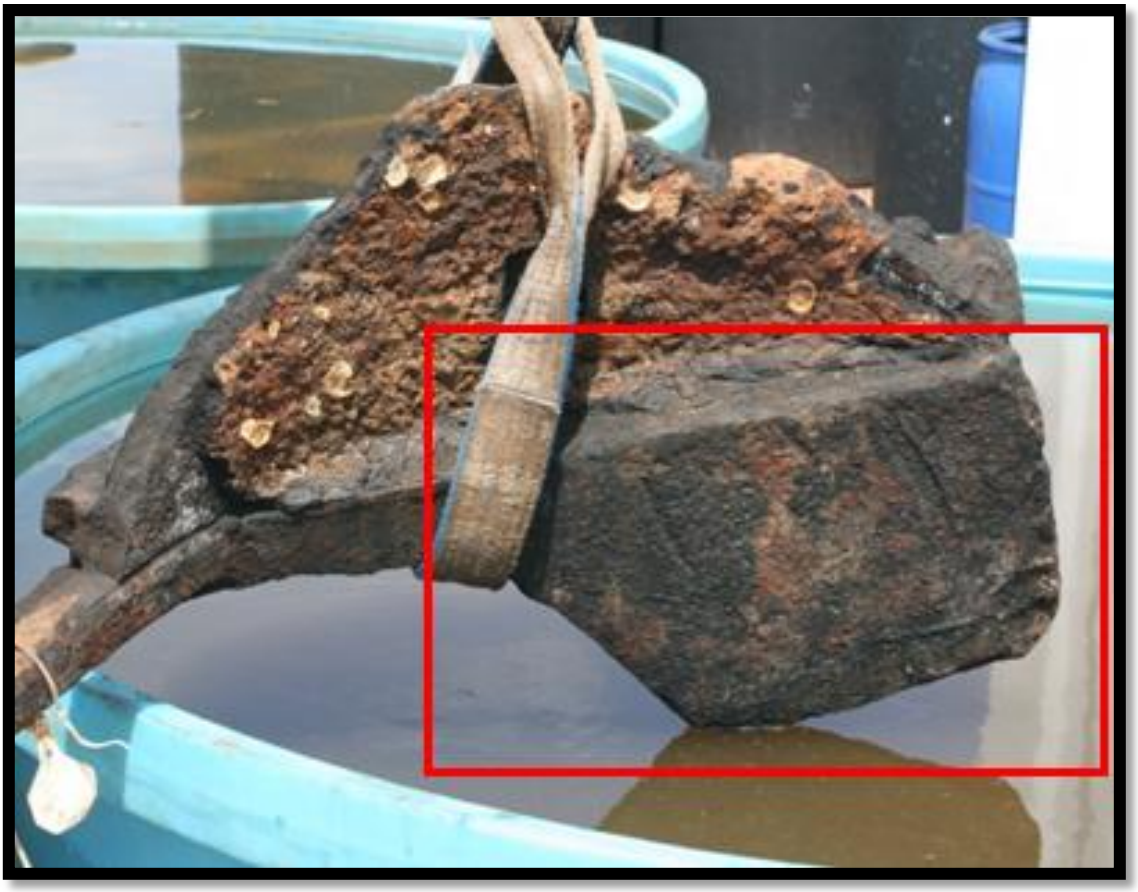

Figure 78. Lower fragment of channel way before conservation (Artifact 138-001).

bottom to create a downward sloping floor (Figure 79 and 80). The round after wall terminated sharply to accommodate the narrow width of the channel way (Figure 81). The largest recovered base plate fragment (Artifact 140-004) supported the air pump/hot well cylinder assembly. A surviving section of the inner ring on the base plate has a diameter of 42 in. (107 cm.). Remnants of the channel way show that its walls slightly narrow in the forward direction to accommodate the smaller diameter of the air pump cylinder (Figure 82). Artifact 140-004 is also from the starboard side of the channel way.

Figure 79. Rounded fragment from rear channel way wall with outlined evidence of a downward sloping floor (Artifact 133-004).

Figure 80. Reverse side of the rounded fragment from the rear channel way wall with outlined evidence of a transition to sharp side walls (Artifact 133-004).

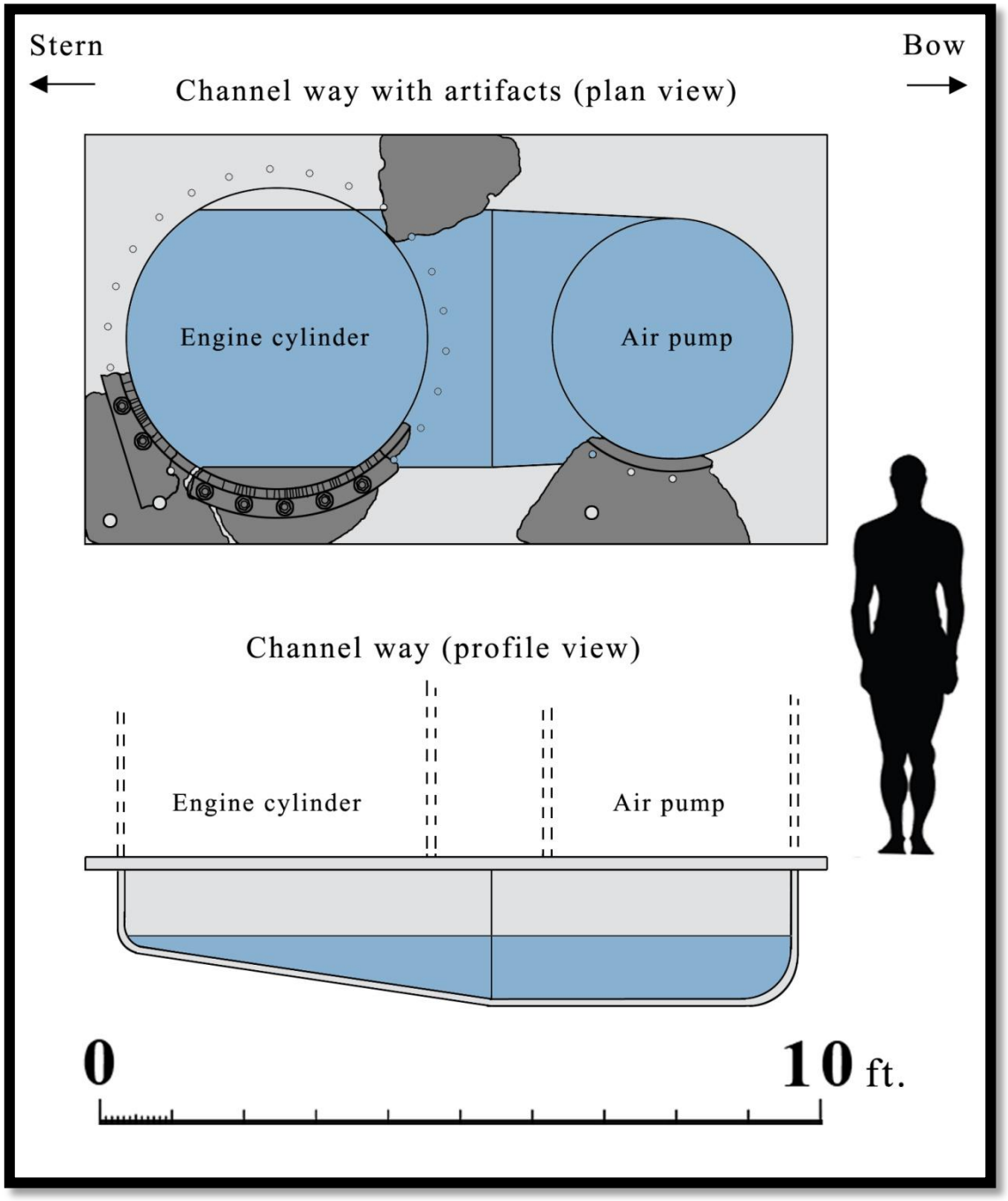

Figure 81. Reconstruction of channel way beneath cylinder assembly (by author and Glenn Grieco).

Figure 82. Underside of air pump base plate with a narrowing channel way wall (Artifact 140-004; scale cm.).

Air Pump and Hot Well Assembly

No historical information has been found regarding the construction of *Westfield*'s air pump and hot well. Fortunately, in addition to the lower base plate fragment (Artifact 140-004), a large artifact from the air pump was recovered remarkably intact (Artifact 132-017). This artifact is one of two valve assemblies that received water from the upper hot well reservoir as a means to refuel the boilers' water level (Figure 83). Like the base plate fragment, the recovered valve assembly came from the starboard side of the engine assembly. This placement is evident due to the forward flowing direction of the interior valves. The artifact measures 2 ft. (61 cm.) long, 10 in. (25.4 cm.) wide, and 6 in. (15.2 cm.) tall. The pipe that led to the forward boilers has a diameter of 4 in. (10.2 cm.) and an attachment flange with a diameter of 9 in. (22.9 cm.).

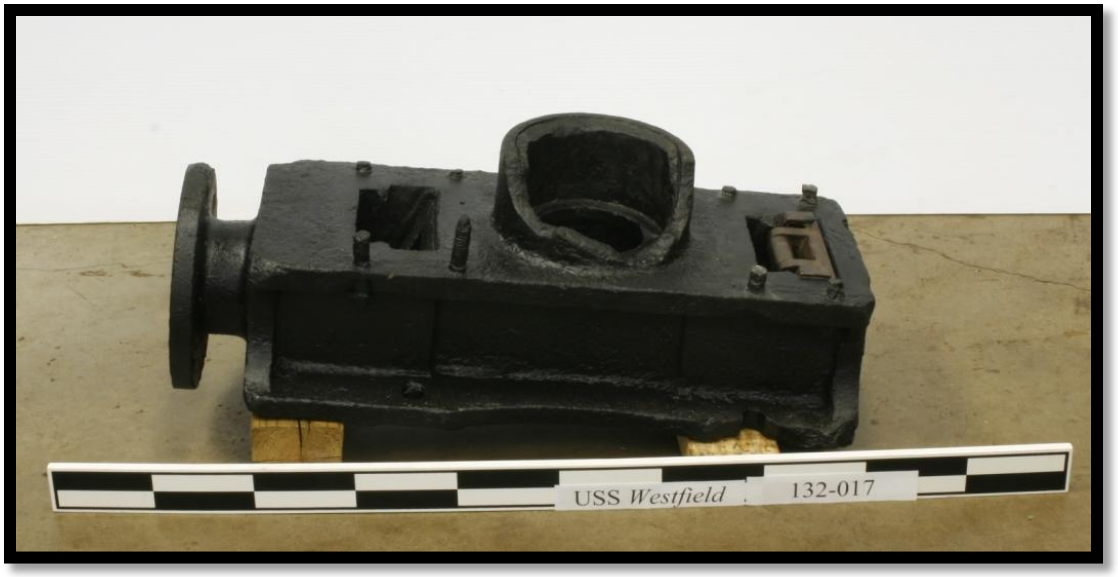

Figure 83. Valve assembly from the air pump/hot well reservoir (Artifact 132-017; scale dm.).

After removing protective cover plates and broken pipe flanges, conservators recovered all of the original sealing gaskets (Figure 84). Inside the artifact, two cupreous valves are held in place by cupreous wedges, all of which are seated in lead (Figure 85).

Originally, this artifact was mounted outside the air pump cylinder on a shelf, directly beneath the hot well reservoir (Figure 86). Both the shelf and a large fragment of the air pump cylinder survived with the valve assembly. The shelf measured 1 ft. 4 in. (40.6 cm.) wide and 6 in. (15.2 cm.) tall from the base plate. The air pump cylinder fragment indicates an internal diameter of 40 in. (1.02 m.) that fit into the curved portion of the base plate (Artifact 140-004), and like the condenser/engine cylinder, was mounted with a reinforced supporting flange that bolted down over the plate. Unfortunately, the exact heights of the air pump and the hot well can only be speculated. On most walking beam engines, this dual assembly was generally slightly taller than the

Figure 84. Examples of intact composite fabric gaskets from the valve assembly (Artifacts 132-017.6 and 132-017.8; scale cm.).

Figure 85. Cupreous valve and wedge from the valve assembly (Artifacts 132-017.12 and 132-017.13).

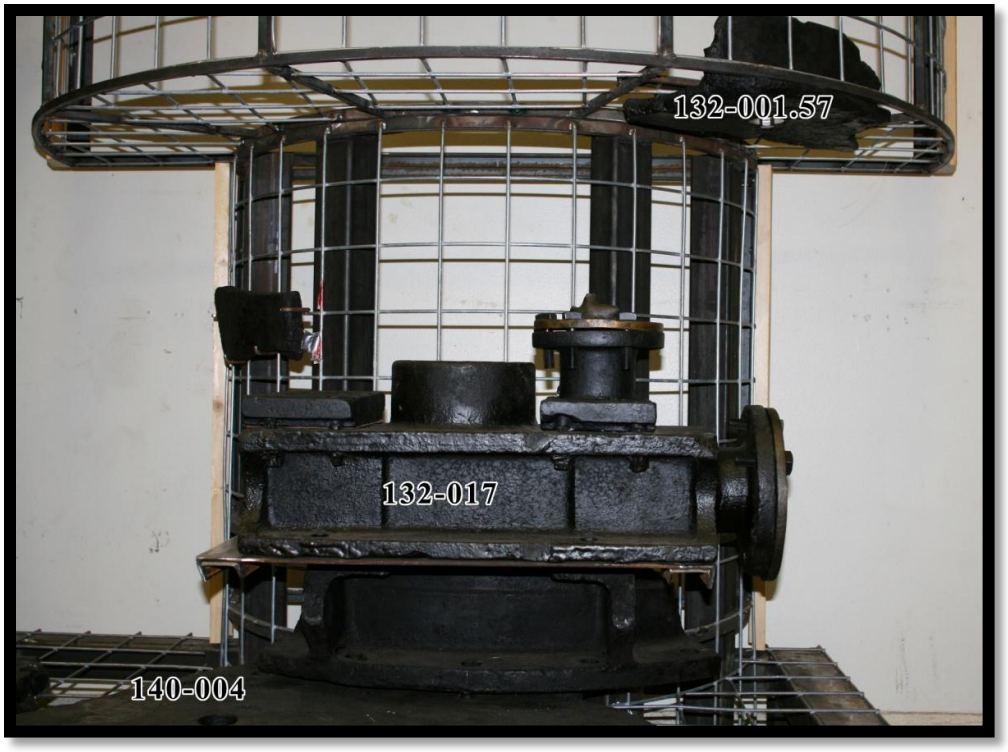

Figure 86. Reconstructed valve assembly on the shelf and lower base plate fragment (Artifacts 132-017 and 140-004); the support flange fragment for the upper hotwell is in upper right corner (Artifact 132-001.57).

condenser and the engine cylinder's lower piston bed. Applying this generality to *Westfield*, the height measured approximately 6 ft. (1.83 m.) tall. Based on other walking beam engines, the air pump cylinder likely contained a rounded flange at the top with a rim that stood just inside the edge. This flange was utilized as a lower base plate for the hot well reservoir cover (Figures 86 and 87). During the assembly of the engine, the cover would have been lowered down and seated onto this plate. The rim on the plate sat inside the cover, preventing the cover from sliding off. One fragment from this plate (Figure 88) and rim survived (Artifact 132-001.57). The rim sits 1-1/2 in. (3.81 cm.) inward from the ledge, indicating that the cover contained a general thickness of 1

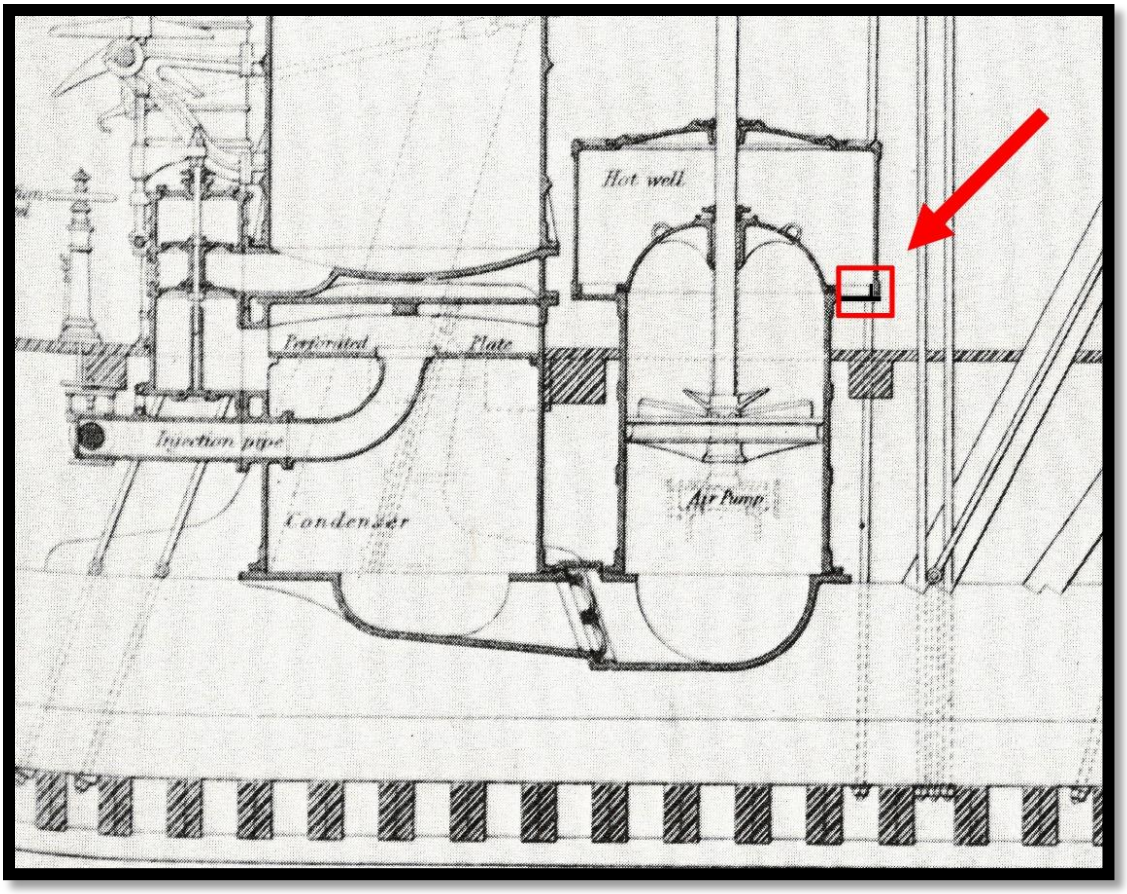

Figure 87. Rounded flange on a schematic detailing the steamship *New World*'s engine; modified from Whittier (1987:12).

Figure 88. Surviving rounded flange piece from *Westfield* (Artifact 132-001.57; scale cm.).

in. (2.54 cm.), plus a 1/2 in. (1.27 cm.) reinforcing ring at the bottom. Based on the curvature, the rim on the plate had an inside diameter of 5 ft. 2 in. (1.57 m.). Adding the thickness of the missing cover (not accounting for the reinforcing rim), the hot well reservoir had an inside diameter of 5 ft. 4 in. (1.63 m.).

The combined base plate for both cylinders was attached to the lower bed frame timbers with massive wrought iron bolts. Several of these bolts were recovered. The tops of the bolts are threaded, and they were secured with a single square nut (Artifacts 117-001 and 138-003). The bolts passed through rounded holes in the base plate as seen in Figures 75 and 82. Each hole had a diameter of 2 to 2-1/4 in. (5.08 to 5.71 cm.). Cast iron square or rectangular washers lay between the nut and the plate surface (Figure 89). The washers acted as a surface that could rotate if needed and spread the load placed on the bolt heads. A variant of this bolt type was also recovered (Artifact 132-001.92). Rather than containing a smaller square nut and an underlying washer, this bolt instead utilized a single larger wrought iron nut that accomplished both tasks (Figure 90).

Reconstructing the A-frame

Like the cylinder and condenser assembly, *Westfield*'s A-frame can be reconstructed through a piecemeal process. The Memphis drawing portrayed approximately 18 ft. (5.49 m.) of *Westfield*'s A-frame rising above the main cabin. The lower portion can be determined by accounting for the combined 12 ft. 11 in. (3.94 m.) depth of the hold, the 1 ft. (30.5 cm.) thick main deck, and the 8 ft. (2.44 m.) high main cabin; in all, approximately 21 ft. 11 in. (6.68 m.) of the A-frame lay hidden from view.

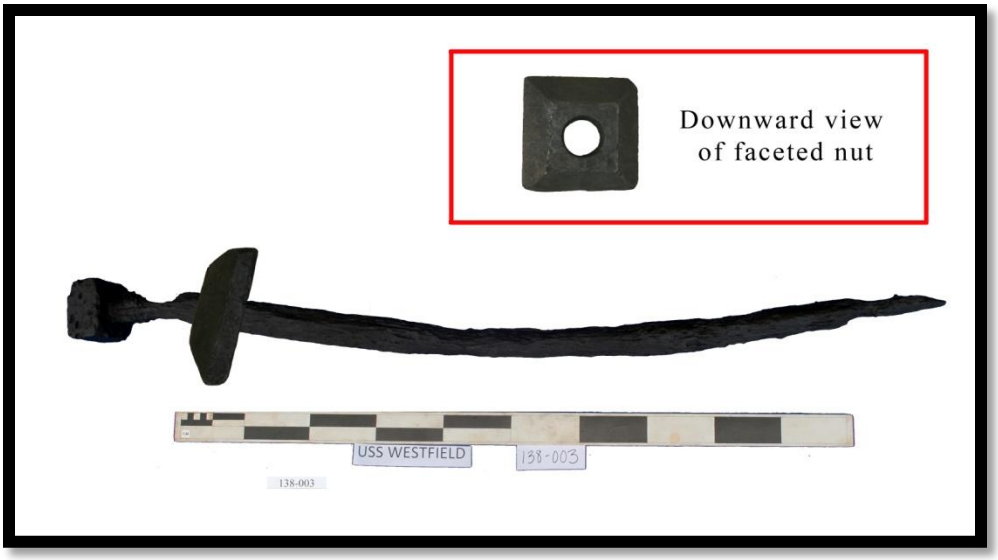

Figure 89. Type 1 massive bolt and washer fastener for cylinder base/bed frame timbers (Artifact 138-003; scale cm./dm.).

Figure 90. Type 2 massive bolt fastener for cylinder base/bed frame timbers (Artifact 132-001.92; scale dm.).

Adding the hidden 21 ft. 11 in. (6.68 m.) section and the 18 ft. (5.49 m.) visible section, *Westfield*'s A-frame reached 39 ft. 11 in. (12.2 m.) or nearly 40 ft. tall (12.2 m.). The projected height of the A-frame makes sense when compared to the engine height on the *Southfield* II plans, since *Westfield* had a substantially taller superstructure before the U.S. Navy converted the vessel into a gunboat.

On the Memphis drawing (Figure 27), the artist incorporated a curious vertically-oriented oval shape into the A-frame structure underneath the walking beam. There has been much controversy among *Westfield*'s researchers about what this oval represents. A image of the 1890 built ferryboat *Eureka* offers a means to settle this discussion for it displays what appears to be a similar shape (Figure 91). Close examination of the *Eureka* image reveals that the oval is an optical illusion caused by shadows cast from the bearing block onto reinforcement knees. This realization assisted the reconstruction by allowing two larger wooden knees to be added to the upper portion of *Westfield*'s A-frame. As far as the hidden portions of the frame are concerned, the placement of similar knees and supports must be conjectural, based upon other walking beam engines.

During *Westfield*'s excavation, archaeologists recovered one of the two large bearing blocks (Artifact 133-002) that supported the trunnions of the walking beam (Figure 92). This artifact provided significant information that assisted in reconstructing *Westfield*'s A-frame. The bearing block was made up of two large cast iron components that were connected by long wrought iron rods. Although reduced during the wrecking process to a height of 6 ft. (1.83 m.), a protruding connecting rod suggested that the original bearing block assembly measured over 7 ft. 6 in. (2.29 m.) tall. This

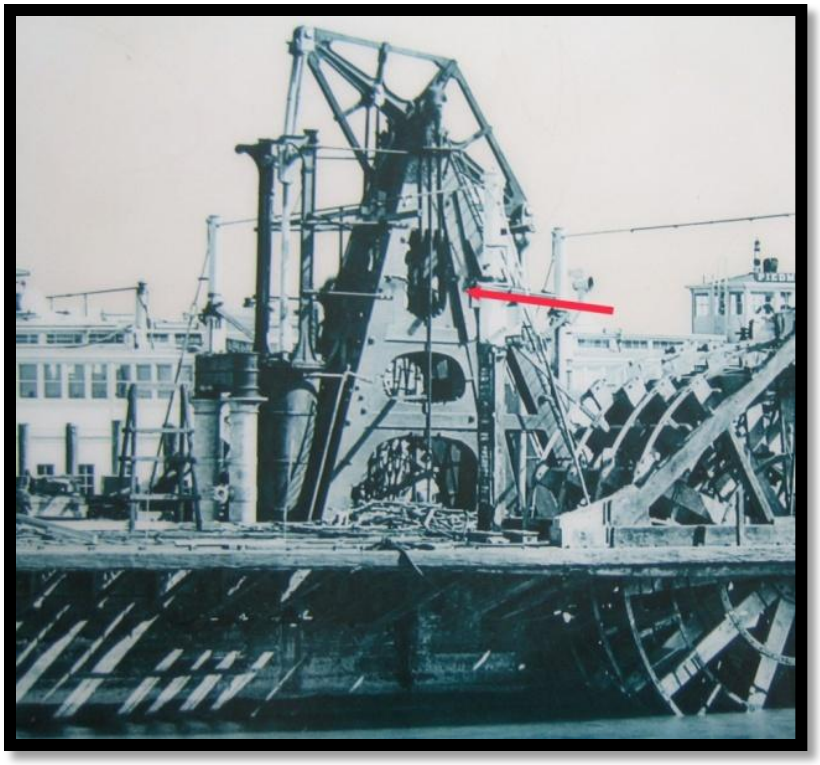

Figure 91. Walking beam of the ferryboat *Eureka* - large knees created oval openings in the A-frame (Image courtesy of the San Francisco National Historical Park).

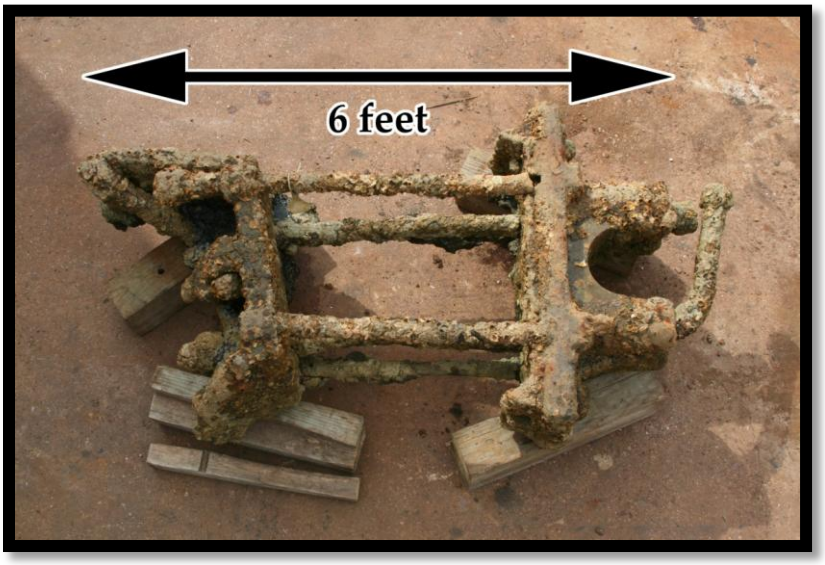

Figure 92. Encrusted bearing block from *Westfield*'s walking beam before conservation (Artifact 133-002; scale feet).

measurement does not account for the missing bearing cap.

In its original position, the bearing block clamped the A-frame's beams together at the pinnacle. Since the beams rested between the bearing block's two parts, the components were molded to support the angle of the beams (Figure 93). On the lower piece, the sides flared out to 285 and 255 degrees, indicating the interior angle of the primary wooden structure that supported the walking beam. The upper component has angles measuring 285 and 245 degrees. The 245 degree measurement indicates the angle for the secondary beams that supported the paddlewheel shaft. The depth of these two components measured 1 ft. 6 in. (45.7 cm.), indicating the thickness of the beams at the highest point.

Numerous iron rods secured the A-frame within the hull. These irons rods were tightened using turnbuckles. The placement of three of these rods can be identified on the bearing block. On each end of the bearing block's upper component, two reinforced holes ran at the same angles as the secondary beams. This indicates that each side of the bearing block contained a rod that ran down the sides of the A-frame. A large shackle secured to the lower portion of the bearing block contained a short rounded stub with a 1 in. (2.54 cm.) diameter. The stub indicates that another securing rod broke off from this location. The shackle allowed the former rod to descend at a wide angle toward the side of the vessel.

Excavations recovered two wrought iron turn buckles of differing sizes. The smaller of these has one end broken off and measures about 3 in. (7.62 cm.) wide across the buckle (Artifact 133-034; Figure 94). The A-frame required substantial reinforced

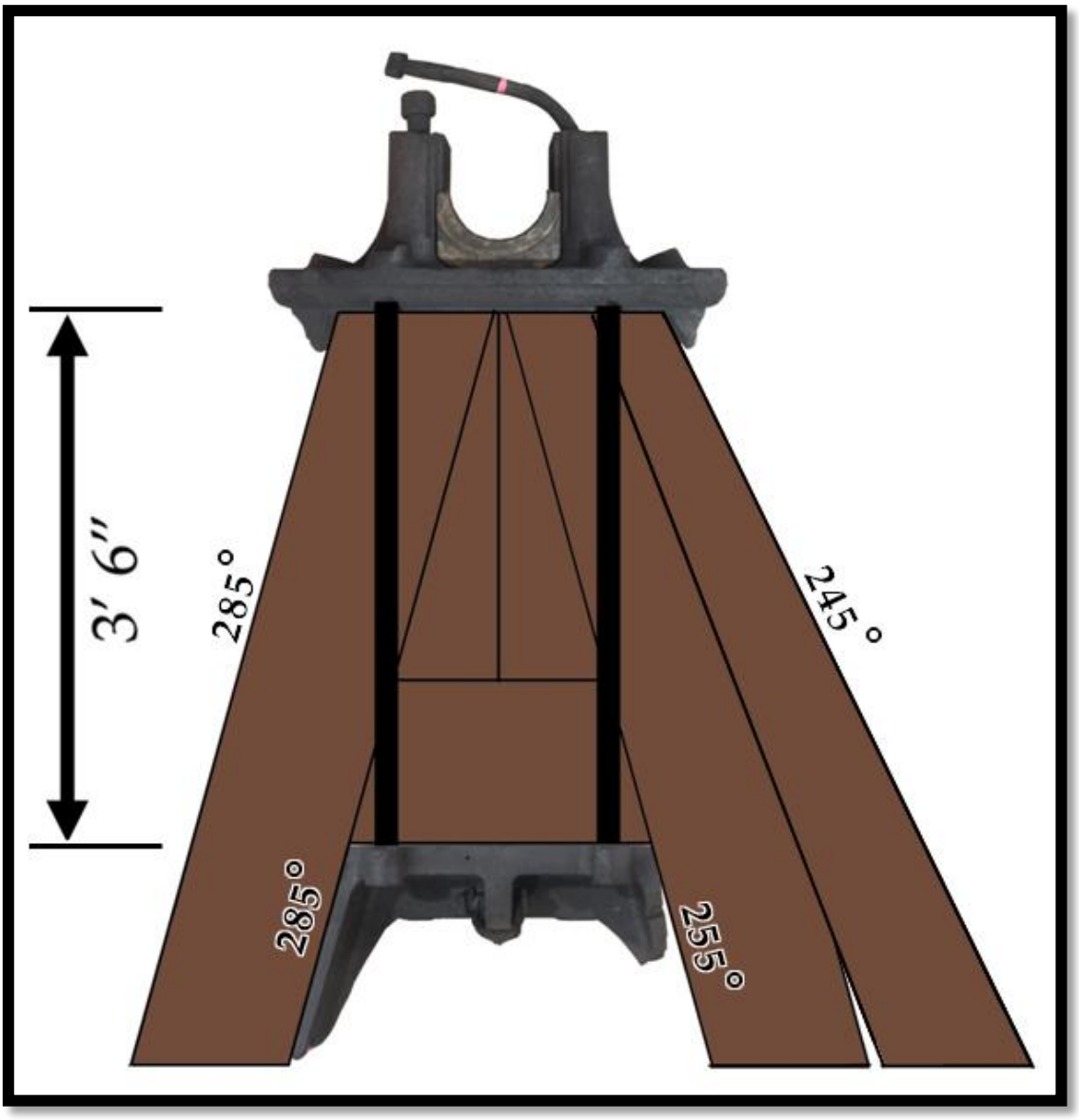

Figure 93. Upper bearing block reconstruction (Artifact 133-002; scale feet; by author).

rods and turnbuckles to counteract the forces of the constantly moving engine. The larger turn buckle (Artifact 117-002) measured 1 ft. 8 in. (50.8 cm.) long, 6 in. (15.2 cm.) wide, and 2 in. (5.08 cm.) thick, and contained 9 ft. (2.74 m.) of cable rod. Conservators cut these rod portions down to an approximate foot on each end (Figure 95). Like the stub on the bearing block shackle, the rod has a diameter of 1 in. (2.54 cm.). Numerous other wrought iron rod fragments were recovered. All of these artifacts contained hexagonal nuts that were threaded onto the rods. Interestingly, some of the threads on these wrought iron rods were formed by inserting a threaded cupreous bushing. Artifact 133-053 contains a heavily eroded nut that allows parts of the cupreous threading to be inspected (Figure 96). This cupreous bushing prevented the nut and bolt from rusting together, therefore allowing tightening or loosening as needed.

Walking Beam

The Memphis drawing (Figure 27) offered considerable information about *Westfield*'s walking beam. The artist made great efforts to detail the internal cast iron skeleton with all the numerous arms and reinforced ridges. Based on the drawing, the walking beam measured 22 ft. (6.71 m.) wide by 12 ft. (2.66 m.) tall. Another source of potential information can be found in *Westfield*'s sister ship USS *Clifton*. Said to be "equal in every respect", both were built simultaneously at the Simonson Shipyard (*Richmond County Gazette* 1861). The main difference lay in the iron works companies that built the engines. Morgan Iron Works built *Westfield*'s engine, while Allaire Iron

Figure 94. Smaller turnbuckle from the A-frame (Artifact 133-034; scale cm./dm.).

Figure 95. Larger turnbuckle from the A-frame (Artifact 117-002; scale cm./dm.).

Figure 96. Rod artifact with threaded cupreous bushing (Artifact 133-053; scale cm.).

Works constructed *Clifton*'s engine. Both engines had cylinders 50 in. (1.27 m.) in diameter and with a 10 ft. (3.05 m.) stroke.

Like *Westfield*, *Clifton* sank in Texas during the Civil War. Salvage operations recovered *Clifton*'s walking beam during the early 20th century (Figure 97). In 2012, this artifact underwent conservation at the CRL. During conservation, measurements recorded from *Clifton*'s walking beam were smaller than those indicated by the Memphis drawing, at 20 ft. (6.10 m.) wide by 9 ft. (2.74 m.) tall. This difference in size may be an issue of artistic interpretation or engine manufacturers. But, since the vessels were built at the same time and designed for the same engine, a substantial difference in walking beam size is unlikely. Evidence from an artifact is more reliable than a drawing; therefore, *Westfield*'s reconstruction follows the dimensions of *Clifton*'s walking beam.

Missing Components

There are still many components of *Westfield*'s walking beam engine that did not survive archaeologically and have not been recorded in historical documents. Some of these missing components were restored based on the proportions of surrounding engine parts. Others must be reconstructed based on other archaeological or historical evidence.

The missing crank arm was briefly mentioned in the section on engine proportions. As discussed, the length of the crank arm, or the throw of the crank, measured exactly half of the piston stroke. This measurement was taken from center point to center point and did not account for the thickness of the paddlewheel shaft or the hub for the connecting rod. Paddlewheel shafts generally had a diameter between 12

Figure 97. Walking beam from USS *Clifton* at Riverfront Park, Beaumont, Texas.

in. and 16 in. (30.5 and 40.6 cm.)(Whittier 1983:13, 15). *Westfield*'s shaft was reportedly 13 in. (33 cm.) in diameter (Galveston Daily News 1899). Based on *Westfield*'s 10 ft. (3.05 m.) engine stroke, the crank arm measured 5 ft. (1.52 m.) center point to center point, and approximately 6 ft. (1.86 m.) long edge of paddlewheel shaft to edge of connecting hub. The extra 1 ft. (30.5 cm.) was conjectural, but required consideration to ensure the adequate thickness of the crank arm.

Based on the position of the paddlewheel shaft and crank arm in relation to the reconstructed A-frame and walking beam, *Westfield* required a connecting arm approximately 26 ft. 6 in. (8.08 m.) long, center point to center point. On the opposite side of the walking beam, the connecting links that reached down to the piston rod

necessitated a length of 11 ft. 6 in. (3.51 m.) long, also center point to center point.

A rule may have existed to determine the offset for the eccentric circle at the paddlewheel shaft, and the length of the arm necessary to adequately rock the rocker arm. For purposes of this reconstruction, the length of the eccentric arm was restored to an approximate 25 ft. (7.62 m.) length to allow the arm to reach from the paddlewheel shaft to the rocker arm when the engine rested at mid-stroke.

The remaining components included the steam chest, the engineering controls, and the number of supporting struts for the crosshead channel. Without more information, these final elements must be left to conjecture. The placement of these elements on the reconstruction simply attempts to mirror those found on other plans. See Figure 98 for a reconstruction of *Westfield*'s engine.

Unidentified Machinery

In addition to artifacts that are known to have come from *Westfield*'s walking beam engine, excavations recovered other machinery components that remain unidentified. Some of these artifacts may have come from the engine, others may have been utilized in machinery elsewhere on the vessel.

Just south of the firebox on what would have been *Westfield*'s starboard side, a unique object shaped like a quarter moon with a larger flat edge was recovered during the excavation (Artifact 40; Figure 99). The metal was too corroded to save, yet conservators successfully made a mold and resin copy of the original to allow for study. This artifact was made of cast iron and contained a odd curve along the length. The

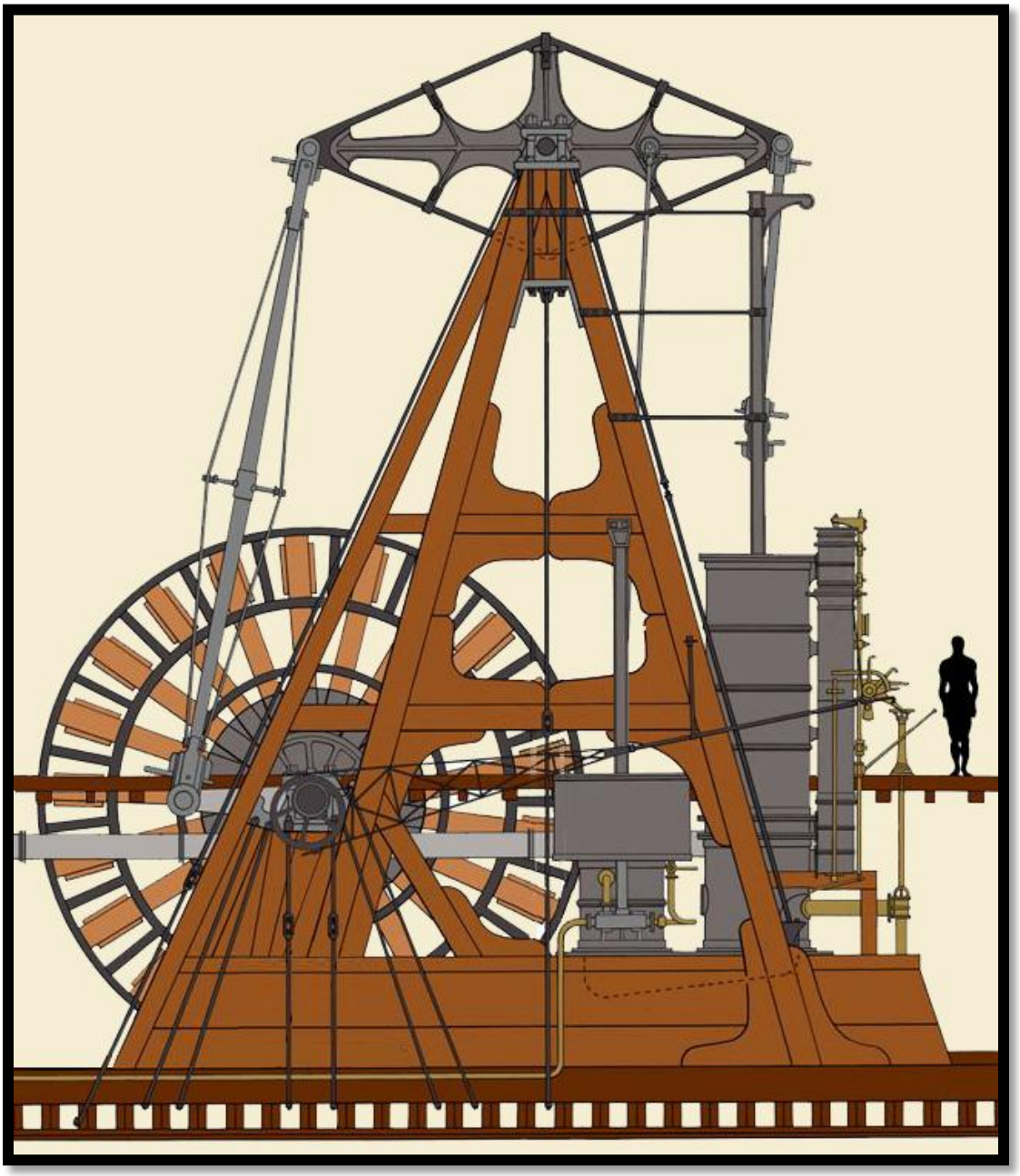

Figure 98. Reconstruction of *Westfield*'s engine (by author).

Figure 99. Unidentified moon-shaped machinery component (Artifact 40; scale cm.).

curve prevented the object from lying flat. On the rounded edge, an indentation was molded at the time the artifact was manufactured. This indention may have allowed the artifact to be easily removed from another object. How this artifact was used remains unclear.

On the port side of the vessel, outside the area believed to have been the main cabin, a large cast iron artifact was recovered (Artifact 106-004). One of the largest pieces of machinery recovered from *Westfield*, it was composed of two pieces (Figure 100). The artifact was designed to accommodate a heavy load. A flat base measuring 22 by 18 by 1 in. (55.9 by 45.7 by 2.54 cm.) contains a central hole with a reinforced upper ring. The central hole supports a cylindrical shaft that once rotated. The top of the shaft contains three fins, each with a small 1 in. (2.54 cm.) semi-circular hole at the bottom. Below the base, the shaft changes shape and becomes square. This square portion may have been a key that engaged into another part of a larger machinery assembly. Although

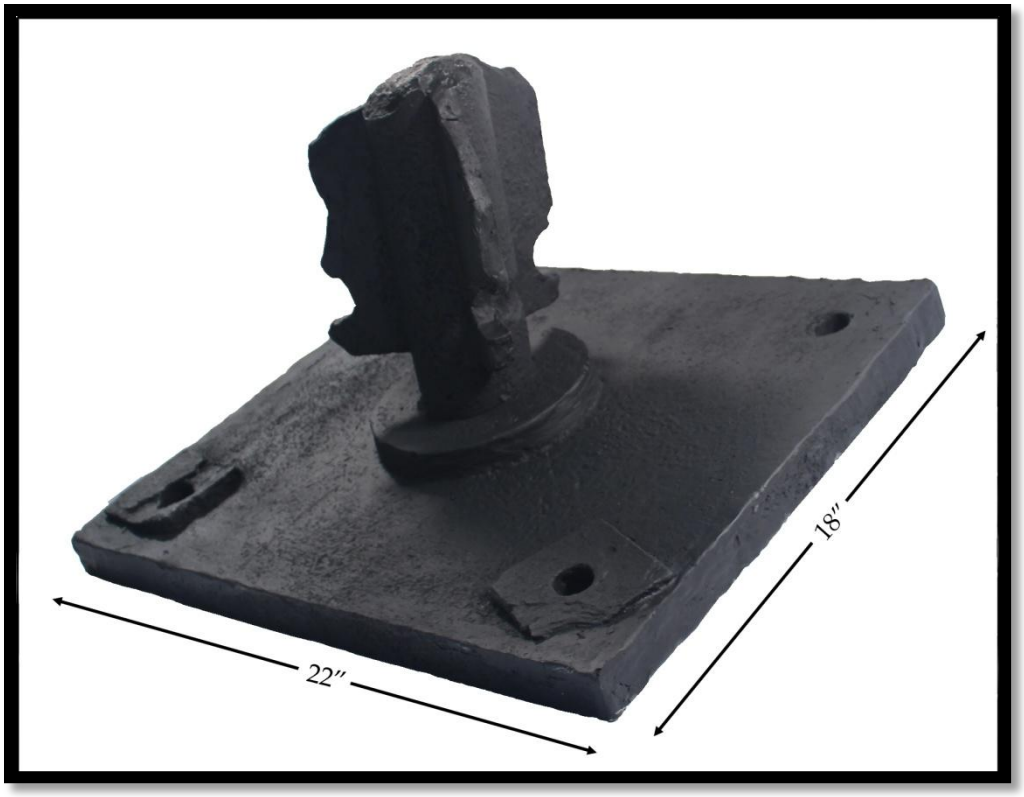

Figure 100. Unidentified machinery - possibly a steam driven winch or capstan component (Artifact 106-004; scale inches).

the exact purpose of this machinery is not clear, the evidence suggests a rotating winch of some sort. If the artifact's recovered location remains close to where it was originally used, the provenience suggests that the object may have once been part of steam driven capstan utilized for the rear anchor chains.

Artifact 129-002 is an 19th century brake pad from a steam locomotive (Figure 101). The artifact is listed as unidentified because it is not clear why this object was found on *Westfield*'s wreck site. It is possible that it was repurposed by *Westfield*'s crew or even taken onboard as a curiosity. While numerous components on *Westfield*'s walking beam engine rotated, there does not seem to be any fitting equivalent to this

Figure 101. Steam locomotive brake pad with embossed "313" (Artifact 129-002; scale cm.).

type of object on walking beam engine plans that allowed for its use.

One of the first artifacts conserved by the CRL was a pedestal-like artifact made of cast iron (Artifact 132-001-51). The main body of the artifact is heavily constructed, rounded on two sides, and contains a central mounting hole for a recessed square headed bolt (Figure 102). On the bottom side of the object, two projecting ridges (one is broken off), one on each side of the central hole, indicate that it sat on a mounting with dual recesses to receive the artifact. The ridges prevented the artifact from slipping and the upper recessed bolt secured both objects together. Based on tiny fragments of wood recovered from the recessed bolt hole, conservators believe the other object was made of wood. Branching off from the wider rounded side of the artifact, a unique rim shape contains a reinforced mounting hole for another unknown object. How this object was used is unclear, but the heavy construction and reinforcing features indicate it may have been a part utilized in machinery.

Artifact 132-001.59 contains many features to suggest it was the base of a three-part bearing block for a larger piece of machinery (Figure 103). Four hexagonal bolts near the center likely joined the artifact to the now missing bearing cap. The interior is hollowed out in a rectangle that follows the shape of the exterior. Across the hollowed out center, there are three semi-circles on each outside wall. If this was a bearing block, then the missing upper section likely had matching semi-circles to seat the shafts or rollers the artifact intended to bear. The outer semi-circles are smaller and retain wrought iron axle-and-roller elements that are now fused to the cast iron lower bearing. The center larger semi-circles are open, indicating that the object they supported is now

Figure 102. Unidentified cast iron pedestal-like object (Artifact 132-001.51; scale cm.).

Figure 103. Unidentified small bearing block (Artifact 132-001.59; scale cm.).

lost. The surviving axles and rollers may have assisted in rotating a belt of some sort through the machinery. The exact function of the entire assembly remains speculative.

Boilers

During the mid-19th century, numerous types of boilers were utilized in maritime navigation. The return flue boiler was one of the most common designs used in the United States because it was simple and relatively easy to maintain. In return flue boilers, the firebox generally consisted of one or more furnaces arranged side by side (Figure 104). The furnaces were divided by cast iron bars creating an upper and lower section. The top section was where the fuel was placed and the fire burned. This upper portion was accessed through a hinged port, known as the fire door. Behind the door, the bars, known as fire grates were laid out perpendicular to the boiler's front and angled slightly downward towards the back of the boiler. Typically, the fire grates were packed together in two rows (smaller boilers had one row) with only enough room between them to allow for heat expansion of the grates. Three long cast iron bars known as bearing bars supported the two rows of fire grates. The forward bar was called the dead plate, while the other two were the middle and rear bearing bars. The lower section of the furnace was called the ash pit (Main and Brown 1865:52). Spent fuel fell through openings in the fire grates and collected within this area. Some, but not all boilers contained a door over this opening as a means to help control the fire's draft.

Heated gases from the furnaces left the firebox and traveled through large flues within a rear tubular section of the boiler, known as the boiler barrel. Near the back of

Figure 104. Cutaway of return flue boiler from the blockade runner *Denbigh*
(Image courtesy of Andrew Hall and the Institute for Nautical Archaeology).

the barrel, the flues joined together in a combined space called the combustion chamber. This space allowed for further combustion of the fuel, which aided the heat transfer in the back of the boiler. The heat travelled upwards within this chamber, before returning to the front of the boiler through a series of smaller flues, known as fire tubes. The remaining heat, gases, and any residual burning ash vented upward, out of the boiler through a chimney flue, and finally away from the vessel through the smoke stack. The

smoke stack served two functions. The first being that the stack created a high point above the boiler, which enhanced the draft of the fires. The taller the stack, the more powerful the draft. This draft pulled or ripped the heated gases through the boiler, ensuring that the heat made contact with all the desired transfer points. The second function of the stack was to carry the smoke and any remaining burning embers away from the vessel at a safe height. This also had an aesthetic benefit, in that the stack prevented the smoke and ash from staining a vessel's painted woodwork.

The boiler barrel was filled with water to the optimal level of 12 in. (30.5 cm.) above the fire tubes (Bartol 1851:1). Heat transferred from both the lower flues and the upper fire tubes into the water, eventually bringing the water to a boil. Steam gathered in the upper portion of the barrel and travelled into a higher drum, where it was directed to the engine through the main steam pipe. As technology improved, boiler manufacturers discovered additional ways to maximize the heat transfer into the water. Like the flues, fireboxes eventually became encased in water on several or all sides. This encasement covered the front of the firebox, as well as portions of the rear firebox wall that lay outside the diameter of boiler barrel. This was achieved by securing a water tight encasement or water jacket around the surfaces intended to transfer heat. Constructed in the same manner as the furnaces, the water jacket incorporated numerous iron sheets that were riveted together. Staybolt fasteners secured the furnace walls to the outer jacket. Fireboxes that utilized jacket encasements can be divided into two classifications, dry-bottom boilers and wet-bottom boilers. On dry-bottom boilers, the water jacket terminated at lowest level of the firebox. This created a series of water-filled legs at the

boiler's base, typically one on each side of the boiler, and one dividing each furnace. Although this type of encasement was very common, very little water circulated within the legs, leading to a buildup of sediment and corrosion. To prevent this, engineers onboard ships often filled the legs with cement up to the level of the fire grates (Unidentified 1902:521). Wet-bottom boilers also contained water legs, but improved the circulation by continuing the water jacket underneath the furnaces. Each furnace contained rounded lower edges to help facilitate the movement of water, and prevent sediment build up in any one location. This design enabled the firebox to be suspended within the front of the boiler and to disperse heat to all six sides of the box.

Most return flue boilers in the mid-19th century operated at pressures between 40-50 lbs. (18.2-22.7 kg.) per square inch (Whittier 1983:18). These were considered low pressure boilers as opposed to their western river counterparts that reached pressures as high as 125 lbs. (56.7 kg.) per square inch (Hunter 1943:214). In the event of a rupture, the superheated pressurized water instantly converted to steam, multiplying in volume by 1700 times, often resulting in a violent explosion (Bates 1996:9). To prevent distortion that could lead to a rupture, boiler manufacturers tried to limit the amount of flat plates on a boiler. Rounded plates such as those found on the outer shell of the boiler barrel, or the top of the firebox, maintained their shape as they expanded under pressure. However, the front and back portions of the firebox, as well as the back of the boiler barrel were flat. Under pressure, these plates could easily expand outward, buckle, and rupture, leading to a boiler explosion. To prevent this occurrence, staying devices were utilized throughout the boiler on flat surfaces or other areas that were considered to be

under heavy strain. These staying devices created an internal web of crisscrossing bars that enabled the boiler to safely expand and contract without jeopardizing the shape of its plates.

Hinged doors were built into the front of the fireboxes for accessing fire grates and ash pits. Other doors were required to access the front portion of the upper fire tubes and the bottom of the rear combustion chamber; these doors were within the draft zone from the boiler's fires and could only be opened for cleaning purposes when the boiler's fires were extinguished. Opening doors to the fire tubes or combustion chamber when the boiler was in operation would have created an immediate (and possibly deadly) evacuation point for heated gases.

Additional access to the boiler's interior was achieved through hand holes and man holes. These openings facilitated access to areas of the boiler normally under pressure where water was held or steam collected. To withstand the pressure, both types of openings utilized thick cast iron cover plates. The plates were mounted in the boiler's interior and held in place by an inner lip that projected out of the hole, thus preventing the plate from sliding out of position. Around the lip, a heavy rubber gasket ensured a tight seal when under pressure. A bolt passed through the back center of the plate, out of the boiler, to an arched handle. The handle was tightened down against the outer boiler wall by securing a nut. When the handle and nut were in place, the cover did not move. These covers were elliptical in shape, so that when not under pressure, they could be removed and passed through the hole to the outside of the boiler.

Hand holes and man holes were needed for routine maintenance, because over

time sediment and scale built up in crevices and on top of the flues. If such debris was not periodically removed, corrosion could damage the internal components of the boiler. Hand holes were used as small cleaning ports for removing sediment with long scrapers, rods, or brushes. Typically, these holes were placed at all corners of the firebox, on the water legs, and between and next to the arches above the furnaces. Man holes allowed a fireman to physically enter into the water and steam chambers of the boiler. These entry points were commonly placed at the top of the boiler barrel, the back of the boiler barrel, or sometimes at the widest point of the arches between the furnaces. Upon entering the boiler, navigating from one point to another was a very difficult job due to the numerous staying devices that crisscrossed the interior. One fireman recalled:

> Being a slim lad, one of my duties was to creep into the boilers through the man hole, which was just large enough to let me through; and with a hammer and a sharp-linked chain I must "scale" the boilers by pounding on the two large flues and the sides with the hammer, and sawing the chain around the flues until all the accumulated mud and sediment was loosened. Scaling boilers was what decided me not to persevere in the engineering line. To lie flat on one's stomach on the tip of a 12 in. (30.5 cm.) flue, studded with rivet heads, with a space of only 15 in. (38.1 cm.) above one's head, and in this position haul a chain back and forth without any leverage whatever, simply by the muscles of the arm, with the thermometer 90 degrees [32.2 Celsius] in the shade, was a practice well calculated to disillusion any one not wholly given over to mechanics (Merrick 1909:37).

Westfield*'s Boilers*

Archival evidence has not provided information on the type or number of boilers aboard *Westfield*. However, one firsthand account from USS *Clifton* implies that the vessel had two boilers. A letter from Acting Lieutenant E. H. Baldwin, to Commander D. D. Porter, of the Bomb Flotilla, refers to battle damage sustained to *Clifton*'s "starboard boiler" and mentions how the damaged boiler would be out of service for ten days and as a result the vessel could only make six knots. This statement is a clear indication that there was still a second functioning boiler. A second letter to Flag-Officer D. G. Farragut confirms this information, where Porter provides an update to his superior that *Clifton* was "temporarily repaired" and now "working under one boiler" (U.S. House of Representatives 1863:396, 410).

Since *Westfield* and *Clifton* were built together at the same time, and following the same design, it is reasonable to assume that both vessels contained the same type and number of boilers. Secondary source information from a British naval engineer suggests that both *Westfield* and *Clifton* utilized dual return flue boilers. The engineer noted: "They were 224 ft. [68.3 m.] long, 34-1/2 ft. [10.5 m.] beam and 13 ft. [3.96 m.] deep, tonnage 977 tons [886.319 mt.]. They had a single beam engine, cylinder 50 in. [1.27 m.] diam. by 10 ft. [3.05 m.] stroke, paddle wheels 22 ft. [6.71 m.] diam. by 9 ft. [2.74 m.] face; two return flue boilers, grate surface 97 sq. ft. [9.01 sm.], heating surface 2706 sq. ft. [251.4 sm.], steam pressure 30 lbs. [13.61 kg.], cutoff at half stroke, revo. 26 per min., speed 16 miles an hour" (Main 1893:133). Most of this information closely follows what archaeologists believe to be true about *Westfield*. Archival evidence offered that

Westfield's lower hull 213 ft. 4 in. (65 m.) by 34 ft. (10.4 m.) by 12 ft. 11 in. (3.94 m.) at 891 tons (808.302 mt.)(Williams 1861; Borgens et al. 2010:Appendix A-1). Only after rescaling a lines drawing of *Southfield* II to fit these measurements, were archaeologists able to determine that *Westfield*'s overall superstructure measured 225 ft. (68.6 m.). These measurements only differ from Main's measurements by minor proportions of a foot (30.5 cm.) or less. This suggests that Main had access to reliable information and therefore his statement about *Westfield* and *Clifton*'s boilers is likely trustworthy.

Main's statement that the boilers used were of the return flue type is not surprising. *Westfield* and *Clifton*'s later replacements on the ferryboat circuit in New York City, *Westfield* II and *Clifton* II, both contained a single large return flue boiler. *Westfield* II's single boiler was mentioned following a rupture that caused a catastrophic explosion, killing many of the passengers (*Harper's Weekly* 1871; *New York Times* 1904:6; Stiles 2009:514). *Clifton* II's boiler was extensively documented by the Navy's Chief Engineer for the Bureau of Steam Engineering. This was done after the vessel was purchased by the Navy and renamed USS *Shockokon* (Isherwood 1865:207-223, plate VII). The single boiler contained three furnaces and measured 12 ft. (3.66 m.) wide by 24 ft. (7.32 m.) long, with a rear boiler barrel diameter of 10 ft. (3.05 m.). While this information does not clarify how many boilers the first *Westfield* contained, the information at least confirms that the Simonson-built ferries utilized return flue boilers.

Although *Westfield* was extensively destroyed, salvaged, and cleared, the excavation offers more clues about the number of boilers. Most of the larger recovered artifacts from the wreck site are boiler related objects. Yet, the hundreds of artifacts

combined barely account for one boiler, much less two. Additionally, only one firebox was recovered (Artifact 132-001; Figure 105 and 106). The recovered firebox measured 9 ft. 3 in. (2.82 m.) wide and contained two furnaces. Four recovered boiler mounts (Artifacts 105-005, 119-018, 119-024, and 120-003; Figure 107), show that the rear boiler drum contained a diameter of approximately 8 ft. (2.44 m.). These measurements indicate that the boilers were much smaller than the type found on *Westfield* II and *Clifton* II. Since the first *Westfield* was much larger than both of those vessels, a single boiler would not likely have produced the amount of steam required for the engine cylinder.

The most significant and clarifying evidence comes from remnants of the fire doors and a single section of riveted plating. One mostly complete fire door (Artifact 120-063) was recovered as well as two separate fire door back plates (Artifacts 119-020 and 131-014; Figure 108). The idea of a spare fire door is unlikely, and therefore the third back plate likely came from a second missing boiler.

A section of riveted plating clarifies how the two boilers were originally joined together. Unlike other recovered boiler plates, this small fragment (Artifact NP-50) contained not only a folded riveted seam, but a reinforced underlying plate secured by square-headed bolts (Figure 109). An example of this type of plate can be found on an image of *Clifton*'s upper steam drum, photographed over 70 years after the vessel's sinking (highlighted in Figure 110). This image offers considerable information about how the boilers were constructed. Following manufacture, the boilers were individually lowered and mounted into *Clifton*'s hull. Based on this image, each boiler contained half

Figure 105. Remains of the lower firebox (Artifact 132-001).

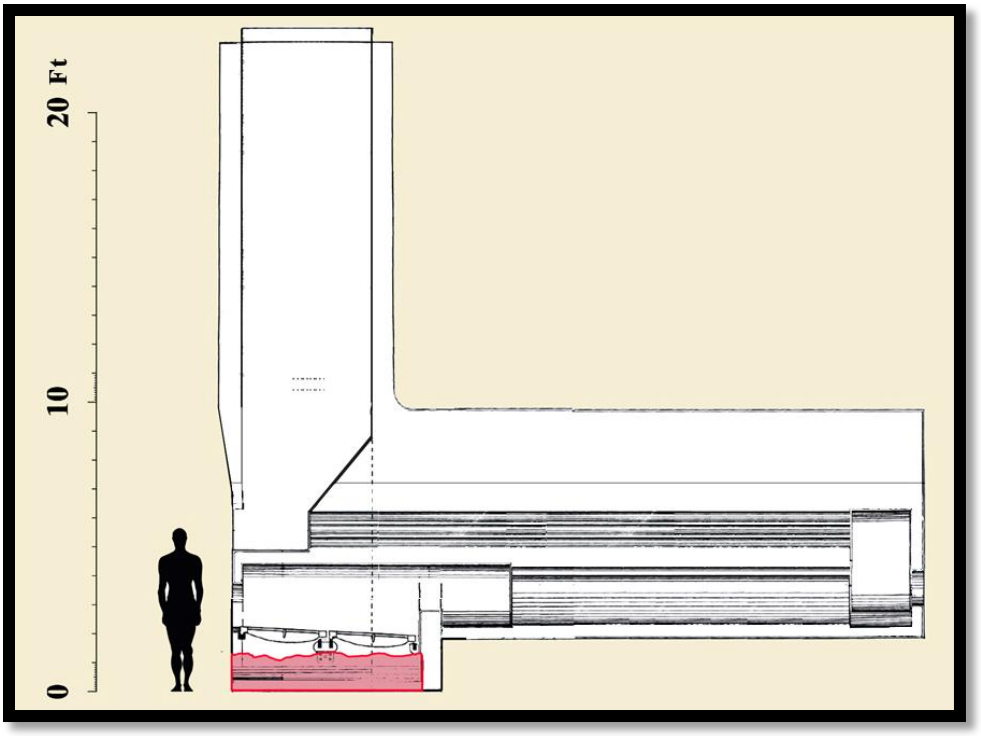

Figure 106. Remains of the lower firebox in context (Artifact 132-001).

Figure 107. Boiler mount (Artifact 120-003; scale dm.).

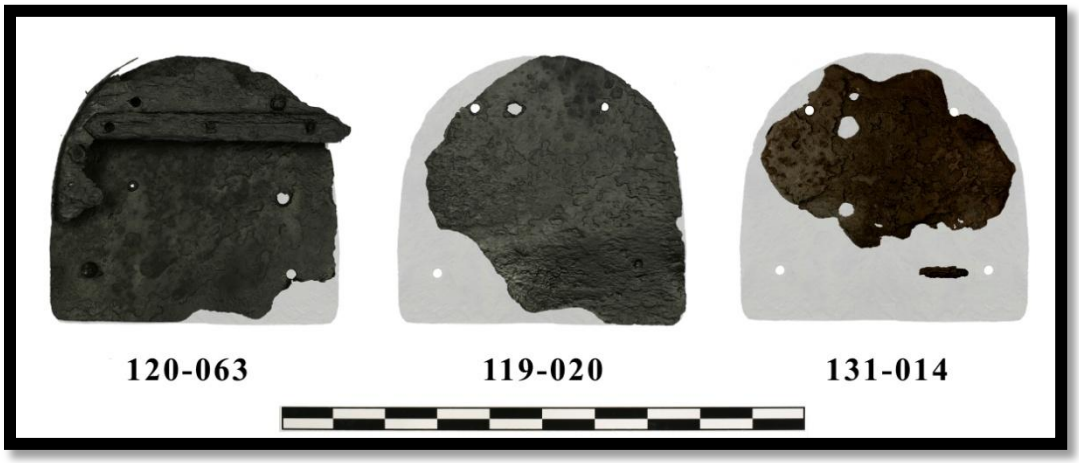

Figure 108. Fire doors (Artifacts 119-020, 120-063, and 131-014; scale dm.).

Figure 109. Riveted plate from steam drum (Artifact NP-50); scale inches.

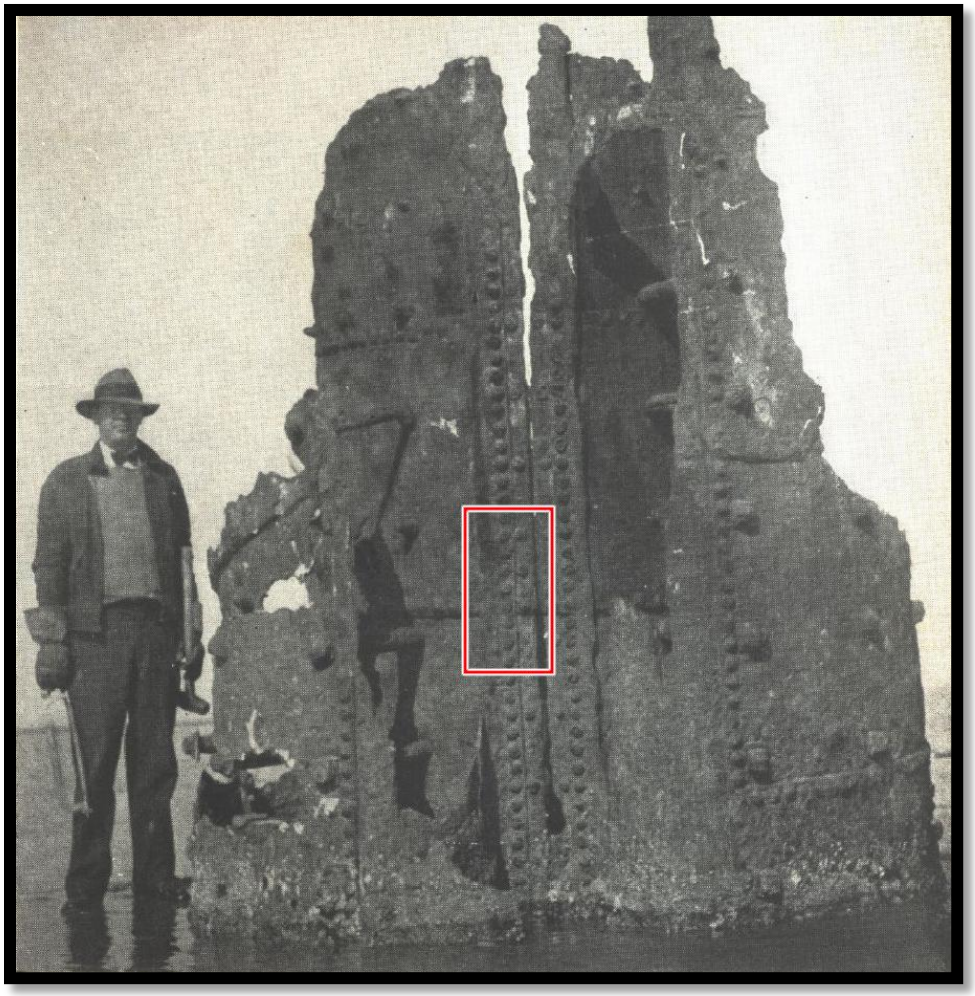

Figure 110. Remains of USS *Clifton*'s steam drum (Wilten and Dixon 1935:63).

Figure 111. Large staybolts from upper steam drum (scale inches).

of a shared upper chimney flue. The flue fed up and out of the vessel's central machinery compartment, before connecting to the single smoke stack. The two portions of the flue were joined together along a central seam, reinforced on both sides by square-headed bolts.

By this period, iron works often wrapped the steam drum around the upper flue as a final means to absorb heat before the remaining gases left the vessel. Additionally, this carried the steam higher, allowing excess water droplets to be removed before the steam entered the engine. Numerous large staybolts from *Westfield*'s wreck site indicate that the vessel utilized this type of steam drum (Figure 111). On the *Clifton* image, rather than completely encircling the flue, the plates of the steam drum abruptly curve inward, and are securely riveted before reaching the reinforced central seam. This indicates that each boiler utilized a separate steam drum compartment. While the other side of the drum cannot be seen within the image, the arrangement was likely identical to the one

found on the front. This would have created two distinct semi-circular steam compartments (Figure 112).

Reconstructing the Remaining Boiler

Historic charts indicate that part of *Westfield*'s boilers remained visible above water for several decades following the war, finally sinking out of sight during a hurricane in 1886 (Ziegler 1938:240). Like *Clifton*, this exposed portion of the boiler likely consisted of the upper flue and steam drums. Descriptions of the *Westfield* explosion do not recount the destruction of the boilers, although a second explosion might be alluded to in one account. That eyewitness recounted years later that "the machinery had not been destroyed, as the singing of the steam was distinctly heard after the explosion . . . for ten minutes, when there was another flash, and she was speedily wrapped in flames" (Scharf 1887:507-508). If Commodore Renshaw chained down the boiler safety valves as was described (Bosson 1886:112, *Boston Journal* 1863, *New York Times* 1863), the boilers would have eventually ruptured, leading to at least partial destruction and deformation. This damage may have been extensive, but not enough to account for the disarticulation of the boiler artifacts that were found widely dispersed across the site. Clearing of the site by the USACE's predecessor organization in 1906, which included the use of explosives, may account for the disarticulation, and the complete destruction of at least one of the boilers. The limited number of the boiler artifacts that remained, and the absence of a second firebox, implies that the other boiler was entirely removed from the site during that time.

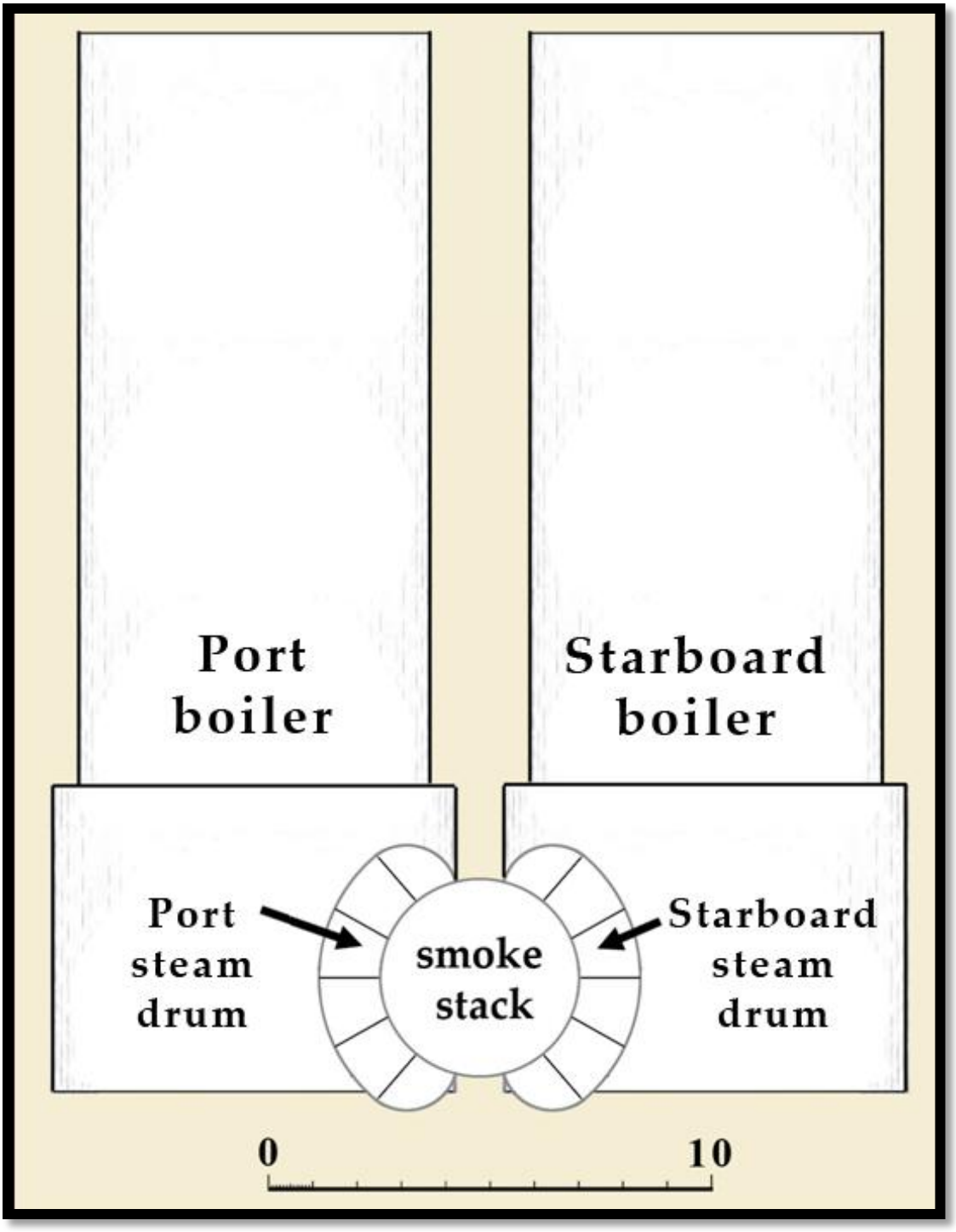

Figure 112. *Westfield*'s two boilers sharing a single smokestack,
yet with a divided outer steam drum; viewed from above (by author).

Enough diagnostic features survived on the artifacts that were recovered to determine how *Westfield*'s boilers were constructed. These include the firebox, a portion of the flues, fire grates, internal staying devices, various door types, cleaning hatches, and numerous types of riveted metal plates that represent different parts of the boiler.

Aside from boiler plating, the most abundant type of boiler artifact was internal staying devices. Due to the extreme pressures within the boiler, the internal structure incorporated many strengthening devices such as crowfoot fasteners, staybolts, and longitudinal and vertical supports. Figures 113 and 114 illustrate a replacement tubular flue boiler manufactured in 1902 for the U.S. revenue cutter *Perry* (Unidentified 1902:522-523). The boiler was unusual as, at the time of its construction, return flue boilers had been supplanted by newer, or more-efficient models such as the Scotch marine boiler and water tube boiler (Peabody and Miller 1894:9–10; Sheret 2005:31–34). The boiler for *Perry* was a modernized interpretation of the older boiler style, yet it incorporated the same design features and has helped identify artifacts from the *Westfield* site.

Crowfoot fasteners came in several variations. The majority are of the single type, made out of two pieces of rectangular boiler iron bent into a "T" shape. This was riveted to a boiler plate and then a staying rod with end loops was attached to the device. To secure the rod, a bolt was passed through the loops and the shaft of the "T" (Figure 115). Another type incorporated two longer boiler straps that were folded down on all four ends, creating a double crowfoot in the shape of a handle (Figure 116; Peabody and Miller 1894:92). Several big plates believed to have come from the lower portion of the

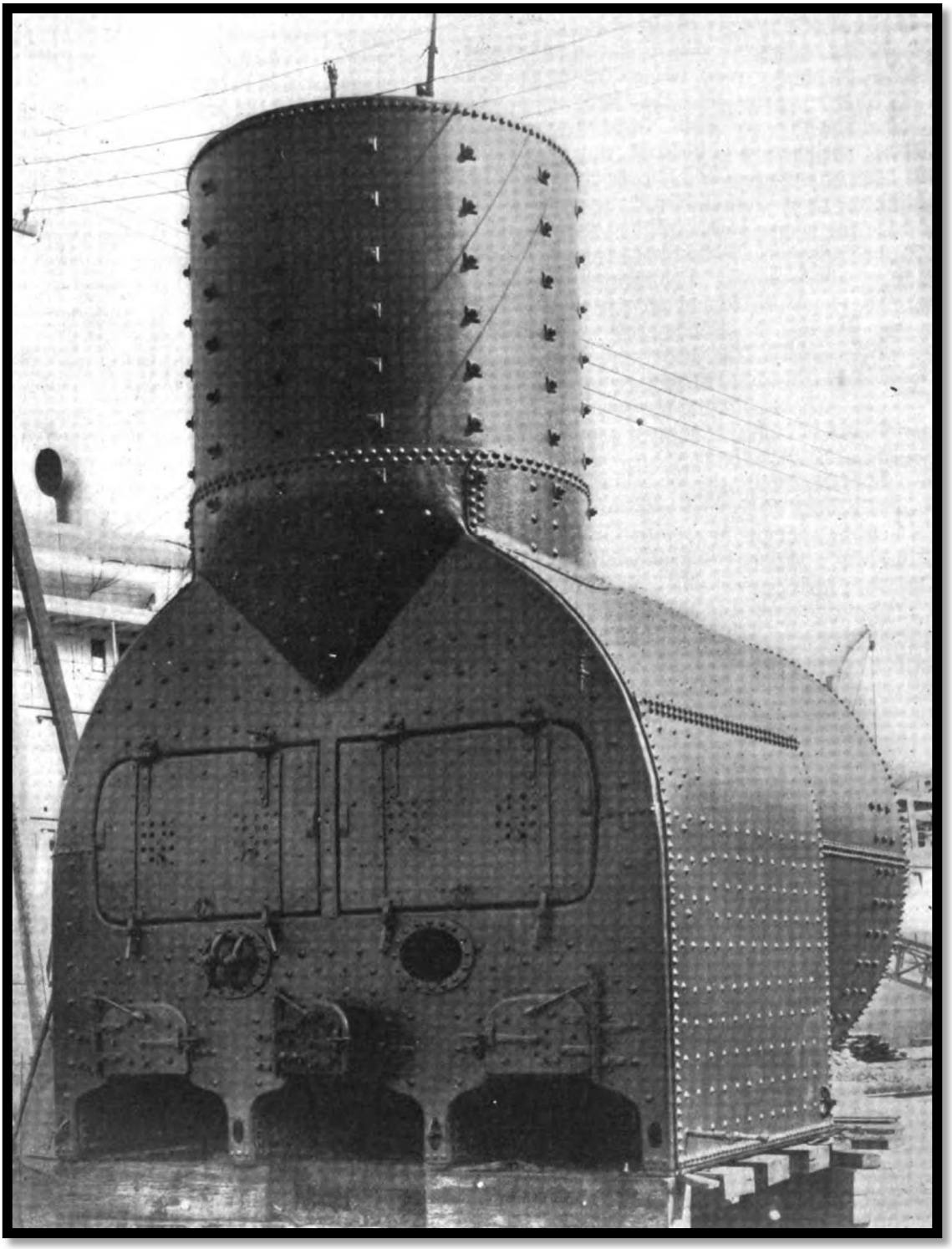

Figure 113. Return flue boiler from the revenue cutter *Perry* (Unidentified 1902:523).

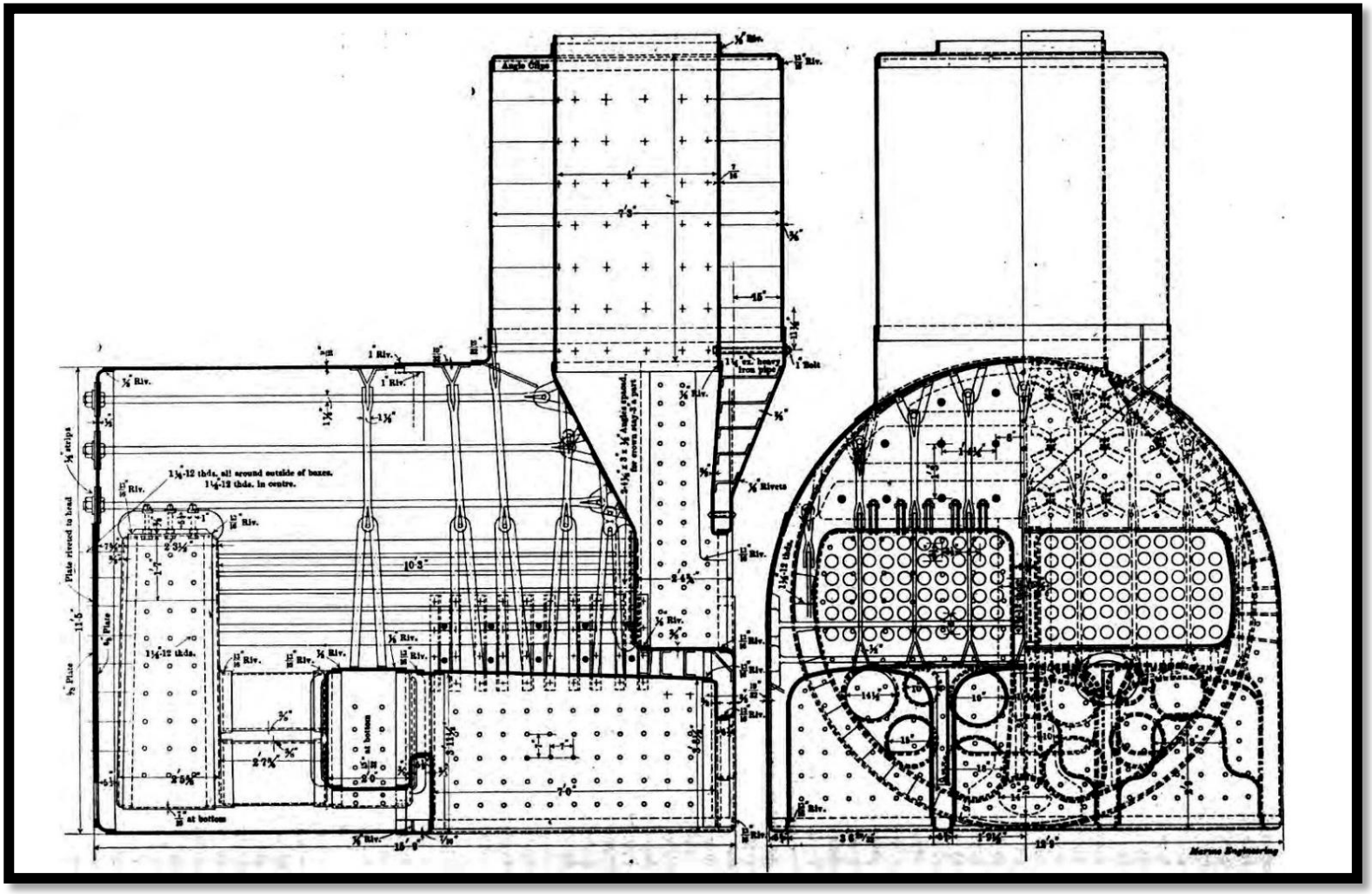

Figure 114. Interior schematic of staying devices within *Perry*'s boiler (Unidentified 1902:522).

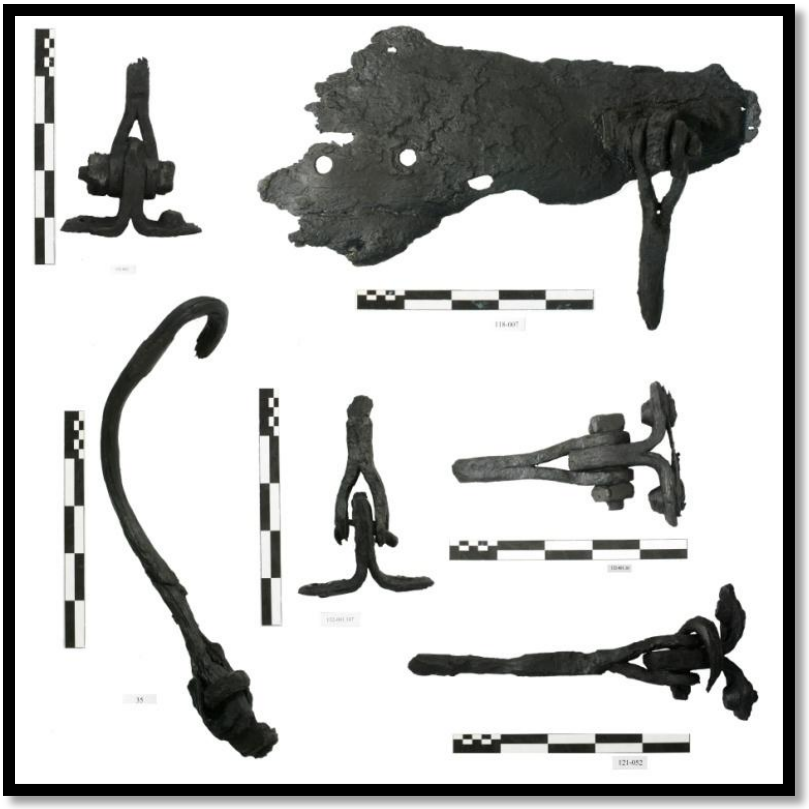

Figure 115. Crowfoot staying devices (scale cm.).

Figure 116. Handle-shaped double crowfoot with a hooked receiving rod (Artifact 132-001.49; scale cm.).

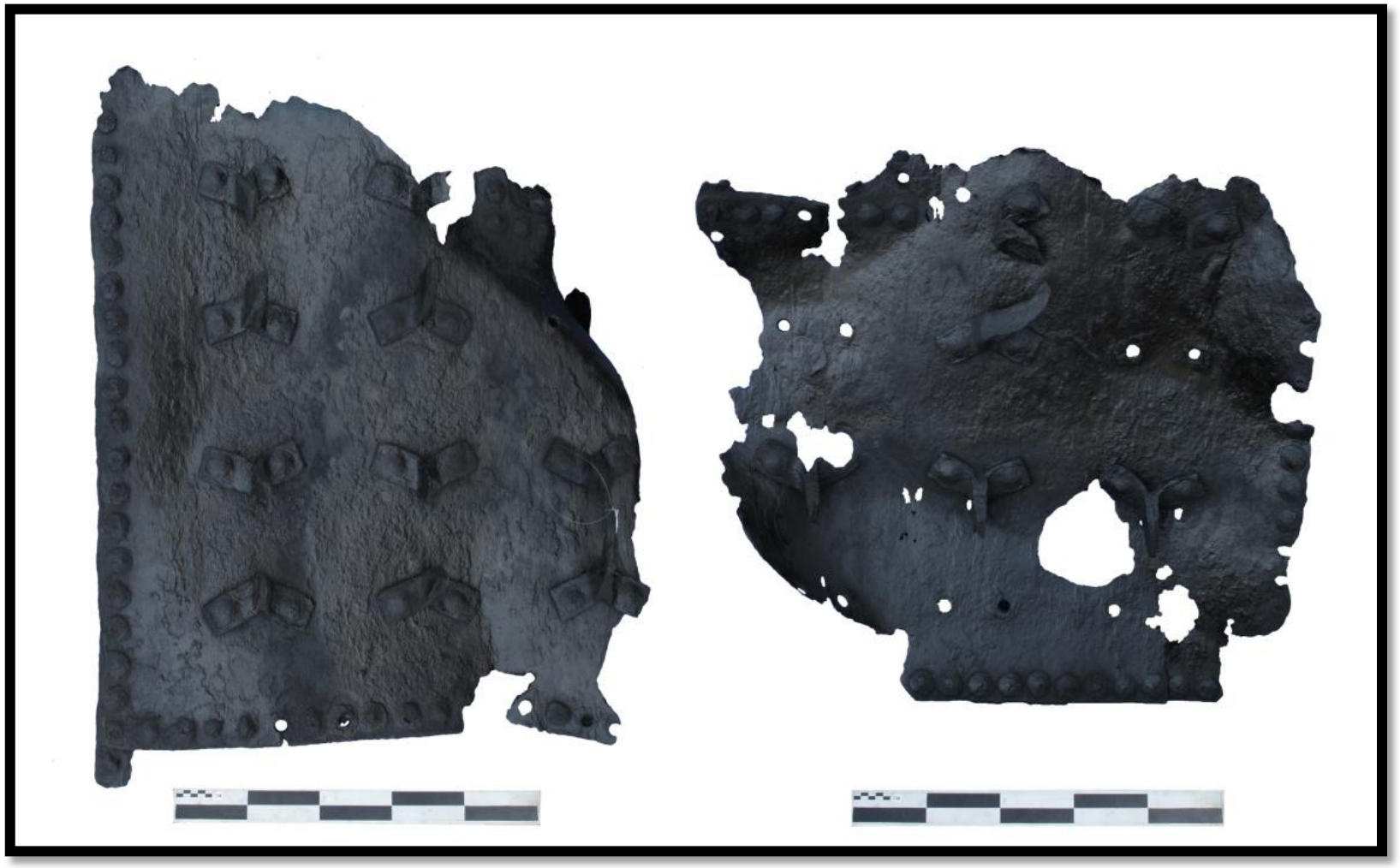

Figure 117. Large plates with double crowfoot handle attachments (Artifacts 109-003 and 121-013; scale cm./dm.).

chimney flue utilized many of these double crowfoot fasteners (Figure 117). The handle-like staying devices received vertical support rods attached to the crowns of the furnaces and the longitudinal supports that ran the length of the boiler. Another example consisted of a double crowfoot that was shaped like the cross section of an "I" beam. This type of fastener was used on the bottom of the boiler and supported heavier objects such as the firebox and rear combustion chamber.

The most complex object recovered was the base of the firebox (Figure 105). When the firebox was documented under the water in 2009, the fire grate assemblage had collapsed downward into the ash-pits due to the corrosion of the wall tabs that once supported the bearing bars. Despite this, the entire assemblage of both the fire grates and the lower bearing bars remained intact in the same manner as when they were originally in use (Figures 118 and 119). Only one quadrant of grates had shifted from its original position. This could have been due to either corrosion on the outer furnace wall or from damage during the 1906 demolition operations. The remarkably intact assemblage suggests that the box lay relatively undisturbed since the vessel's sinking. The firebox consisted of two furnaces, each measuring approximately 6 by 4 ft. (1.83 by 1.22 m.). This allowed for an internal grate surface of 96 sq. ft. (8.91 sq. m.), a measurement that is close to Main's stated measurement of 97 sq. ft. (9.01 sq. m.)(1893:133). The furnaces were connected to one another and to the outer water jacket by a series of staybolts spaced 8-1/4 in. (2.51 m.) apart horizontally, and 7-1/4 in. (2.21 m.) apart vertically. This arrangement created three water legs, one between the furnaces, and one on each side of the firebox. During the recovery, the far right water leg broke off just above the

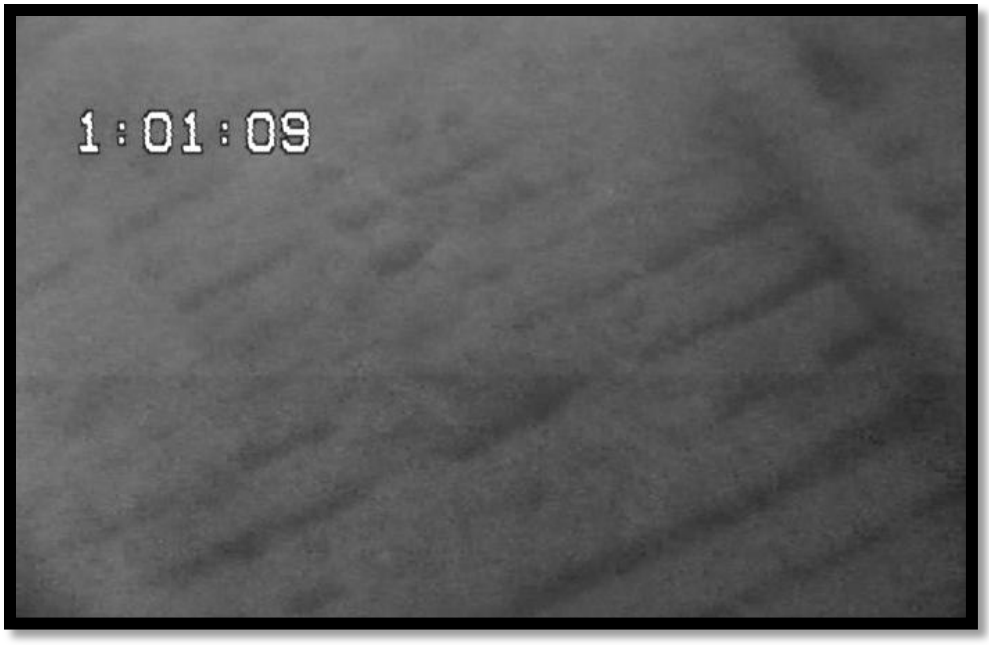

Figure 118. Underwater image of intact fire grates *in situ* (Image courtesy of Atkins Global).

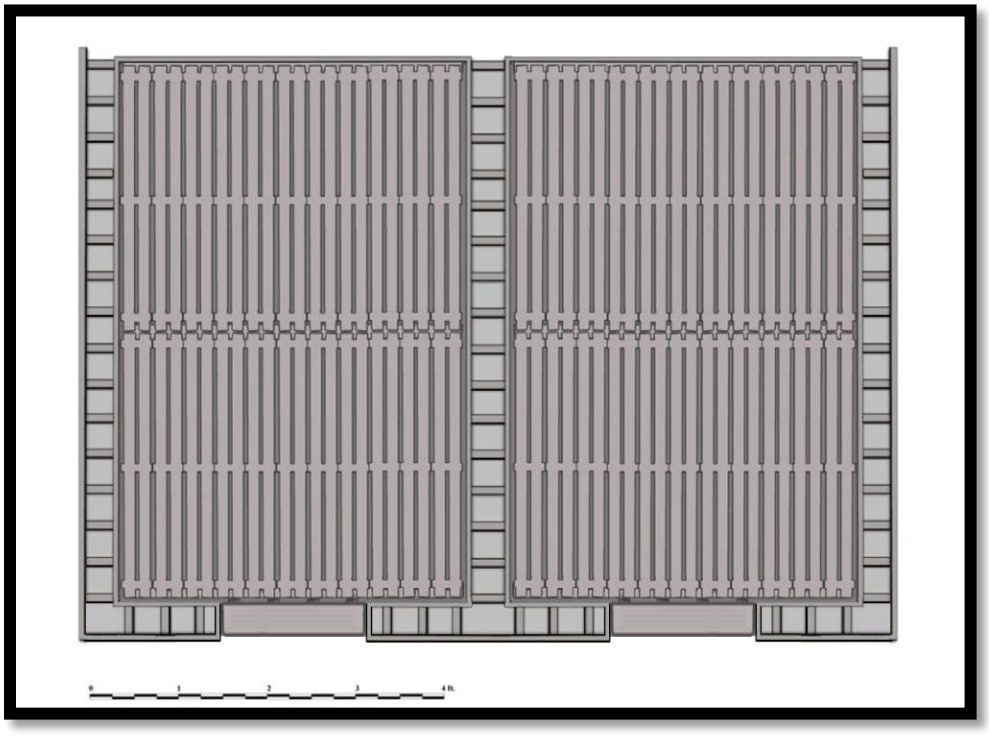

Figure 119. Reconstruction of the fire box with rows of fire grates and forward bearing bars (Scale inches; drawing by Amy Borgens; modified by Justin Parkoff).

lower curve on the firebox. This artifact (132-001.79) was conserved as a large representative example to show how the staybolts connected the furnace wall to the outer water jacket (Figure 120). Underneath the furnaces and the water legs, the staybolts transitioned to double-ended crowfoot fastener brackets that were arranged in four rows per furnace, with nine brackets per row (seventy-two total). These brackets were much like the staybolts and were secured by four rivets, two on top and two on bottom, to join the outer water jacket to the bottom of the furnaces (Figure 121). The transition to these fasteners was likely necessary to prevent the furnaces from shifting under the weight of the fire grates, which may have happened if the furnaces stood on top of cylindrical staybolts, rather than flat-surfaced brackets.

Numerous hand holes permitted access to different parts of the water jacket surrounding the firebox for occasional cleaning. Exactly where these hand holes were placed on *Westfield*'s boilers is speculative. Yet as mentioned earlier, convenient placements would have positioned many on the corner edges of the firebox, on the water legs, and between and next to the arches above the furnaces (Figure 122). The plate on the hand hole could be removed when the boiler was not pressurized. This was done by unthreading a nut and removing the securing handle. Three different sizes of hand hole covers were recovered. The smallest measured 6-3/8 in. by 4-3/8 in. (16.2 by 11.1 cm.). While the cast iron was in relatively good condition, the handle did not survive (Figure 123). The middle size measured 7-5/8 in. by 5-5/8 in. (19.4 by 14.3 cm.). This type used a double-arched handle, which looks like an "X" (Figure 124). The larger size measured 10-1/8 in. by 7-5/8 in. (25.7 by 19.4 cm.). The handle on this version was singular,

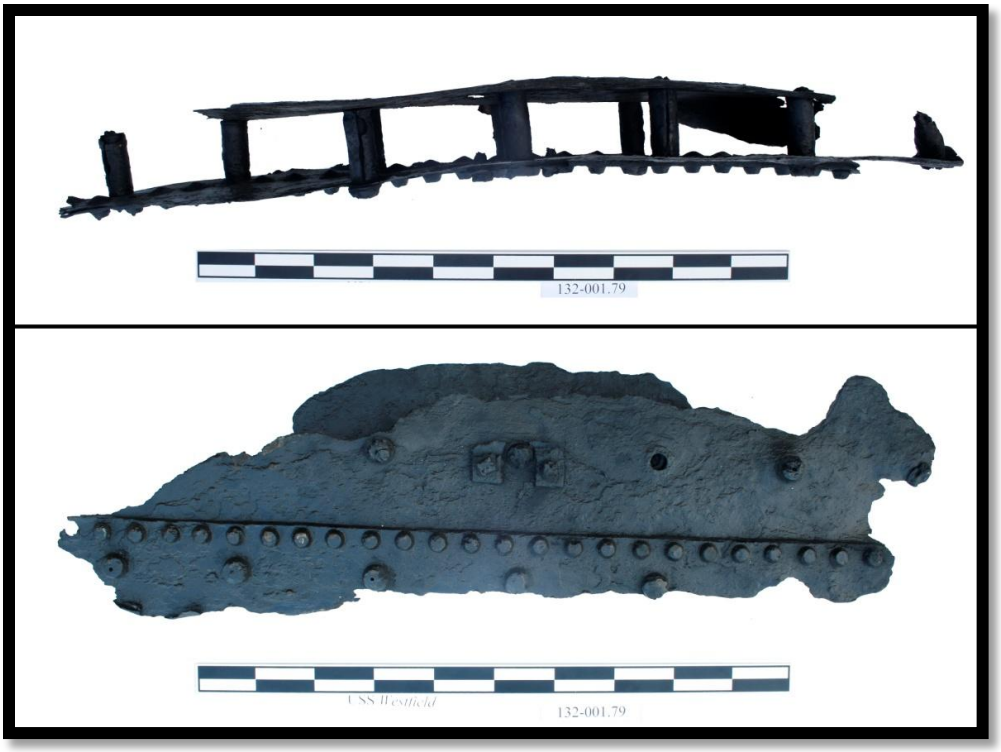

Figure 120. Right water leg of the boiler (Artifact 132-001.79; scale dm.).

Figure 121. Double-ended crowfoot fastener (Artifact 132-431; scale cm./dm.).

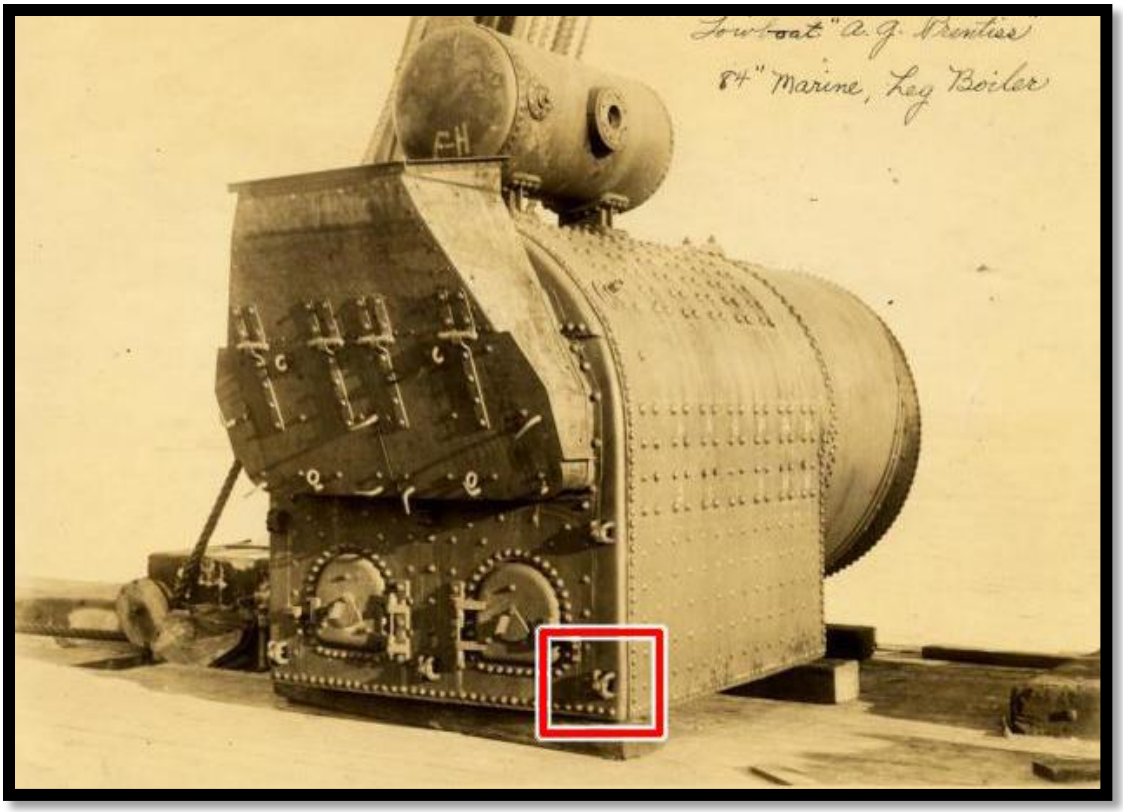

Figure 122. Examples of hand holes on water legs (Image of boiler from *A. G. Prentiss* (Image courtesy of the Maine Historical Society; reference # Collection. 242 B40a 5-12).

Figure 123. Smaller sized hand hole cleaning cover (Artifact 132-001.55; scale cm.).

Figure 124. Medium sized hand hole cleaning cover (Artifact 118-178; scale cm.).

Figure 125. Larger sized hand hole cleaning cover (Artifact 120-053; scale cm.).

consisting of only one arch (Figure 125).

A similar, yet much larger version of these artifacts was known as a man hole. This artifact type permitted a person to enter into the boiler's interior. Two of these large openings and their covers were recovered (Artifacts 119-019 and 122-042). In general appearance, man holes resembled hand holes, but were considerably more reinforced (Figure 126). The back plates measured 14-1/2 in. by 12 in. (36.8 by 30.5 cm.). Both of the recovered man hole covers contained a single arched handle. Rather than just relying on the handle to secure the covers in place, the entire back plate was secured against a thick wrought iron lip that was rivet down onto the boilerplate. One of these man hole covers (Artifact 119-019) is believed to have come from the rear of the boiler barrel (Figure 127). The artifact still retains a large piece of boiler plating complete with a rounded strap of rivets (Figure 128). A third man hole was indirectly identified. Knowledge of the object's former presence can be found in two cast iron fragments (Artifacts 131-019 and 132-001.56) that once formed the man hole's frame (Figure 129). This missing man hole is also believed to have come from the boiler barrel, specifically on the top. These artifacts suggest the original shape was oval. Yet, while the tops of these artifacts are flat, their bases are arched, indicating that they were mounted to a cylindrical surface. An identical example of this frame can be seen on the boiler plan for the USS *Commodore Barney* (Figure 130).

Although the water jacket is heavily distorted, the overall front width of the boiler can be determined by adding the plate thicknesses together, the length of the staybolts, and the width of the furnaces. Based on core samples taken from plating that

Figure 126. Man hole access hatch into boiler (Artifact 122-042; scale cm./dm.).

Figure 127. Man hole access hatch from rear boiler barrel (Artifact 119-019; scale dm.).

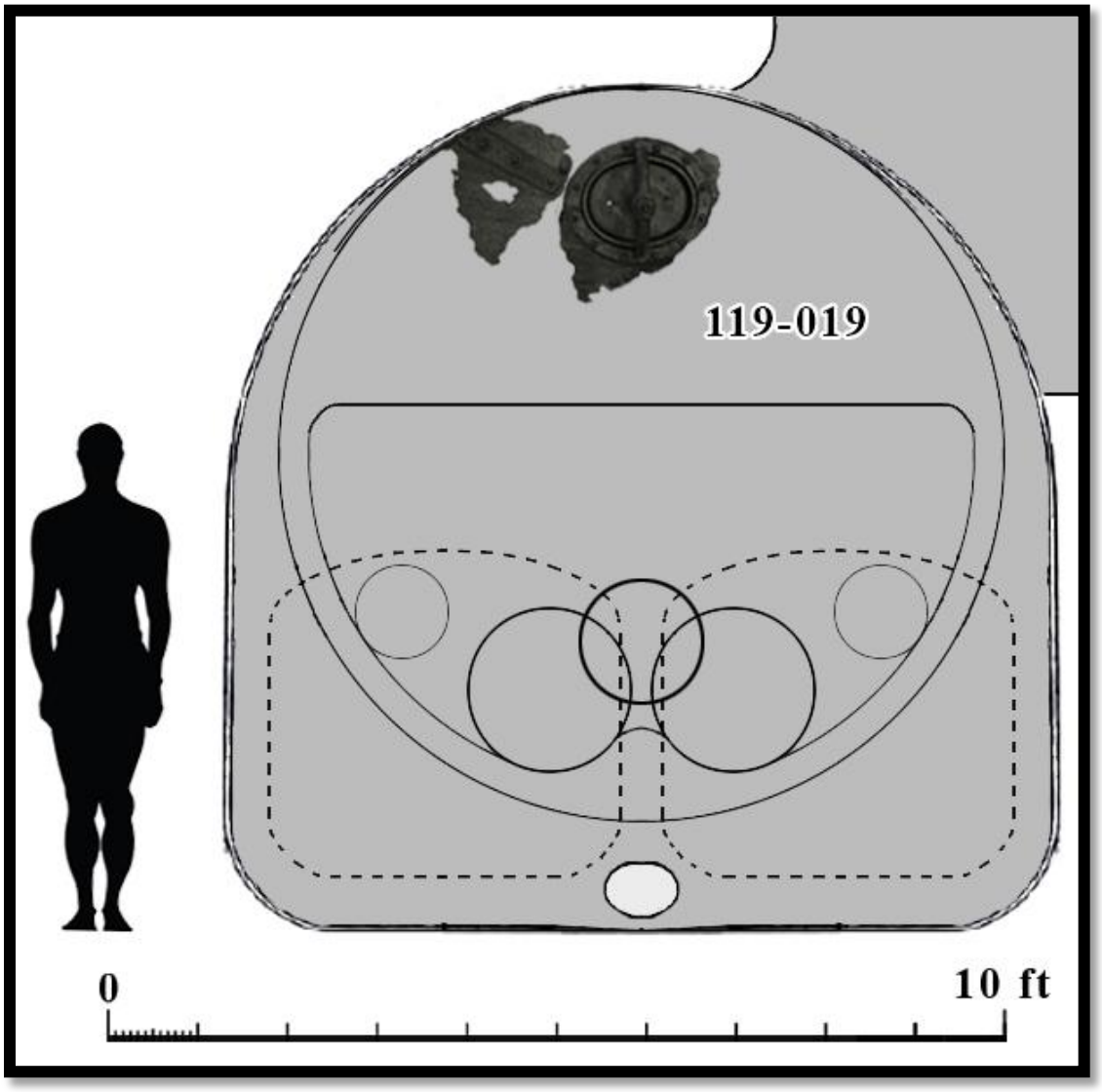

Figure 128. Man hole access hatch from rear boiler barrel in context; viewed back to front; Artifact 119-019 (by author).

Figure 129. Fragments of man hole frame from
top of boiler barrel (Artifacts 131-019 and 132-001.56).

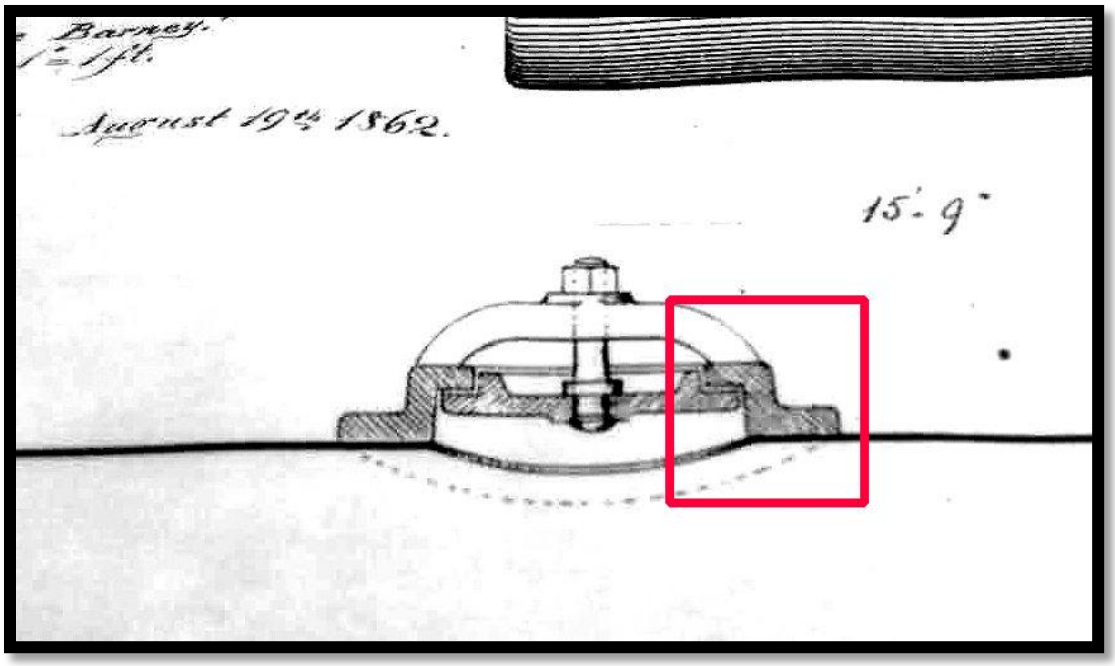

Figure 130. Plan of boiler barrel access hatch from Civil War
steamer USS *Commodore Barney* (Isherwood 1865:plate XIV).

was protected, (plates that were sandwiched between other plates), the lower firebox utilized plating 5/16 in. (7.94 mm.) thick. This thickness needs to be multiplied by 6 to account for the outer water jacket on the left and right side of the boiler, and the walls of each furnace. The staybolts on each side of the boiler contained a sleeve that evenly separated the water jacket from the furnaces. These sleeves measured 4 in. (10.2 cm.) long (multiplied by 2 for both sides of the boiler). Between the furnaces, longer staybolts sleeves measured 5 in. (12.7 cm.) long (see Figure 131 for side by side comparison). Both furnaces individually measured 48 in. (1.22 m.) wide. Combining these measurements, the reconstructed front of the boiler measures 9 ft. 3 in. (2.82 m.). Although the length of *Westfield*'s boilers cannot be confirmed archaeologically, this width corresponds with a naval proposal to construct purpose-built ferry gunboats comparable in size to *Westfield* and *Clifton*. The proposed gunboat boilers measured 9 ft. 3 in. (2.82 m.) wide by 24 ft. (7.32 m.) long (U.S. Navy Department 1862). *Westfield*'s boilers were likely of a similar length.

Inside the firebox, each furnace contained two rows of fire grates, with 12 grates in each row (Figure 119). The grates measure 3 ft. (0.914 m.) long by 4 in. (10.2 cm.) wide and are 5 in. (12.7 cm.) thick at the midsection, tapering to 2-1/2 in. (6.35 cm.) at each end (Figure 132). Several of the bearing bars were successfully recovered from underneath the two rows of grates. These bars are similar in shape to a fire grate, with the exception of being longer and solid to support a greater weight (Figure 133). Each bar rested on tabs that were riveted to the furnace walls. The best preserved example of one of these tabs can be found on the surviving water leg, Artifact 113-001.79 (Figures

Figure 131. Examples of fire box staybolts
(Artifacts 132-001.64 and 132-001.67).

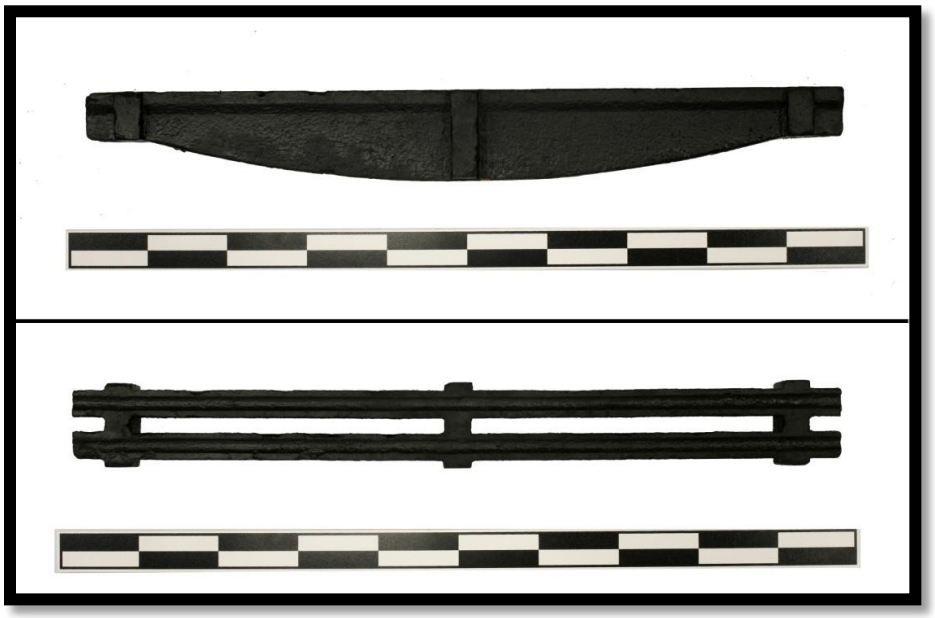

Figure 132. Example of fire grate (Artifact 132-001.02.1.01; scale dm.).

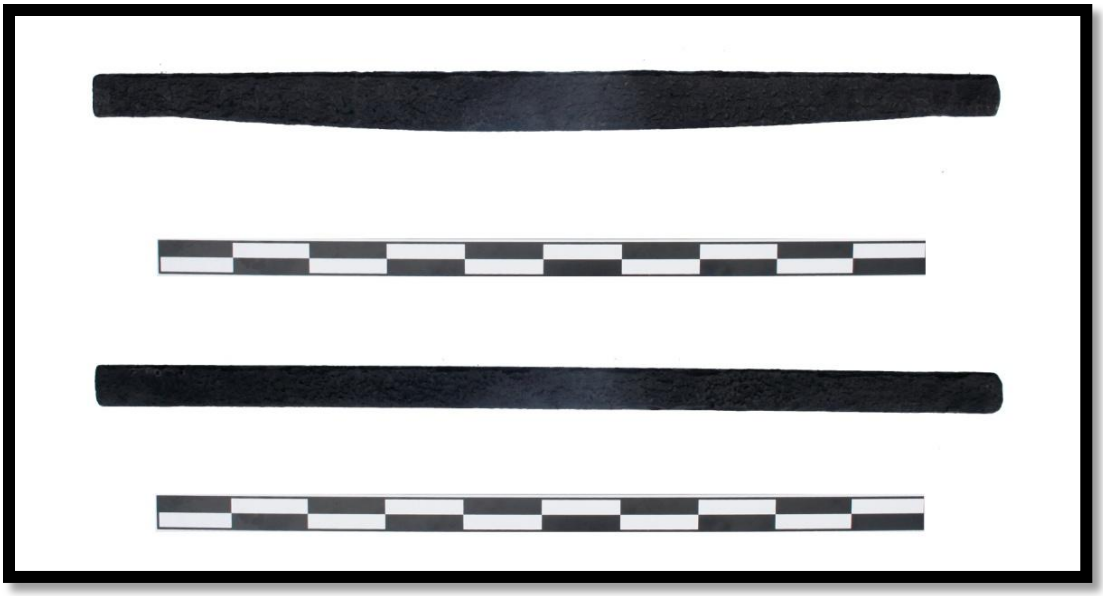

Figure 133. Example of center or rear bearing bar (Artifact 132-001.02.6.01; scale dm.).

Figure 134. Broken tab for supporting bearing bars (close up shot from water leg; Artifact 132-001.79; also seen in Figure 120).

120 and 134). The lower portion of the tab is secured to the water leg with two square-headed bolts. Although broken, the tab appears to have once bent outward into the furnace to support the end of a bearing bar. How the bar stayed on the tab without sliding forward or aft is not clear.

The forward bars or dead plates offered a significant amount of information on how the shape of the inner fire door frames related to the lower ash pits. On some boilers, the openings for the fire doors and the ash-pits were separate openings within the forward water jacket (Figure 135). On other boilers, the fire door frames and the ash-pit frames retained their necessary shapes, but connected together as a single opening that was bisected by the dead plate bearing bar. The dead plate bars from *Westfield* incorporated a shelf that extended out into the water jacket (Figures 136 and 119). This shelf indicates that the lower fire doors and lower ash-pits on *Westfield*'s boilers were joined and were only functionally separated by the dead plate bars. The extended shelf on the dead plate bearing bars was likely utilized as a place for the firemen to rest their shovels or stoking tools.

If the lower ash-pits were individual openings, the openings would normally adopt a flat-sided oval shape or a rectangular frame. When the lower ash-pit and upper fire door frame joined as one, the shape of the opening required a frame that merged between the two shapes. Artifact 120-279 contains a unique shape unlike any other found within the boiler artifacts (Figure 137). The top plate contains a line of rivets that are purposely placed to help fold an underlying plate into a distinct shape. The curvature of the underlying plate indicates that the artifact came from part of the outer water

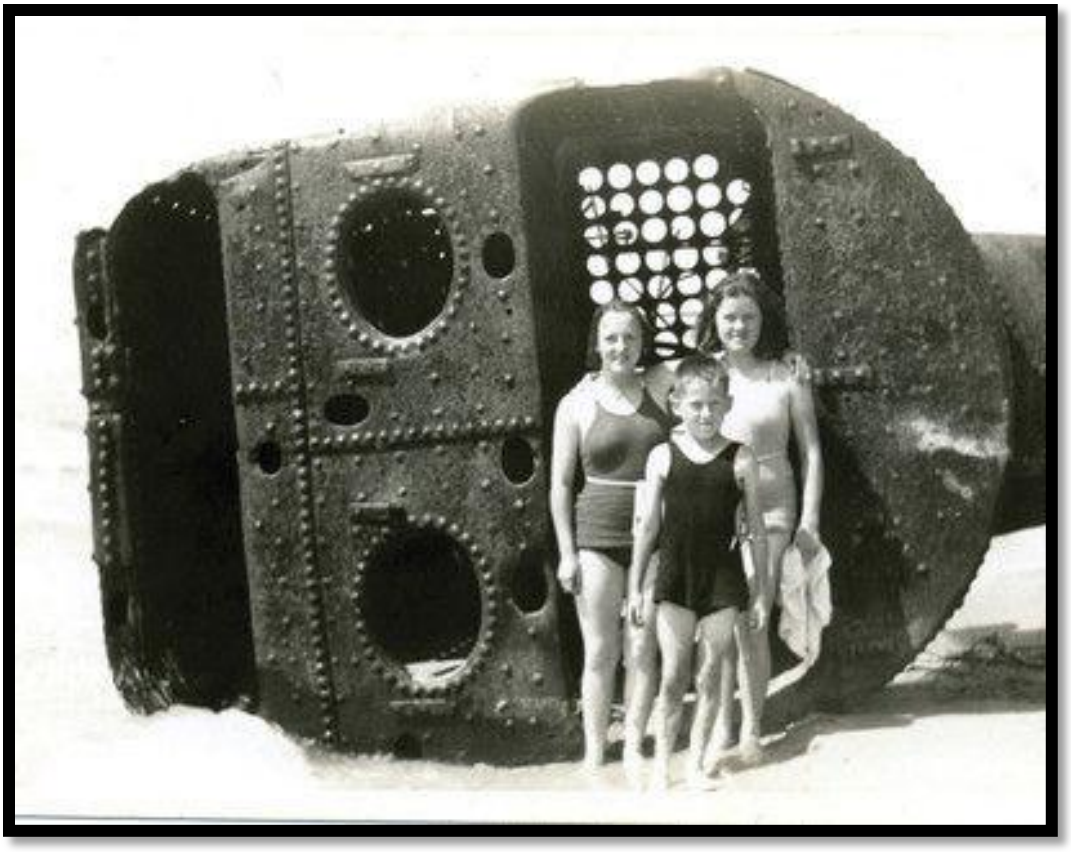

Figure 135. Tipped over boiler with separate fire door and ash pit frames (Image of boiler from *Erie Belle* shipwreck, located in Lake Huron; courtesy of Kathryn Houston and the Walker House Hotel in Kincardine, Ontario).

Figure 136. Forward bearing bar with dead plate (Artifact 132-001.02.3.01; scale dm.).

Figure 137. Transition plates between the lower ash pit and upper fire door frames (Artifact 120-279; scale cm./dm.).

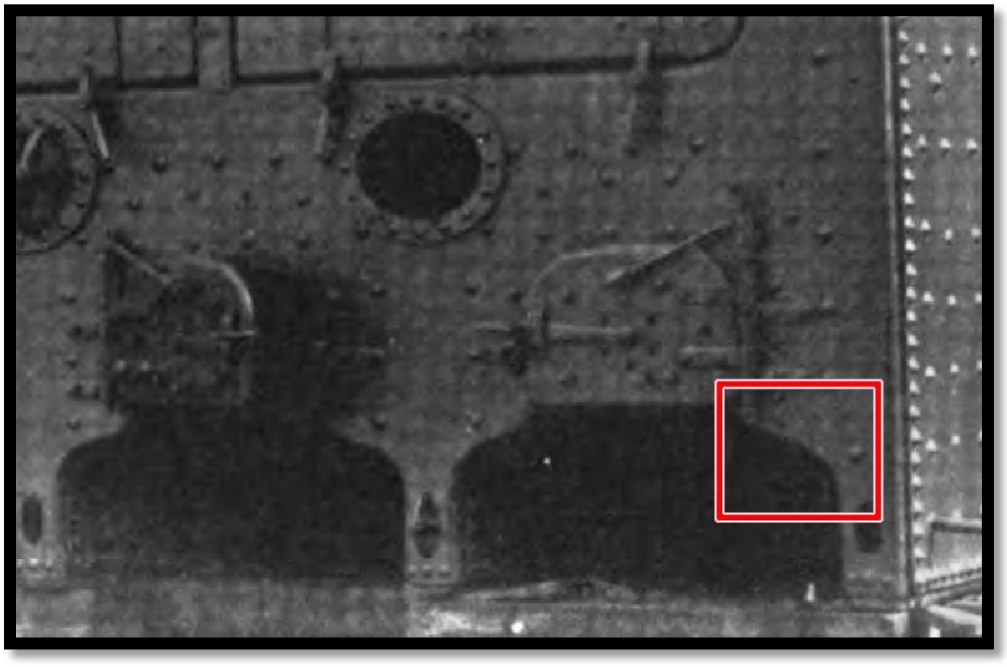

Figure 138. Transition plates the between lower ash pit and upper fire door frame (Unidentified 1902:523).

Figure 139. Twisted frames from the upper fire doors
(Artifacts 120-002 and 120-023; scale cm./dm.).

jacket. The curvature of the riveting pattern tells us this artifact served as the transition point between a lower ash pit and an upper fire door frame (Figure 138). Two portions of fire door frames were recovered (Artifacts 120-002 and 120-023). These artifacts follow the curvature of the fire doors, although both are twisted outwards, away from their original mounting points due to an interior explosion (Figure 139).

When the artifacts first arrived at Texas A&M University, CRL staff speculated that twelve short pieces of railroad iron may have been stored on the ship as replacement fire grates. Following conservation, three of these railroad irons revealed that they were physically cut down to 3 ft. (0.914 m.), the same length as the fire grates (Figure 140). When *Westfield* and other Union vessels were in enemy waters, the crews were required to make use of whatever materials were at hand for repairs or replacements. A single recovered railroad spike (Artifact 132-101) suggests that the railroad irons were not just

Figure 140. Railroad iron possibly reutilized as a replacement fire grate (Artifact 132-001.02.4.02; scale dm.).

Figure 141. Single rail road spike (Artifact 132-101; scale cm.).

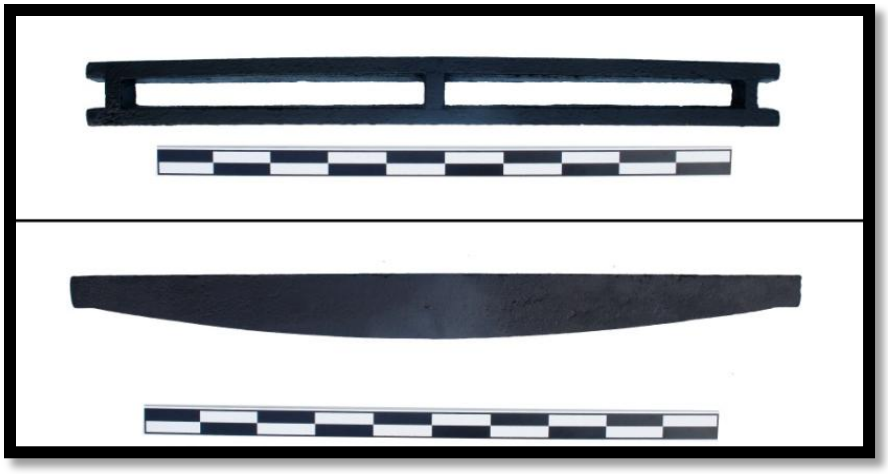

Figure 142. Larger fire grate possibly reutilized as lower bearing bar (Artifact 132-001.02.2.01; scale dm.).

excess pieces, but sections that may have been removed from existing tracks (Figure 141). Scavenging while in Confederate territory was not uncommon. The journal of Henry Gusley, a marine aboard *Westfield* mentioned raiding Confederate towns for food and supplies (Cotham 2006:114).

Other artifacts may have been repurposed as well. Two larger fire grates were found within the vicinity of the firebox, but no definitive explanation could be determined on how these grates were utilized (Figure142). Both of these grates measure 46-1/2 in. (1.18 m.) by 4 in. (10.2 cm.) and are 3 in. (7.62 cm.) thick at the midsection, tapering to 1-1/2 in. (3.81 cm.). These grates led to much speculation by conservators that part of the recovered firebox was missing. Yet, this could not be the case, since all of the lower firebox walls remained relatively intact. While many other boilers incorporated rows of fire grates containing different lengths (Main and Brown 1865:52), the recovered firebox from *Westfield* suggested that all grates were the same size. Interestingly, these two mysterious grates are the same length as the normally solid

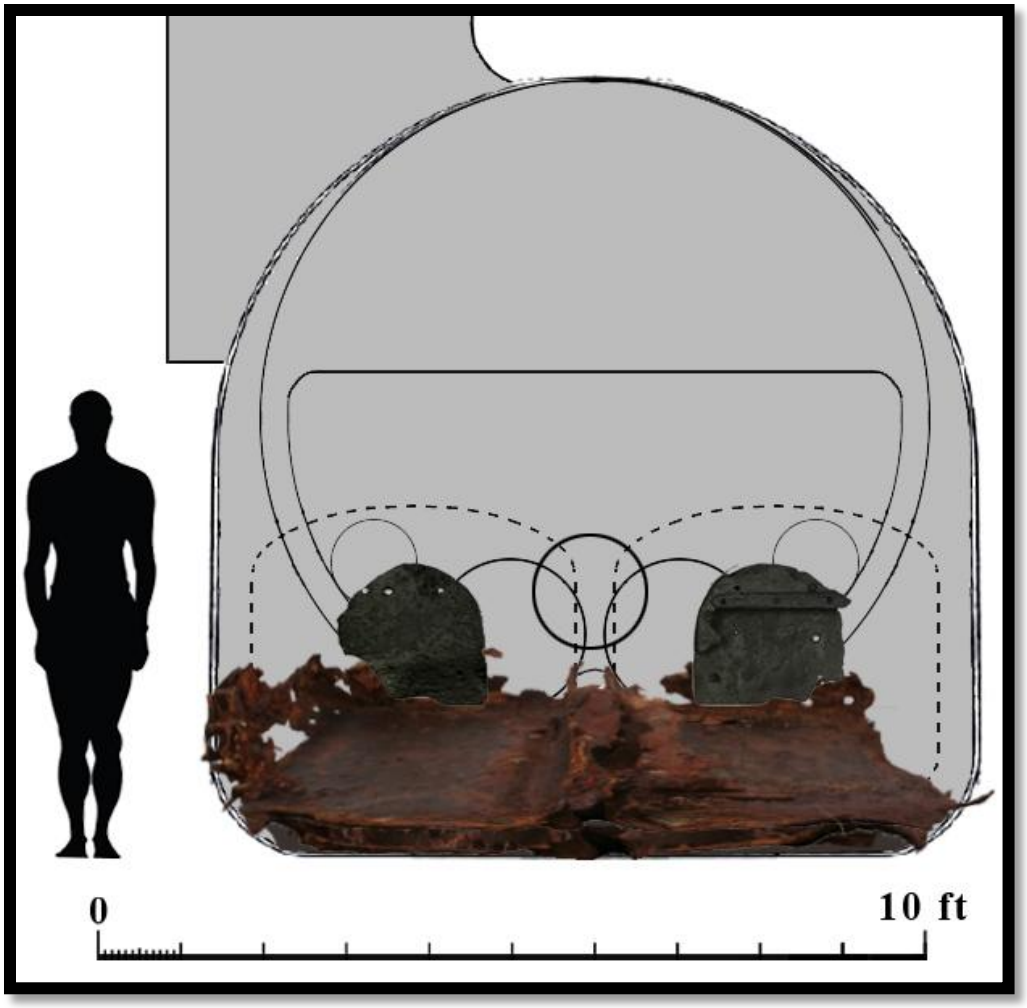

Figure 143. Fire door arrangement on *Westfield*; viewed front to back (by author).

bearing bars beneath the fire grates. Having no other explanation, the author speculates that these fire grates were obtained from a larger boiler and brought aboard *Westfield* to be utilized as replacement bearing bars due to their equivalent size.

As previously mentioned, three fire doors were recovered. One is largely intact (Artifact 120-063); while the others consist of only back plates (Artifacts 119-020 and 131-014). The firebox recovered from *Westfield* had two fire doors (Figure 143). Based on the more intact door, their construction consists of a front and rear plate that are

joined together with four small staybolts. The staybolts have a threaded tip on each end, which is screwed into both plates. To prevent the plates from moving or causing too much wear on the threads, a small sleeve, similar to those found on the firebox, acts as a middle spacer. The door measures 21 in. (53.3 cm.) wide by 20 in. (50.8 cm.) tall, and contains a semicircular top, and slightly rounded lower edges. The outer front plate which faced the crew is considerably damaged and only survives along the top and left side. A single hinge remains bolted to the plate in three locations. The end of the hinge where the pin was located extends off the plate with a downward bend. This suggests that when closed, the entire door rested on the outside of the boiler door frame. That design corresponds with historic photographs of other fire doors (Figures 113 and 122). The other end of the hinge terminates near a small nut. The nut is secured to the front plate by a bolt that appears to have snapped off from the outside of the door. Just below this nut, where the front plate terminates due to damage, a semicircular hole indicates that another bolt and nut were once present. The close proximity of these objects may indicate where a bracket once joined. Based on historic photographs (Figure 144), a bracket in this location would have secured the fire door lever in place.

When a fireman desired to open the door, he lifted the lever up from a securing cradle fastened to the boiler wall, and then pulled the lever and door open. One of these fire door levers was recovered (Artifact 125-006). The lever consists of an elongated bar with a lifting handle on one end and a pivot ring and inner pin on the other (Figure 145).

One fragment of a baffle plate was recovered (Artifact 119-197). This was made of cast iron, and pierced by numerous holes that facilitated draft (Figure 146). Each of

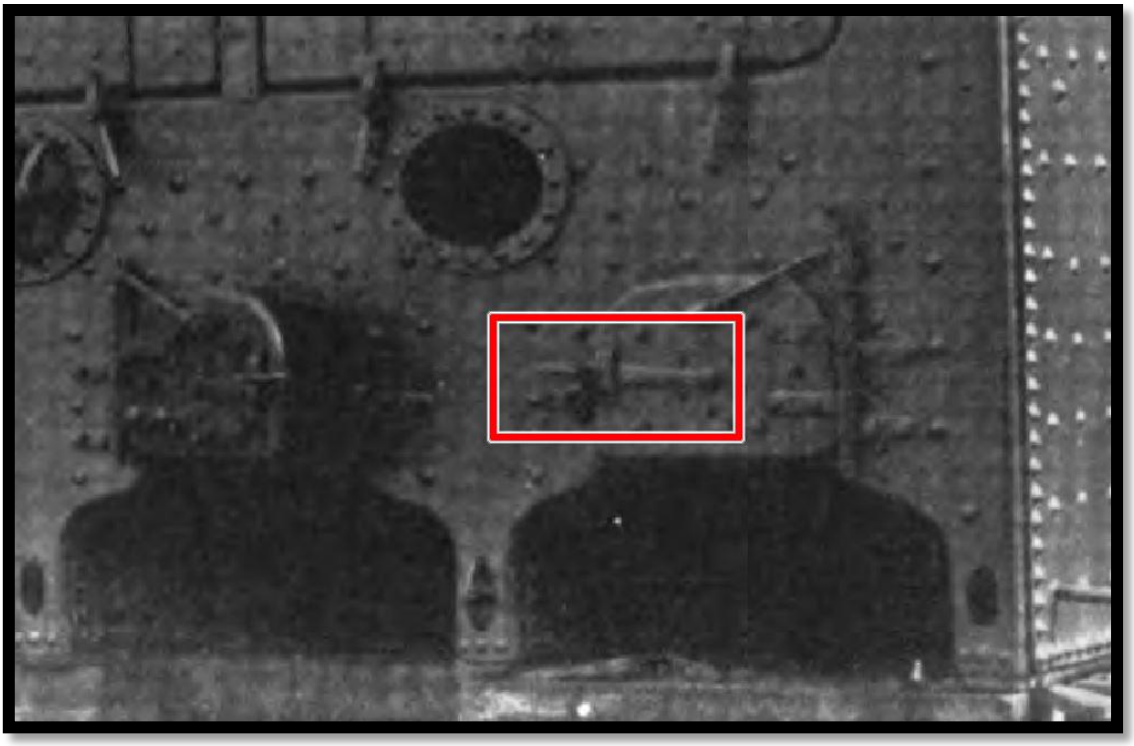

Figure 144. Fire door hand lever on *Perry*'s boiler (Unidentified 1902:523).

Figure 145. Fire door lever and pin (Artifact 125-006; scale cm./dm.).

Figure 146. Cast iron fragment of baffle plate (Artifact 119-197; scale cm.).

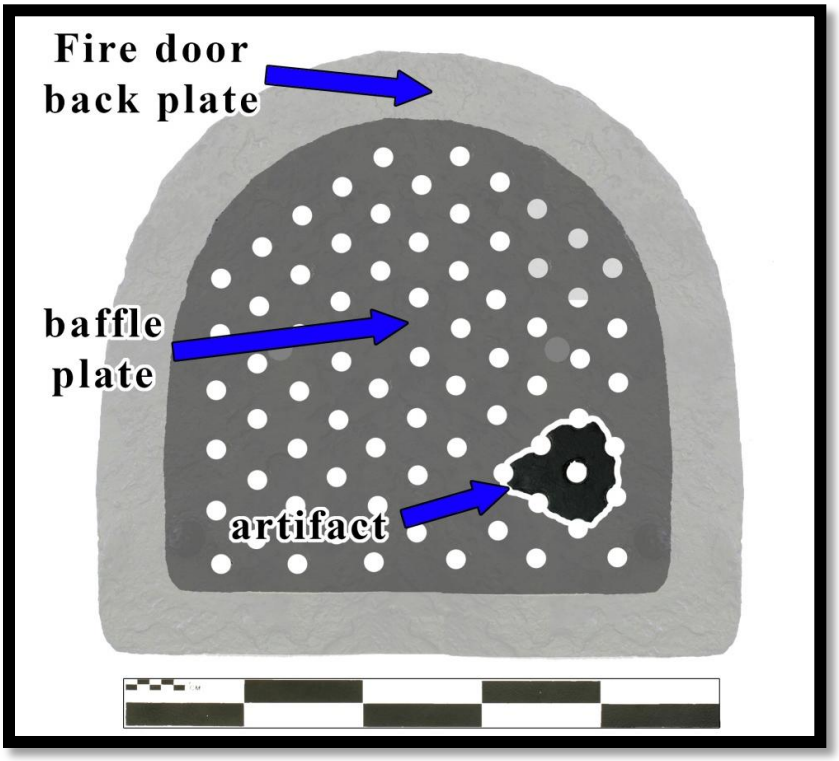

Figure 147. *Westfield*'s reconstructed baffle plate (by author).

Figure 148. Baffle plate from the steamboat *Moyie* (Image courtesy of SS *Moyie* National Historic Site of Canada).

these holes measures 3/4 in. (1.90 cm.) in diameter. The baffle plate followed the shape of the fire door but were of reduced height and width (Figure 147). This allowed the door to be closed flush against the door frame, while permitting the baffle plate to rest just above the dead plate. A similar example of a baffle plate can be seen on the steamboat *Moyie* (Figure 148). The spacing of the holes and the thickness of the cast iron is almost identical to the fragment recovered from *Westfield*.

The firemen moved about considerably when utilizing the fire doors. To prevent slipping, the floor of the boiler room was covered with cast iron diamond patterned scuff plates. A large quantity of scuff plate pieces was recovered near both the firebox and the former engineering compartment. The best preserved example consists of a relatively large and mostly intact plate (Figure 149). The plate measures 29 by 24 in. (73.7 by 61 cm.) and 1/2 in. (1.27 cm.) thick and has countersunk holes in the corners for some form of fasteners. A smaller fragment of this plate type has a stepped section on the edge that

Figure 149. Diamond patterned scuff plate from the boiler room (Artifact 133-004; scale dm.).

Figure 150. Diamond patterned scuff plate with a joining seam (Artifact 132-001.73; scale cm.).

once formed the seam between two plates. The adjacent plate fit over this stepped edge, interlocking the two plates together (Figure 150). Another type of diamond panel was utilized above the boiler room, in the upper machinery compartment of the main deck (Figure 151). This diamond panel was open like a grate, so the heat from below could rise up and out of the lower hull. A similar example can be seen in the burned out hulk of the ferryboat *Plainfield* (Figure 152).

The chimney flue was situated above the fire doors and the inner furnaces. This location marked the termination point for the fire tubes. While no remnants of the fire tubes were found, a single access door for maintaining and cleaning the tubes was recovered (Artifact 109-127). Known as a flue door, this artifact was considerably damaged and twisted (Figure 153). It originally measured approximately 22 in. (55.9 cm.) wide by 16 in. (40.6 cm.) tall. Based on the width of the boiler, three or four of these doors likely existed. A series of fastener holes indicate that this artifact was similar in construction to the fire doors. The surviving portion of the door represents the outer cover plate. The rear plate and staybolts are missing. Other holes on the plate may indicate where hinges were placed. Unfortunately, not enough of the plate survives to reach any definitive conclusions.

The top of the firebox portion of the boiler was originally rounded. In this location, water gauges and cocks were placed just above head level to prevent damage from working firemen, but also to give a clear vantage point to the men stoking the boilers. These gauges were essential for preventing the water level in the boiler from becoming too low. A large plate (Artifact 124-032) recovered from the wreck is believed

Figure 151. Open diamond patterned scuff plate from the main deck (Artifacts 120-033 and 120-034; scale cm.).

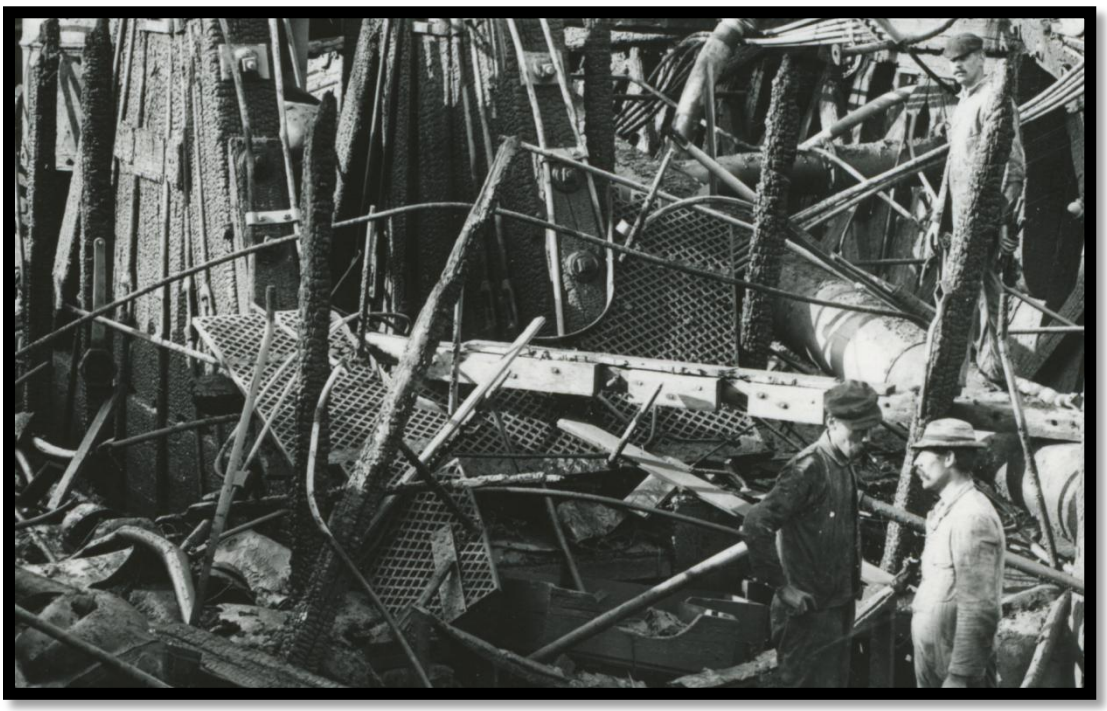

Figure 152. Collapsed open diamond patterned scuff plates from the burned out hulk of the ferryboat *Plainfield* (Image courtesy of Mystic Seaport; reference #1964.660.128).

Figure 153. Flue door from *Westfield*'s boiler (Artifact 109-127; scale cm./dm.).

to have come from this location (Figures 154 and 155). The plate contains a rounded top and many internal staying devices. More importantly, a threaded cupreous pipe was screwed through the surface to the internal chamber. The end of the pipe on the outside of the boiler is broken. The pipe likely supported some form of water gauge.

Large flues carried the heated gases, ash, and smoke from the firebox into the boiler barrel. Unlike the firebox, the barrel no longer exists. Yet numerous fragments survived that help explain the original design. Most of the riveted plate recovered from the wreck site is believed to have originated from the boiler barrel, because while most of the plates are deformed they still retain curvature. Two of the best examples can be found in Artifacts 110-005 and 119-001 (Figures 156 and 157). One of the most notable features of these artifacts is the absence of internal staying devices. This is not to say that these devices did not exist in the barrel, but only that they were not as necessary and

Figure 154. Plate from the upper fire box water jacket (Artifact 124-032; scale dm.).

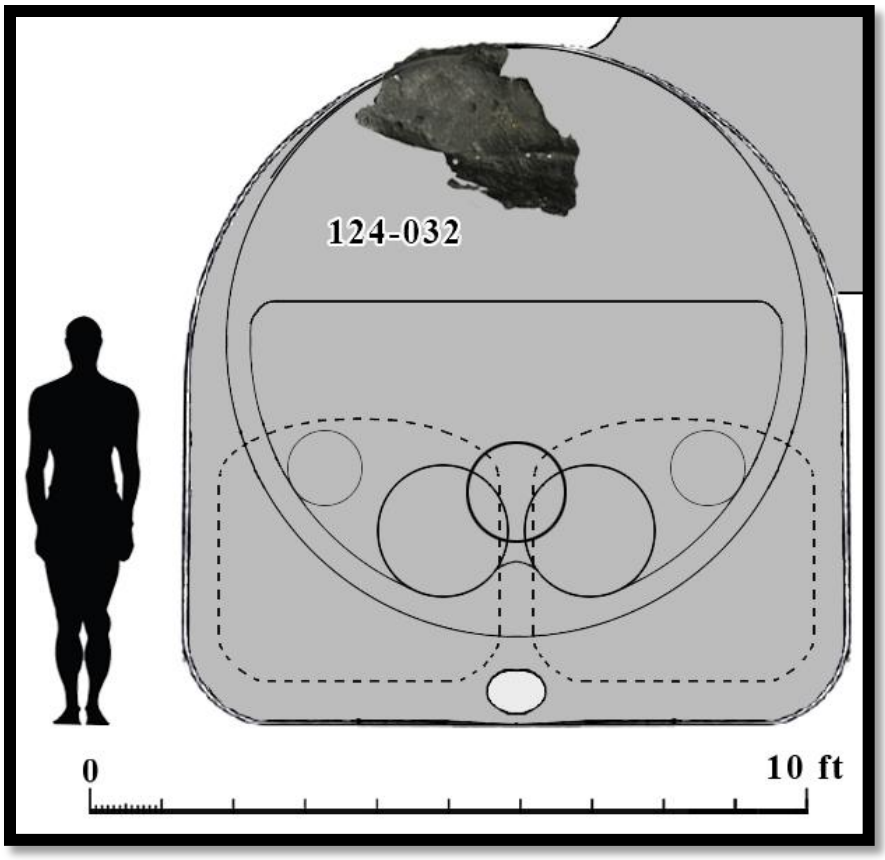

Figure 155. Plate from the upper fire box water jacket in context; viewed front to back (by author).

Figure 156. Large section of plating from the outer boiler barrel (Artifact 110-005; scale cm./dm.).

Figure 157. Small section of plating from the outer boiler barrel (Artifact 119-001; scale cm./dm.).

therefore more sparingly used. Unlike the firebox which required heavy staying on the numerous flat surfaces, the round shape of the barrel expanded and contracted with less chance of distortion.

The barrel originally sat higher than the firebox and required large mounts to hold the rounded structure in place. During the mapping of the wreck site, eight of these boiler mounts were identified. Four were successfully recovered (Artifacts 105-005, 119-018, 119-024, and 120-003), and two were conserved (Artifacts 119-026 and 120-003). The mounts are made of heavy cast iron and consist of a rectangular lower base and a curved upper portion that matched the shape of the outer barrel (Figure 107). Between the mounts' upper curvature and lower base, cross bars were cast into the mounts at an angle. The angle helped disperse the weight of the barrel through the mounts diagonally to prevent vertical crushing. To ensure that the mounts did not push away from each other or from the barrel, a large bolt originally ran through each mount lengthwise and connected with the counterpart mount on the other side of the barrel. An example of this arrangement can be seen on the burned out hulk of the ferryboat *Plainfield*. The boiler has been removed and the mounts with their connecting bolts are visible (Figures 158 and 159). As in the image, *Westfield*'s mounts would have been placed over large wooden beams that ran perpendicularly across the center keelson and sister keelsons. Wood from these beams remained concreted to the mounts following recovery. These fragments were removed and conserved.

Curvature on the boiler mounts indicates that the rear boiler barrel had an 8 ft. (2.44 m.) diameter. This information helps determine how the barrel connected to the

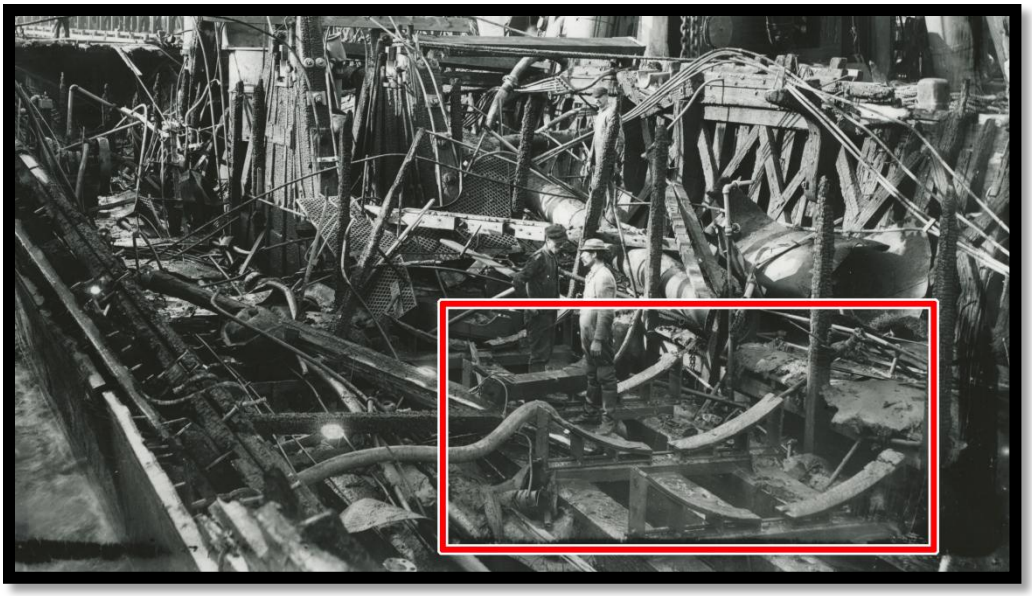

Figure 158. Boiler mounts from the burned out hulk of the ferryboat *Plainfield* (Image courtesy of Mystic Seaport; reference #1964.660.128).

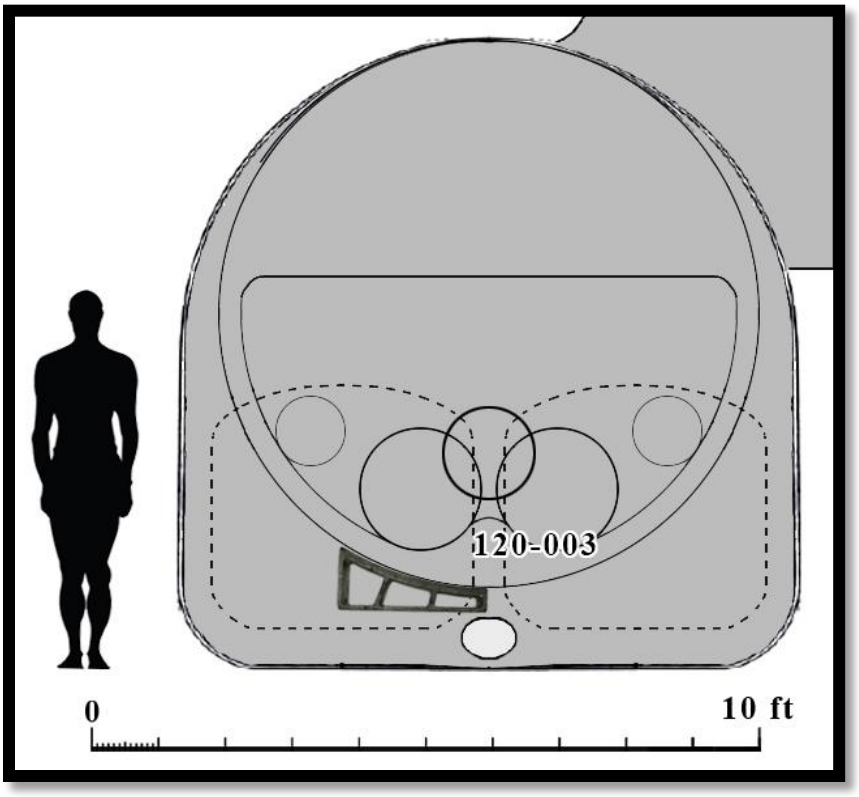

Figure 159. One of *Westfield*'s boiler mounts in context; viewed back to front (by author).

firebox. On some boilers, the curved top of the firebox section extended all the way to the back of the barrel. This meant that the barrel shared the same diameter or width as the firebox. Other times, the top of the firebox and the barrel contained two different diameters that joined together on a common edge as eccentric circles. Based on the measurements from *Westfield*'s artifacts, this latter scenario seems to be the case. Three other artifacts offer evidence that support this idea (Artifacts 119-003, 121-014, and 121-017). These artifacts consist of heavily reinforced riveted plates that once attached the barrel to the back of the firebox. Although now relatively flattened, Artifact 121-017 originally formed the highest connection point between the firebox and the barrel (Figure 160). At this height, the two different diameters are less evident. On the artifact, three distinct levels of plating can be seen. As the plates extend towards the firebox, each plate level steps upwards, and is securely riveted together. The lowest underlying plate represents the boiler barrel. The middle plate with two lines of rivets served as the connecting strap. The highest plate formed the edge of the firebox. Artifact 121-014 is also flattened, but still retains a purposefully folded plate that shows where the two circles began to deviate away from each other due to their different sized diameters (Figure 161). On Artifact 119-003, this deviation becomes fully recognizable as the folded plate clearly arches upward towards the firebox and away from the lower barrel (Figure 162). In Figure 163, all three artifacts can be seen in their original context.

Like the previous artifacts, Artifact 133-011 served as a connection point between the boiler barrel and firebox; however, this object originated from the bottom of

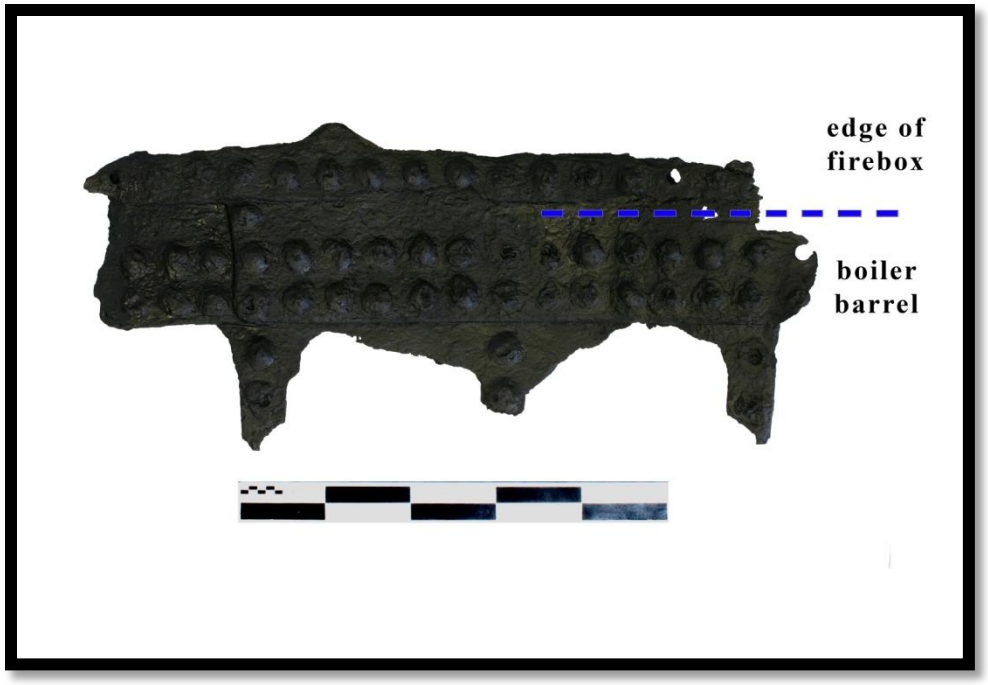

Figure 160. Upper boiler barrel connection plates (Artifact 121-017; scale cm./dm.).

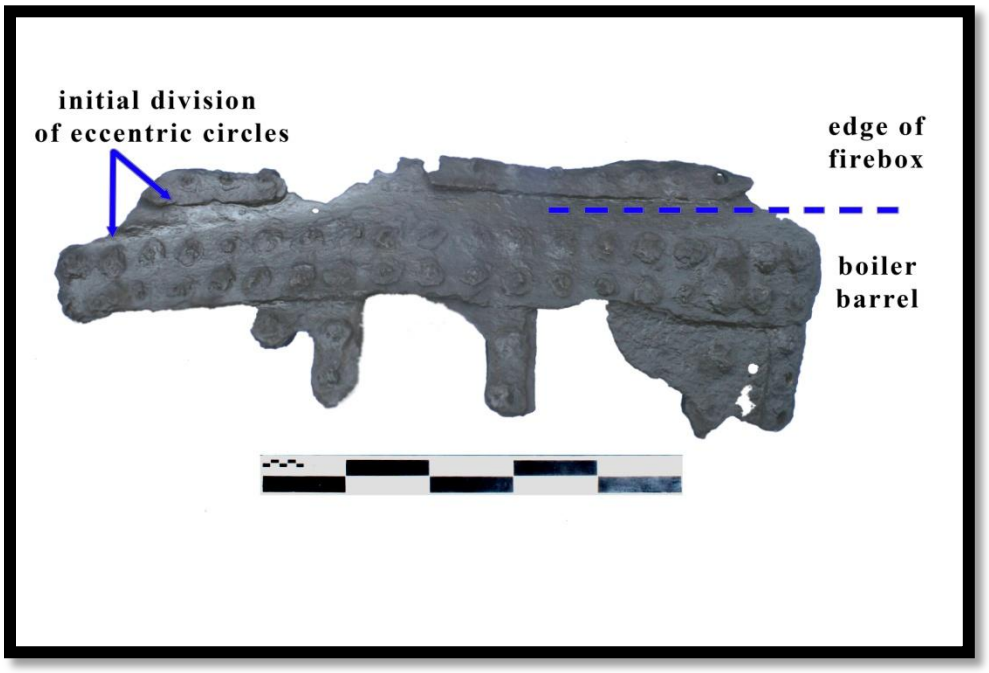

Figure 161. Upper to middle boiler barrel connection plates (Artifact 121-014; scale cm./dm.).

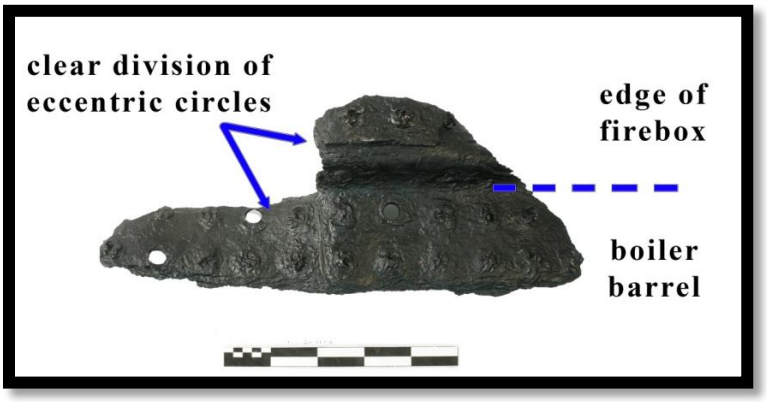

Figure 162. Middle boiler barrel connection plates (Artifact 119-003; scale cm./dm.).

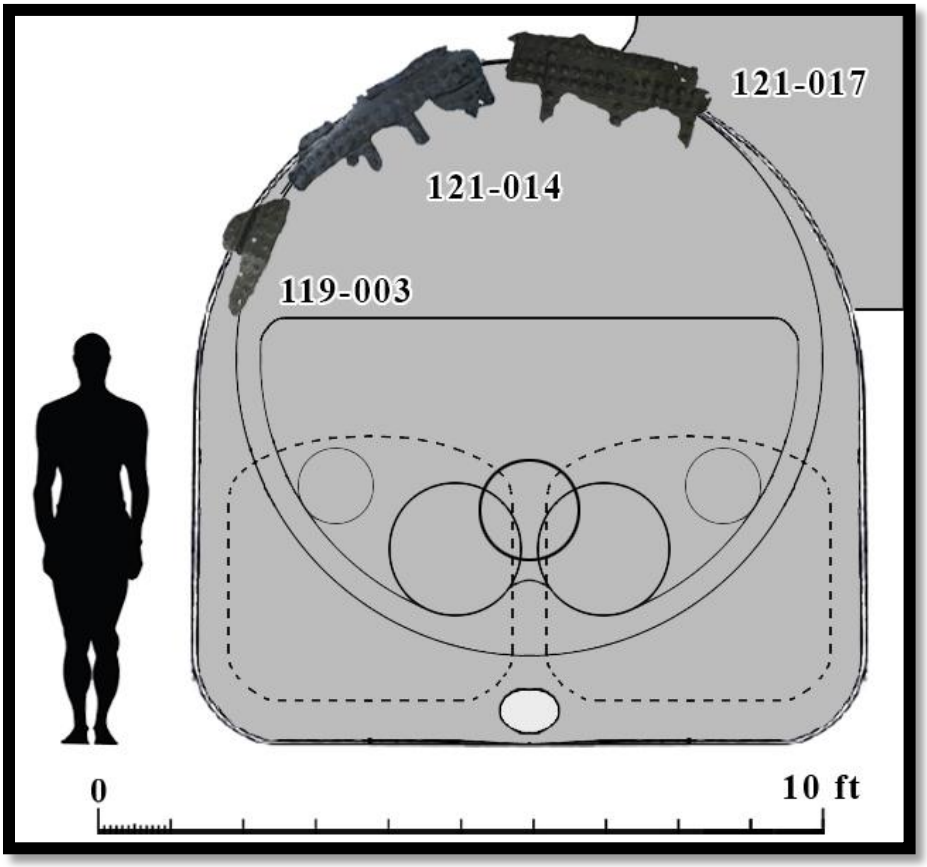

Figure 163. Boiler barrel connection plates in context; viewed back to front (by author).

the boiler (Figure 164). For this reason, the artifact does not display the eccentric circles. Instead the artifact contains a well preserved, albeit slightly crushed portion of the barrel curve, and a section from the rectangular base of the firebox. The artifact also demonstrates that, in its original context, an additional double-riveted strap branched off from the barrel, before running down the back of firebox and folding underneath.

A second artifact came from the same vicinity. Artifact 133-007 was placed slightly higher up on the side of the firebox, yet still below the boiler barrel. Its most noticeable feature consisted of an attached cupreous pipe flange (Figure 165). Feed pipes leading into the boiler would have been used to replenish the water level. This feedwater pipe likely led back to the valve system located beneath the hot well reservoir on the walking beam engine. During conservation, the question arose as to whether this artifact could have come from the front or sides of the boiler, or possibly higher up on the back of the firebox. Several staybolt holes in the metal eliminated any chance that the artifact came from the boiler's front. Staybolts on the front of the boiler would have been on either side of the fire doors. Based on the width of each furnace, this artifact would not have been able to fit without interfering with fire doors. The second evidence comes from the joining of the outer plate with the line of rivets that run up the artifact's side. Based on other recovered artifacts, plates from the front and rear of the firebox, as well as those from the back of the boiler barrel, always tucked underneath the side plates of the boiler. Why this was done is not clear, however based on historic photographs this riveting pattern seems to have been the norm (Figures 113 and 122). The suggestion of the object placed higher on the boiler is also not possible. Anything higher would

Figure 164. Lower boiler barrel connection plates (Artifact 133-011; scale cm./dm.).

Figure 165. Rear firebox feed water pipe (Artifact 133-007; scale cm./dm.).

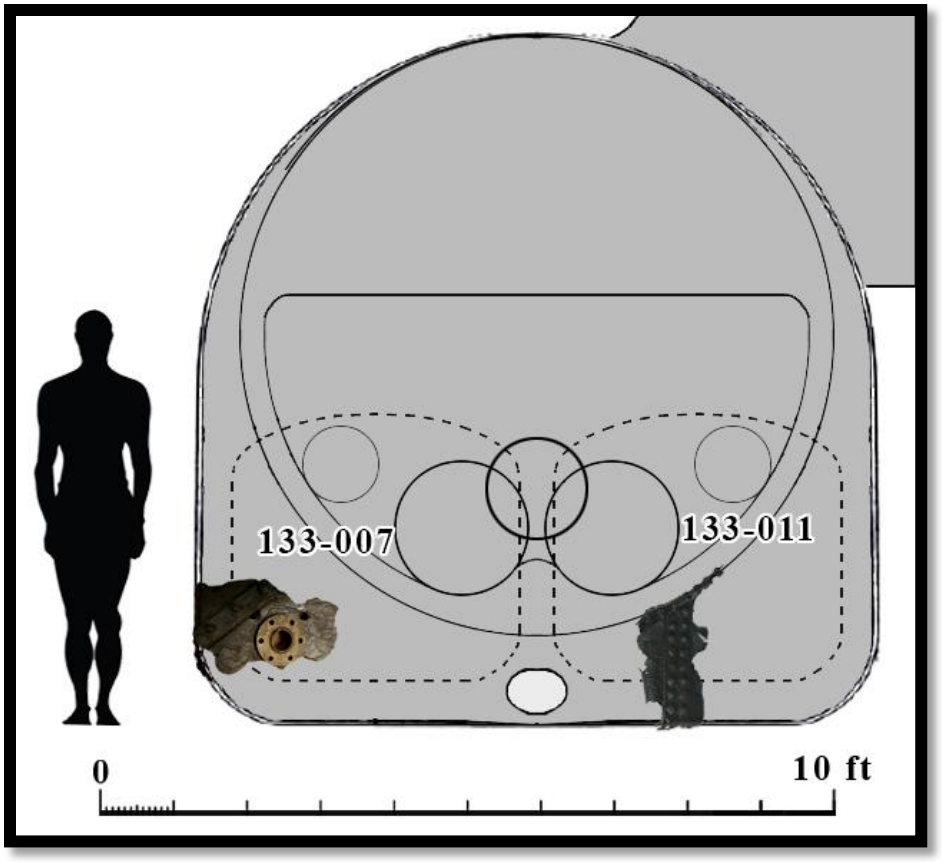

Figure 166. Artifacts 133-007 and 133-011 in context; viewed back to front (by author).

have interfered with the boiler barrel. This suggestion arose due to the curvature on the strap of rivets. Close examination reveals that the seam of Artifact 133-007 contains original curvature. This curvature marks the transition point where one of the water legs began to curve under the boiler. Figure 166 displays Artifacts 133-011 and 133-007 in their original context. A final comment on Artifact 133-007 relates to a bar-like strap that is mounted near the flange with three bolts and underlying washers. One of the recovered man holes still retained a portion of boiler plating (Artifact 119-019). Mounted to that plate was a similar bar-like strap (Figure 127). A considerable amount of this strap material was recovered. These straps secured both boilers together and to

the inner hull of the ship. An identical example can be seen on the steamboat *Ticonderoga* (Figure 167). The only difference is that on *Ticonderoga* the strap material joined to the boilers horizontally. Based on Artifact 133-007, *Westfield* used this strap in a diagonal fashion. The straps crossed between the two boilers, likely at several locations, creating an "X". Artifact 118-002 may be an example of these crossed securing straps from between the boilers (Figure 168). The artifact is constructed of the same thickness and width. Several broken bolts through the metal show how the artifact was once secured.

A substantial section of the lower flues survived from inside the boiler barrel. Artifact 122-001 consists of two flues and the lower base section of the rear combustion chamber (Figure 169). Combined, the artifact measures 10 by 6 by 3 ft. (3.05 by 1.83 by 0.914 m.). The flues were built of wrought iron sheets, folded over, and riveted into tubular sections. Each section was then riveted to the next, to create the overall flue. Inside, each flue has a diameter of 1-3/4 ft. (4.44 cm.). Both flues join onto a plate that has been carefully formed outwards and then tucked inside the base of the combustion chamber. The folds on this plate make the transition of the metal appear almost organic. This same fluid design stands out on Artifact 133-014, although on a much smaller scale (Figure 170). This artifact appears to have served the same function and likely came from higher up on the combustion chamber (Figure 171). While considerably distorted, enough of the original curvature remains to determine that the artifact once held a flue with an internal diameter somewhere between 10 and 14 in. (25.4 and 35.6 cm.).

One smaller separated flue was recovered (Figure 172). Artifact 121-010 consists

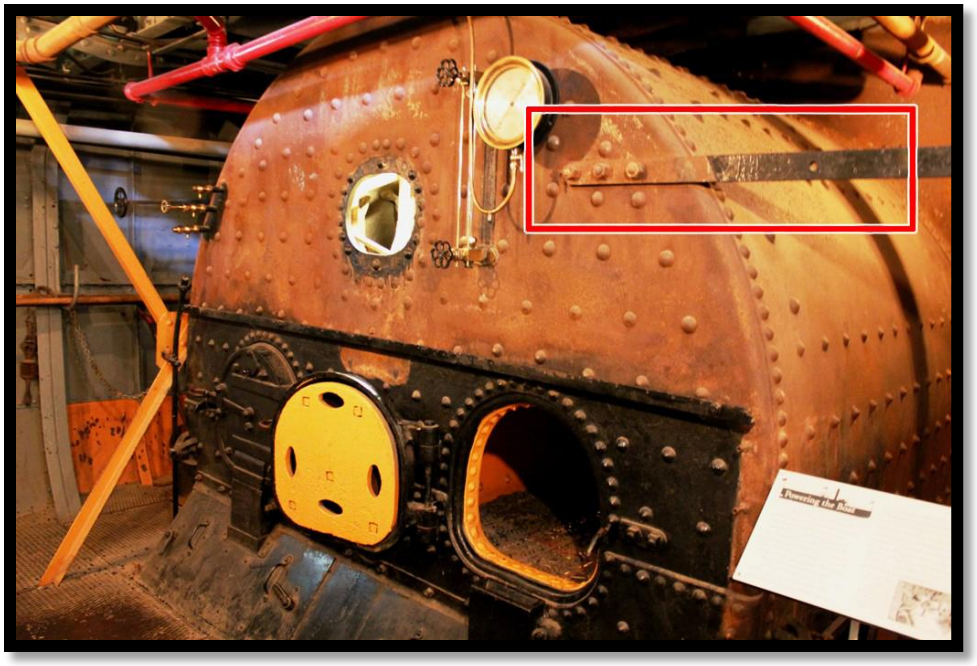

Figure 167. Wrought iron boiler securing straps on the steamboat *Ticonderoga* (Image courtesy of the Shelburne Museum, Shelburne, Vermont).

Figure 168. Wrought iron boiler securing straps from *Westfield* (Artifact 118-002; scale cm./dm.).

Figure 169. *Westfield*'s boiler flues, upside down in a storage container (Artifact 122-001; scale inches).

Figure 170. Plating designed to hold a smaller round flue (Artifact 133-014; scale cm./dm.).

Figure 171. Boiler flues (upside down on pallet) with Artifact 133-014 in context (in author's lap).

Figure 172. Smaller upper side flue on *Westfield* (Artifact 121-010; scale dm.).

of two pipe segments with an internal diameter of approximately 1 ft. (30.5 cm.). Although smaller, the construction is identical to the larger flues. These artifacts suggest that in addition to the two main flues that left the firebox and joined the combustion chamber, additional smaller flues followed that same path. This is to be expected since most boilers of *Westfield*'s size (based on the firebox) utilized smaller upper side flues to maximize the transfer of heat into the water. Several examples of this layout can be found in the U.S. steamers *Commodore Barney*, *Ella*, *Bibb*, and *General Putnam* (Isherwood 1865: plates XIV, XV, XVII, and XXI). Each of these vessels contained return flue boilers of a similar design to what *Westfield* is believed to have used (Figure 173).

The surviving portion of *Westfield*'s combustion chamber measured 2 by 6 by 3 ft. (61 by 183 by 91.4 cm.)(Figure 174). The base of the chamber was secured to the outer boiler barrel with several types of fasteners. Most of the underside, but not the direct bottom, used threaded staybolts. Many bolts of this type were also found on the back wall. All are heavily corroded, with only a few of them displaying their original threads. The better preserved examples show that after placement, the bolts were hammered over on both sides into conical rivets. The spacing appears similar to staybolts on the firebox, but this cannot be confirmed. The plating where most staybolts were positioned has corroded away. Of the staybolts that remain, they are too far from each other to determine a definitive spacing pattern. Several examples of these threaded bolts were found separately from the combustion chamber and are in considerably better condition. These bolts were conserved as representative examples (Figure 175). At the

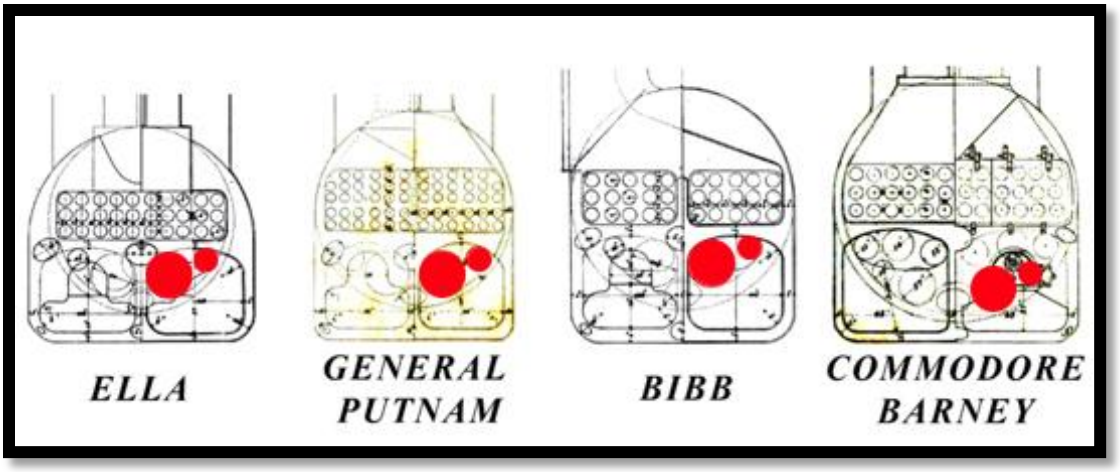

Figure 173. Return flue boilers with smaller upper side flues (Isherwood 1865: plates XIV, XV, XVII, and XXI).

Figure 174. Remains of lower combustion chamber (artifact is upside down).

Figure 175. Threaded staybolt with hammered ends (Artifact 132-182; scale cm.).

very bottom of the chamber, the remnants of two double-ended crowfoot fasteners indicate, that like the firebox, the iron workers did not trust placing a heavy load exclusively on staybolts. Staybolts were utilized inside compartments, but whenever a direct load required support, double-ended crowfoot fasteners were the staying device of choice.

One section from higher up on the combustion chamber was recovered separately (Figure 176). Artifact 132-001.76 consists of plate fragments from both the outer water jacket and the inner combustion chamber. Heavy staybolts secured these plates together. These staybolts are considerably larger and more robust than those found on the firebox. After the bolt passed through the plates and the central sleeve, a large threaded square nut was screwed down over a washer. This was a common design found on other boilers

Figure 176. Upper fragment of combustion chamber (Artifact 132-001.76; scale cm./dm.).

(Figure 177). The heavy-duty nature of these bolts may have something to do with the round shape of the boiler barrel. The interior combustion chamber occupied a large area at the rear of the barrel. As the barrel expanded and contracted, this type of reinforcement may have been necessary to ensure the chamber did not become dislodged. Figures 178 and 179 display the remnants of the rear combustion chamber and Artifact 132-001.76 in context.

The top of the combustion chamber on most boilers was flat, and this was likely the case with *Westfield*'s boilers. To ensure that the top of the chamber did not warp, heavy staying devices were required. These devices, known as girder stays, were typically used when it was difficult to secure a flat surface to another surface within the boiler (Peabody and Miller 1894:108). These devices were commonly used on return

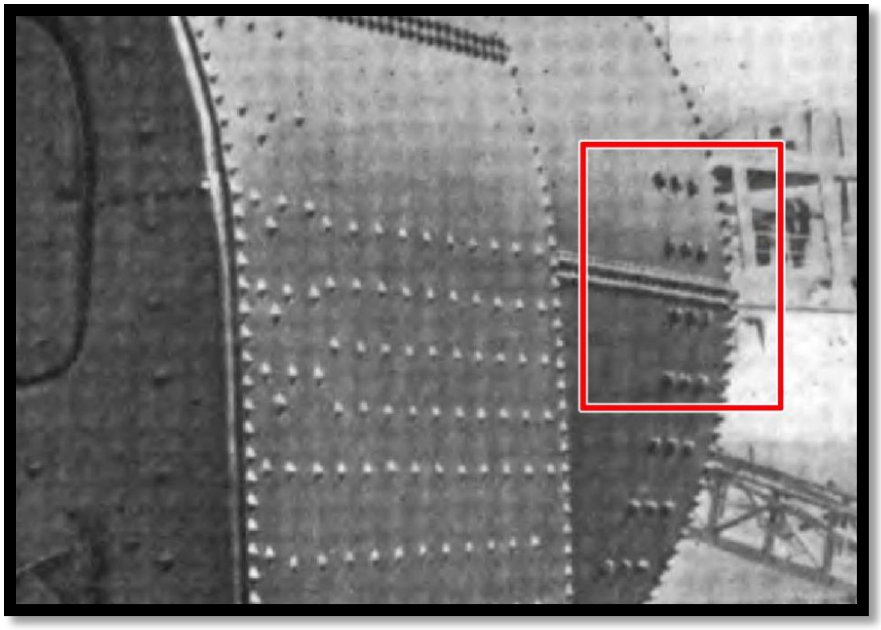

Figure 177. Larger staybolts on *Perry*'s combustion chamber (Unidentified 1902:523).

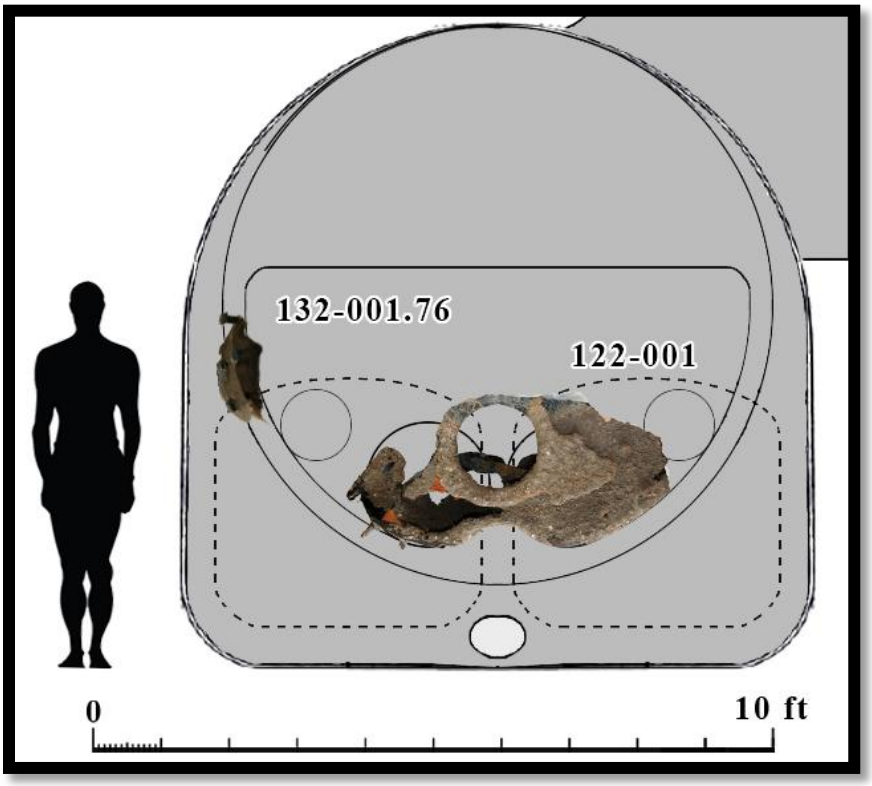

Figure 178. Combustion chamber base and upper fragment in context; viewed back to front (by author).

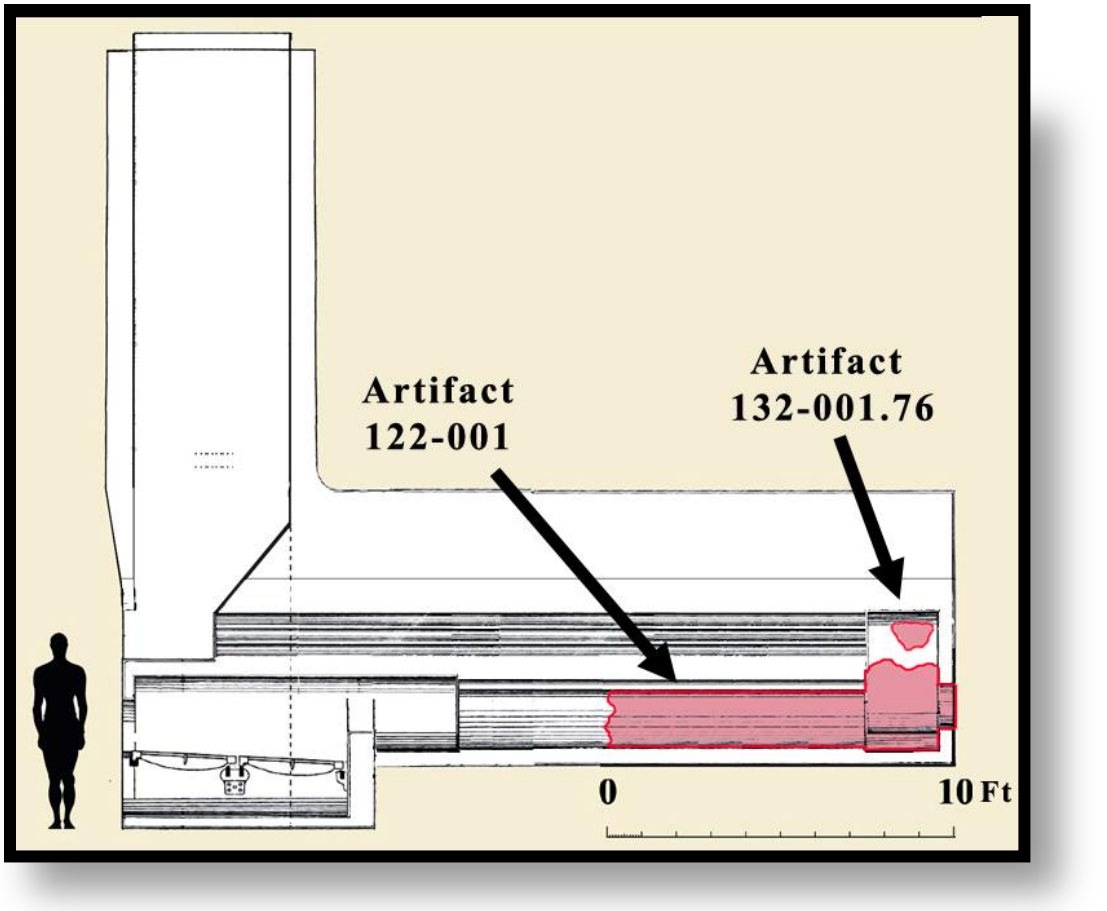

Figure 179. Main flues/rear combustion chamber (Artifact 122-001)
and upper combustion chamber fragment (Artifact 132-001.76) in context.

flue scotch boilers to support a combustion chamber roof (International Correspondence Schools 1897:330). One such device was recovered from *Westfield* (Artifact 132-001.90). The artifact appears very similar to the girder stays found in scotch boilers, although more primitive and therefore possibly an earlier version (Figure 180). One end of the girder stay contains a slightly angled clamp that fit over another object. The other end has broken off, but still retains portions of the clamp, showing that not much of original size has been compromised. Passing through the girder are four threaded bolts containing hooks. The hooks lay over the girder, and the bolts passed through the center,

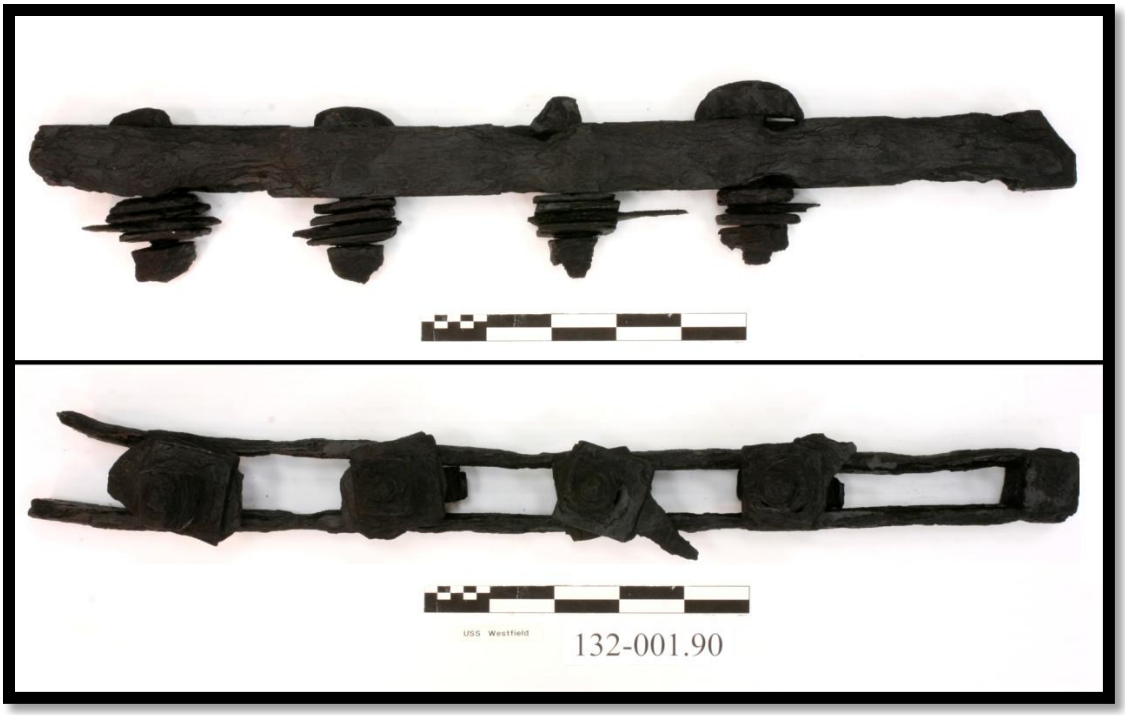

Figure 180. Girder stay from the top of the combustion chamber (Artifact 132-001.90; scale cm.).

and then into the combustion chamber. Fragments from the top plate of the combustion chamber are still threaded onto the bolt. Underneath, on the end of each bolt, square nuts and washers held the entire assembly together. The surviving base of the combustion chamber measures 2 ft. (61 cm.) wide. Not accounting for the end clamps, the central portion of the girder stay measures approximately 29 in. (73.7 cm.). The closeness of these two measurements suggests the girder stay came from this location of the boiler.

In order to clean the interior of the combustion chamber, a large access port was situated on the lower rear wall (Figure 181). This circular opening survived intact, and the inside diameter measures 16 in. (40.6 cm.). A single circular door (Artifact 120-009) was recovered and is believed to have originated from this opening (Figure 182). The

Figure 181. Rear access hatch to the combustion chamber (scale inches).

Figure 182. Door from the rear combustion chamber (Artifact 120-009; scale dm.).

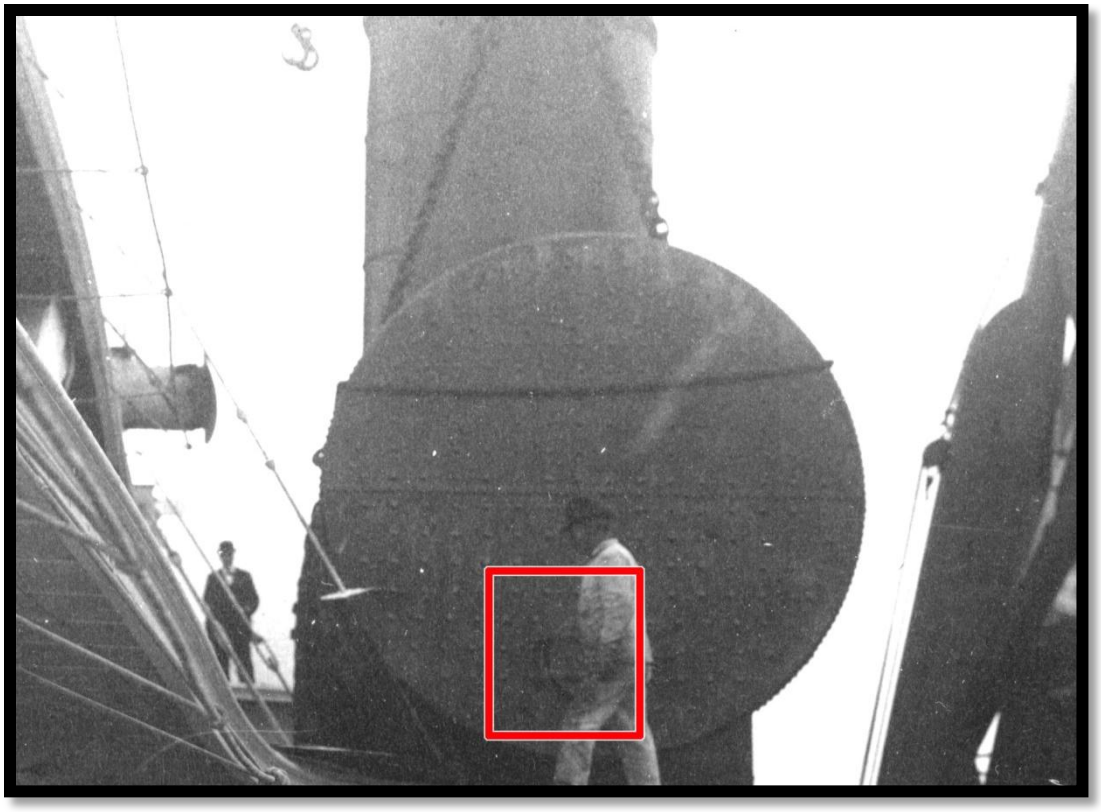

Figure 183. Combustion chamber door on the boiler barrel of the steamer *Mary Powell* (Image courtesy of The Steamship Historical Society of America).

door has a diameter of 22 in. (55.9 cm.). The construction of the door matches that found on the fire doors. A front and rear plate are joined together with four small staybolts to maintain an even space between them. A single hinge runs across the door's outside plate diameter, before breaking off just past the edge. Like the fire doors, this round door closed against the outside of the boiler, rather than being seated in an internal frame. A similar example of this door can be seen in a historic photo of the steamer *Mary Powell* (Figure 183).

Four remaining artifacts fall into a miscellaneous category; however, all are believed to have been associated with the boiler room. Artifact 132-011 consists of a

single cast iron wheel (Figure 184). The wheel contains four reinforced spokes that radiate out from a central hub. Two small holes are evident along the interior walls of this hub. These holes were likely used for a key that held a shaft or axle in place. This wheel is believed to have come from a small engine. *Westfield*'s boiler system required a constant source of water. To accommodate that need, *Westfield*'s walking beam engine powered not only the paddle wheels but also pumped water continuously to the ship's boilers. When *Westfield*'s engine was not in motion, the boilers instead relied on a smaller, independently-run donkey engine. These types of auxiliary engines generally contained a single-acting cylinder and utilized a belt and wheel system that pumped water into the boilers as well as other crucial areas of the ship (Figure 185).

A second artifact (133-132) was likely the handle end of a stoker used to tend the fires within the furnaces (Figure 186). The object consists of a round bar that was bent into a handle shape. One end of the bar was cut to be flat, while the other is broken indicating the side that contained the shaft. Commonly, four types of stoker tools were used (Figure 187). The slice bar broke up the fire's thick surface crust when using bituminous coal. Anthracite coal burned considerably more efficiently, and did not tend to clump together. Generally, only the cinders needed occasional breaking. The similar "T" bar tool achieved this. A hoe bar was used to level the fire and clean out the lower ash pits. Finally, the poker bar reached in between the gratings and allowed the fireman to clean any ash or broken bit of coal out from within the slots (International

Figure 184. Cast iron wheel from a donkey engine (Artifact 132-011; scale cm./dm.).

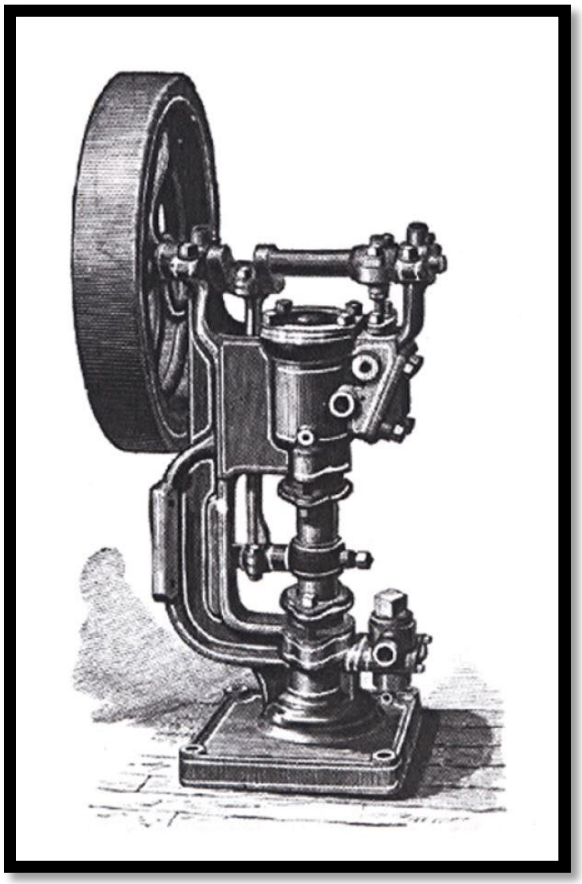

Figure 185. Example of a small auxiliary donkey engine (Whitham 1893:474).

Figure 186. Coal stoker handle (Artifact 133-132; scale cm.).

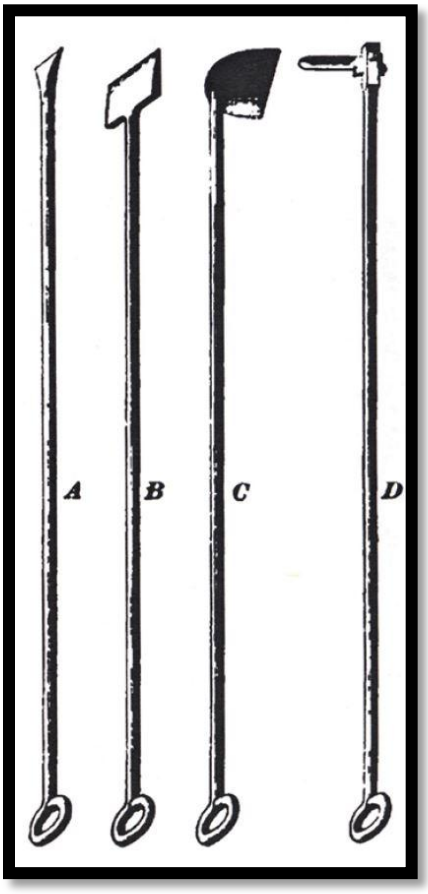

Figure 187. Examples of coal stokers
(International Correspondence Schools 1897: 454).

Figure 188. Cast iron sheaves with cupreous bearings (Artifacts 120-308 and 128-016).

Correspondence Schools 1897:454-455).

The two final artifacts (120-308 and 128-016) are both nearly identical, consisting of a sheave and pin (Figure 188). Individually, each sheave is made up of a cast iron wheel fitted with internal cupreous roller bearings. Within the bearings, both artifacts had a remnant of a wrought iron pin. The edges of the wheel are raised, creating a concave channel to carry a cable or chain. These artifacts seem like they were intended to carry an extremely heavy load. Although the use of these artifacts has not been conclusively identified, there is a possibility that they were used to haul heavy loads of coal. One theory suggests that they may have been positioned on each side of the boiler to allow for the quick transport and refilling of the coal bunkers.

Conclusion

The majority of the larger iron and cupreous artifacts recovered from *Westfield* came from its walking beam engine and boilers. A preliminary plan of *Westfield*'s

machinery was created using *Westfield*'s recorded measurements, the Memphis drawing, and the *Southfield* II plan. This plan was combined with the artifacts to determine how the machinery was designed.

Westfield's engine cylinder contained an internal diameter of 50 in. (1.27 m.). The combined height of *Westfield*'s cylinder and condenser assembly was 16 ft. (4.88 m.) tall including 10 ft. (3.05 m.) for the recorded cylinder stroke, plus 1 ft. (30.5 cm.) for the cover and piston bed, plus 5 ft. (1.52 m.) for the condenser. The bed timbers that supported the engine measured 6 ft. 11 in. (2.11 m.) high. Following *Westfield*'s reduction in cabin height, a box-like structure was constructed over the steam chest to protect the poppet valve assembly.

Underneath the condenser, water was drawn up through a channel way into the hot well reservoir. The channel way was at least 1 ft. (30.5 cm.) deep and almost rectangular with the exception that it slightly narrowed toward the air pump. The air pump contained an internal diameter of 40 in. (1.02 m.), while the hot well reservoir was 5 ft. 4 in. (1.63 m.) internal diameter. *Westfield*'s air pump/hot well assembly theoretically was 6 ft. (1.83 m.) tall. Both the engine cylinder and the air pump/hot well assembly were bolted to a base plate. This base plate was in turn secured to the vessel's engine bed timbers with massive wrought iron bolts and cast iron washers.

Westfield's A-frame measured 40 ft. (12.2 m.) tall. The primary wooden structure flared out to 285 and 255 degrees. The secondary beams that supported the paddlewheel shaft flared out to 245 degrees. The beams measured 1 ft. 6 in. (31.7 cm.) thick at the highest point. Numerous iron rods and turnbuckles secured the A-frame within the hull.

Westfield's walking beam diamond measured 20 ft. (6.10 m.) wide by 9 ft. (2.74 m.) tall. The paddlewheel shaft was recorded as 13 in. (33 cm.) in diameter. The crank arm measured 5 ft. (1.52 cm.) center point to center point, and approximately 6 ft. (1.83 m.) long edge of paddlewheel shaft to edge of connecting hub. *Westfield* required a connecting arm approximately 26 ft. 6 in. (8.08 m.) long, center point to center point. The connecting links that reached down to the piston rod necessitated a length of 11 ft. 6 in. (3.51 m.) long, also center point to center point. The eccentric arm required an approximate length of 25 ft. (7.62 m.).

Westfield utilized two return flue boilers to create steam for the walking beam engine. One boiler was likely cleared from the site by the USACE's predecessor organization in 1906. Each boiler originally measured 24 ft. (7.32 m.) long and 9 ft. 3 in. (2.82 m.) wide. The firebox consisted of two furnaces, each measuring approximately 6 by 4 ft. (1.83 by 1.22 m.) that were connected to one another and to the outer water jacket by a series of staybolts. This arrangement created three water legs, one between the furnaces, and one on each side of the firebox. Three different-sized hand holes types accessed different parts of the water jacket. Man holes permitted people to climb into the boiler's interior, one at the rear, one on top, and likely one in the front. Each furnace contained two rows of fire grates, with 12 grates in each row, supported by three perpendicular bearing bars. The fire doors and ash-pits consisted of one opening. The opening was functionally separated by a shelf on the forward bearing bar. The fire doors contained opening levers on the front and heat shields or baffle plates on the back. The boiler room deck was covered with cast iron diamond-patterned scuff plates. Open

diamond panel grating was utilized above the boiler room, on the main deck, to allow heat generated from below to escape.

Two large 1-3/4 ft. (4.44 cm.) round diameter flues and two smaller 1 ft. (30.5 cm.) diameter flues carried heat to the combustion chamber at the rear of the boiler. The heat returned to the front of the boiler through smaller fire tubes. The flues, combustion chamber, and fire tubes, were all encased in a large water filled 8 ft. (2.44 m.) diameter barrel mounted to the back of the firebox. The combustion chamber at the back of the barrel was accessed through a large round door. The fire tubes terminated in a chimney flue chamber above the fire doors and the inner furnaces. Spanning the front of the boiler, at least three or four of these doors permitted interior access. The heat rose up the chimney flue, into the smoke stack, and left the vessel. Since the two boilers shared a common smoke stack, the steam drum was comprised of two separate compartments that surrounded the stack to ensure that if one boiler became compromised, the other could continue to operate. The boilers were secured within the hull and to each other by large iron straps. Normally, *Westfield*'s engine pumped water into the boilers. However, when the engine was not in operation, the boilers instead relied on a smaller, independently-run donkey engine. Water refilled the boiler through a pipe mounted behind the firebox.

Due to the extreme pressures within the boiler, the internal structure incorporated many strengthening devices including a variety of staybolt types, girder stays, and longitudinal and vertical supports in the form of crowfoot fasteners.

See Figures 189 and 190 for a reconstruction of *Westfield*'s boilers.

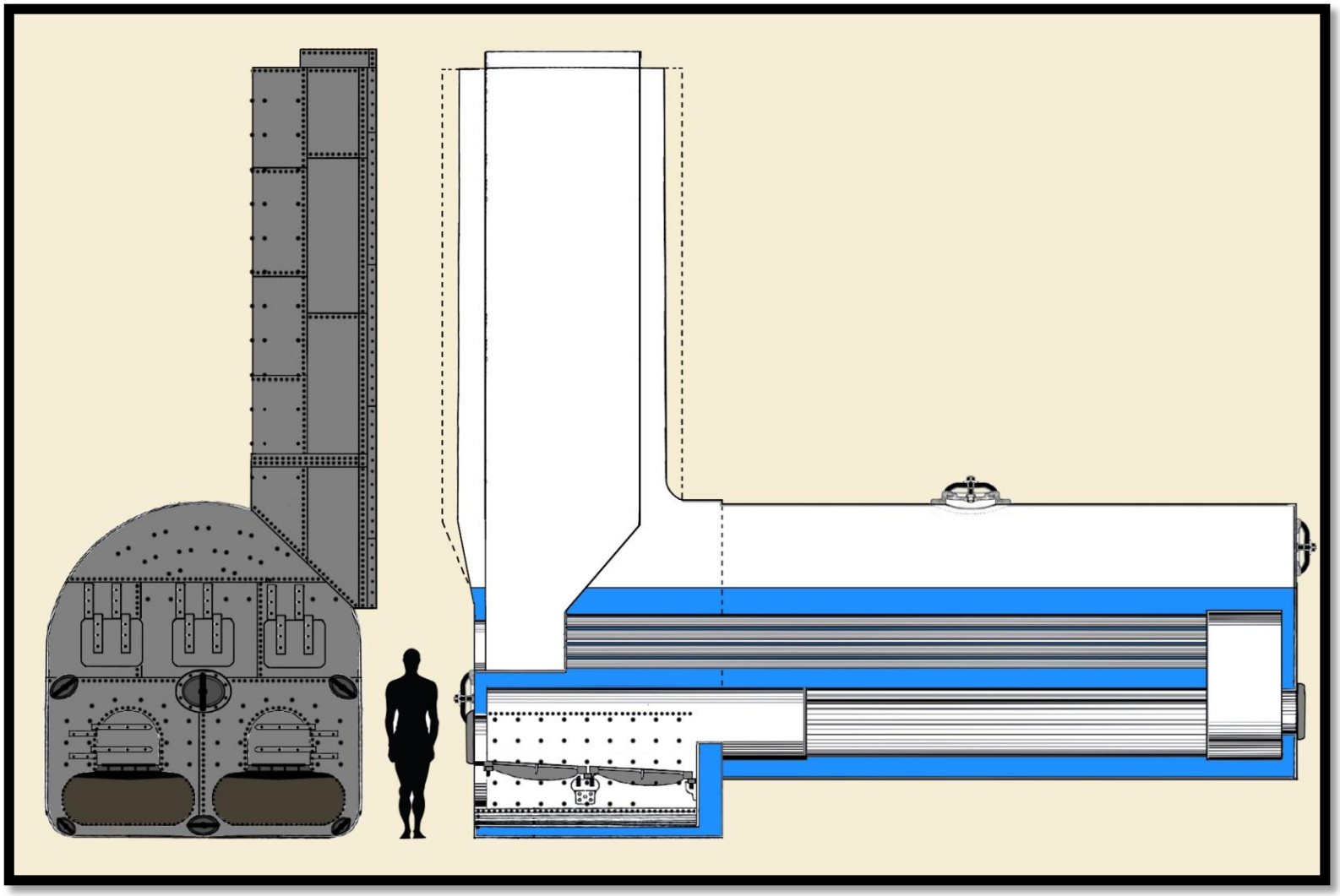

Figure 189. Reconstruction of *Westfield*'s port boiler (by author).

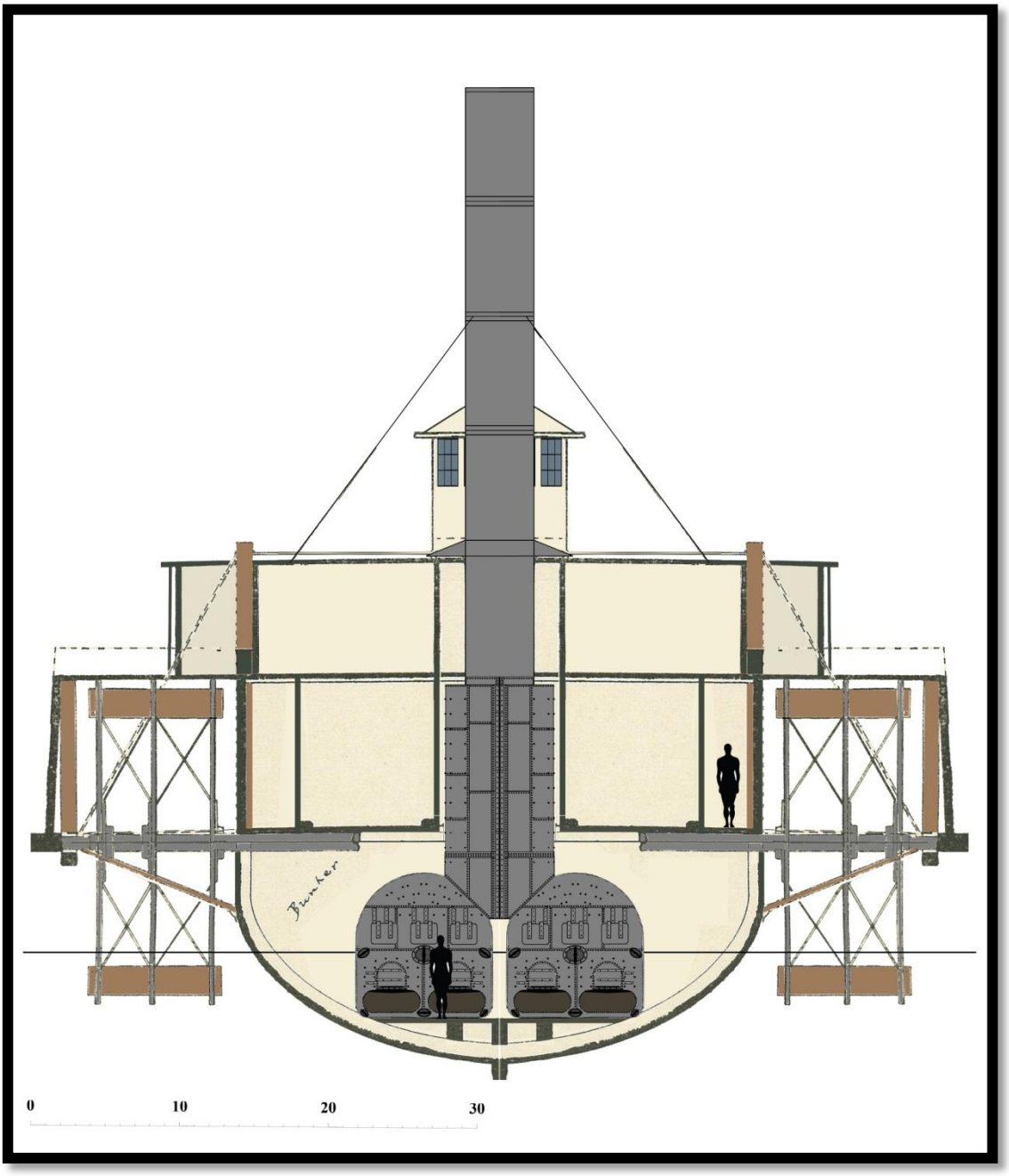

Figure 190. Reconstruction of *Westfield*'s boilers in the lower hull of the ferryboat (by author).

CHAPTER VI

CONCLUSIONS

Introduction

This study examined *Westfield*'s brief history, reconstructed the vessel's plan through historical documentation, and analyzed the recovered artifacts to determine the vessel's construction and steam machinery. Although the wreck site was heavily disarticulated due to the nature of *Westfield*'s explosive destruction, salvage attempts, site clearing operations, and the dynamic nature of the wreck's environment, an abundance of information was obtained from both the artifact assemblage and the archival research conducted.

History

Westfield's time as both a Staten Island ferry and as a U.S. Navy vessel were short lived. *Westfield* served only four months in the ferry service between July and November of 1861 before the Navy purchased the vessel for the war effort. *Westfield* underwent an extensive refit to convert the ferry into a gunboat between December, 1861, and February, 1862. Later that month, the vessel was relaunched and commissioned into the U.S. Navy as USS *Westfield*. *Westfield*'s U.S. Navy career lasted for slightly less than a year. Despite this, *Westfield*'s naval service was eventful and made a significant contribution to the Union's war effort. As a shallow draft vessel, *Westfield* was able to travel into rivers and tributaries that larger ships in the blockading fleet could not reach to deliver troops and to assist in offensive operations. *Westfield* was

used extensively as a towing ship to pull other ships over the sandbars leading into the Mississippi River and to position mortar schooners in range of their targets. When the Confederate troops sent fire rafts down the Mississippi River, *Westfield*'s crew used water hoses retained from the vessel's time as a ferry to extinguish the fires. *Westfield* participated in numerous engagements such as the Battle of Forts Jackson and St. Philips and an assault on Vicksburg. In addition to other skirmishes, the vessel carried out continuous naval operations in the West Gulf Blockading Squadron before being assigned flagship status to set up a Union foothold in Texas. After a leading role in the successful capture of Galveston, *Westfield* strictly enforced the Union's blockade, capturing Confederate prizes and harassing Texas coastal towns. On New Year's Day, 1863, Confederate forces launched a surprise attack on Union forces in Galveston, successfully recapturing the island and forcing the Union Navy from the bay. After running aground during the battle, *Westfield* was scuttled by Union forces to keep the vessel out of enemy hands. The loss of both *Westfield* and Galveston had lasting effect on the Union's operations in Texas. Galveston remained in Confederate hands for the duration of the war and *Westfield*'s visible wreckage served as a continuous reminder of the Confederacy's victory over a stronger enemy. The last of *Westfield*'s scattered remnants were removed from the bay in 2009 during the USACE's operations to deepen the Texas City Channel. The remains were sent to the CRL at Texas A&M University where archaeologists were able to conserve and study a rare type of converted naval vessel. The result of those investigations offered a glimpse into Texas' Maritime history, and a vessel, the loss of which contributed to the Union's failure to retain control of a

naval base in Texas during the American Civil War.

Historical Documentation

Archival research into *Westfield*'s appearance offered numerous insights into the vessel's design that were not available from the artifact assemblage alone. *Westfield*'s wreck site was too highly degraded to determine how the vessel appeared either prior to naval conversion or after. Luckily, research proved that *Westfield*'s class of vessel changed little over the course of a thirty-year period. By combining information obtained from numerous sister ships constructed over that period, a detailed hypothetical reconstruction of *Westfield* was created. Archaeological investigations conducted on *Westfield*'s sister ship, *Southfield*, offered a starting point into understanding the basic layout of the vessel's main deck and shape. From there a generalized plan of *Southfield*'s successor, *Southfield* II, filled in areas of the layout that were not available from *Southfield* (I)'s excavation. From this information, it was ascertained that *Westfield* contained a doubled-ended design with two rudders (one on each end) that allowed the ferry to travel in either direction. To turn one end into a bow, a crewman dropped a pin through the deck and into a metal swing arm attachment, effectively locking the rudder in place. When docked in a ferry berth, passengers and horse teams entered from the stern/bow of the vessel. After crossing above the rudder, wagons and horse teams were parked in the center of the vessel, in two longitudinal corridors within the main superstructure, one on each side of a central machinery compartment. Passengers were guided away from the center of the deck into side cabins adjacent to the two corridors.

To reconstruct these spaces on paper, surviving historical measurements of *Westfield* were applied, and the *Southfield* II plan was scaled to meet those parameters. The result created a ferryboat design that was 225 ft. (68.6 m.) length over all, 213 ft. 4 in. (65 m.) loaded water line, 63 ft. (19.2 m.) beam over guards (approximate), 34 ft. (10.4 m.) lower hull beam (internal measurement), 12 ft. 11 in. (3.94 m.) depth of hold (measured from the underside of main deck to the boiler room flooring), and an estimated 8-1/2 ft. (2.57 m.) loaded draft. Historical photographs filled some details not available from the *Southfield* II plan alone. New York ferries in general were built to carry extremely heavy loads. The construction supported not only the thousands of passengers who used these vessels daily, but the added weight of material goods that were brought on board by horse teams. A photo of the burned out hull of the ferryboat *Plainfield* showed some of this construction. To counteract the weight that these vessels carried, *Westfield* required heavy internal bracing to support the hull and main deck. This consisted of not only closely-set framing, but also cross framing and a massive keelson and sister keelsons to support the weight of both the engine and the boilers. Additional photographs of *Westfield*'s sister ships filled in the smaller details of the vessel's superstructure. A stereoview of an unknown *Westfield* was recovered during archival research. This vessel could be either the first *Westfield* that this dissertation documents or the successor vessel *Westfield* II. Based on photographs of *Southfield* and the later sister vessels, the unknown *Westfield* stereoview represents a transitional phase between *Southfield*'s construction and the refits on the later sister ships. The available evidence suggests the unknown *Westfield* stereoview represents the best example of how the first *Westfield*

was likely constructed. The vessel portrayed a double-ended ferryboat with a central cabin. Above the main cabin, a saloon deck was added for extra passenger space. Unlike the later sister ships, the saloon deck was unrefined and the design required modifications to take place on successor vessels before a standard plan was adopted. In appearance, the saloon deck was rectangular with a crowned hurricane roof that extended out slightly towards the sides of the vessel. Above the hurricane roof, two identical pilot houses were placed at the forward and after ends. The *Southfield* II-based *Westfield* reconstruction was altered to incorporate these newer details. This completed the basic design of how *Westfield* likely appeared as a Staten Island ferry.

Understanding *Westfield*'s conversion to a naval vessel was also accomplished through historical documents. The most useful source of information came from an eyewitness profile of the vessel that was sketched two weeks prior to *Westfield*'s destruction (Memphis drawing). This drawing of the gunboat, complemented by Navy yard correspondence recovered from the National Archives in Washington, D.C., and the New York Historical Society in Manhattan, explained what types of refits were desired by the Navy on *Westfield*. The changes that took place on *Westfield* were made clear by comparing the gunboat sketch of *Westfield* to ferryboat photographs. *Westfield*'s modifications were extensive. The vessel's upper saloon deck and hurricane roof were removed. The main cabin was cut down from 10 ft. to 8 ft. (3.05 to 2.44 m.). One segment of the smoke stack was removed. Two open foyers at the forward and after ends of the main cabin were demolished, reducing the length of the main cabin structure. The result expanded the open deck areas allowing for those spaces to be reutilized as large

gun platforms. But without the extended roof above the foyers, the pilot houses had to be lowered and moved inboard closer to the ship's center part, placing them above the central machinery compartment.

The paddlewheels on the sides of *Westfield*'s wide main deck overhung a narrower lower hull. Diagonal supporting sponsons mounted just above the copper-sheathed waterline ensured that the overhanging deck did not hog down over the sides. The original sponsons were designed for a vessel navigating protected waterways. Since the Navy intended to send *Westfield* into the Gulf of Mexico, these sponsons risked being ripped from the vessel if traveling through rough waters. To prevent this threat, the Navy enclosed these sponsons with planking. This modification created large blisters on each side of the hull, both fore and aft of the paddlewheels. Enclosing the sponsons prevented *Westfield*'s tall rectangular rudders from turning completely without hitting the newly created blisters. To counteract this problem, the rudders were cut down in height, leaving only the rudder post and the metal swing arm that supported the lock pin assembly intact. After the modification, the surviving lower part of the rudder regained maneuverability allowing the swing arm to pass just beyond the range of the two hull blisters.

Westfield's original main deck cabin structure was divided into four passenger cabins, two open horse team corridors, and a central machinery compartment. Following conversion, the horse team corridors were enclosed by new doors on each end. Passenger benches were removed from these large cabins and the interior space was partitioned into smaller cabins that served as quarters for the naval officers stationed onboard.

The most noticeable modification that took place on *Westfield* was the Navy's addition of iron plates that wrapped around the vessel's bulwarks. Large 5 by 5 ft. (1.52 by 1.52 m.) boiler plates protected the main cabin as well as several broadside gun ports that were placed just past the cabin's limits. The height of these plates required the passenger windows to be replaced by smaller portholes which further protected the officers' quarters. Beyond these large plates, shorter plates, approximately 3 by 2-1/2 ft. (91.4 by 76.2 cm.), could be raised or lowered to facilitate the use of long range pivot guns located at the bow and stern.

Artifacts from Construction

Following *Westfield*'s discovery, archaeologists immediately recognized that very few elements of the gunboat's architecture remained intact. The wreck site consisted of a disarticulated debris field spread out over a large area. Despite this, certain artifacts were used to infer details about *Westfield*'s construction. The Memphis drawing shared that the former ferryboat had undergone significant changes. The most recognizable of these changes was the addition of plate armor to the vessel's bulwarks. A large quantity of this armor was recovered from *Westfield*'s wreck site. Although highly corroded, archaeological conservators determined that the original thickness was 5/16 in. (7.94 mm.) thick, likely sufficient only to protect the gun crews from small arms fire and possibly small canister shot. Three types of this armor was found. This included large 5 by 5 ft. (1.52 by 1.52 m.) plates that protected the main cabin and broadside gun decks, a 5 by 3 ft. (1.52 by 0.914 m.) hinged plate for the broadside guns, and 3 by 2-1/2 ft.

(91.4 by 76.2 cm.) hinged plates for the bow and stern long range pivot guns. As a second line of defense behind the iron bulwark armor, *Westfield*'s open gun decks were enclosed by anti-boarding nets. The nets, visible in the Memphis drawing, are represented by a stanchion socket recovered from the wreck site. When needed, stanchions would be placed upright into sockets of this type allowing the netting to be draped between them.

Evidence of *Westfield*'s window configurations survived from both before and after naval conversion. Numerous sash weights were recovered that once served as counterbalance weights for large windows. Due to the rushed nature of *Westfield*'s conversion, many of these sash weights were likely left in the walls after the window frames were removed. Recovered fragments indicate that *Westfield* utilized two sizes of portholes. The smaller size may have been used in the lower hull when *Westfield* was a ferry. Based on the Memphis drawing, the larger size came from portholes that replaced the passenger windows.

As a ferryboat, *Westfield*'s former passenger cabins were only large enough for benches placed along the walls. These benches were removed when the cabins were divided up for naval use. A variety of recovered cupreous cupboard objects suggest that new storage lockers were installed in the cabins to accommodate the equipment and belongings of officers stationed aboard *Westfield*.

Westfield's lower hull did not survive, however numerous components from that structure were recovered. The largest quantity of these components consisted of fasteners. This included tacks, spikes, bolts, and screws. For every cupreous fastener

discovered there was usually an iron counterpart. The cupreous fasteners came from areas of the vessel at or below the waterline, while iron fasteners were used inside the hull or in the vessel's superstructure where they could be painted to prevent corrosion. Short lengths of chain were found in what archaeologists believe was *Westfield*'s stern area. Based on the recovered location, this chain was likely used to steer *Westfield*'s stern rudder.

The lower hull below the waterline was originally sheathed with copper plates. Only a few fragments of these plates were found indicating that most of this metal was likely salvaged. Some artifacts show evidence that salvage took place, saw marks and hack marks for example indicate which artifacts were removed by force.

Artifacts from Steam Machinery

The majority of the largest iron and cupreous artifacts recovered from *Westfield* came from the vessel's walking beam engine and boilers. To understand how these pieces fit in context with the vessel's original design, a preliminary plan of *Westfield*'s machinery was created using historical sources. These sources included *Westfield*'s recorded measurements, the Memphis drawing, and the *Southfield* II plan. Information from the artifacts were then interwoven into that plan to create a representation of how the machinery was designed.

Based on the numerous recovered fragments, *Westfield*'s engine cylinder contained an internal diameter of 50 in. (1.27 m.). This measurement correlated with the historical record. The combined height of *Westfield*'s cylinder and condenser assembly

was about 16 ft. (4.88 m.) tall including 10 ft. (3.05 m.) for the historically recorded cylinder stroke, plus 1 ft. (30.5 cm.) for the cover and piston bed, plus 5 ft. (1.52 m.) for the condenser. The condenser height was reconstructed by comparing the Memphis drawing with the *Southfield* II plan. Continuing with that comparison, the bed timbers that supported the engine were placed above the hull frames and measured 6 ft. 11 in. (2.11 m.) high. Following *Westfield*'s reduction in cabin height, the upper portion of the cylinder and steam chest became exposed to the elements. To protect the steam chest, a box-like structure was constructed over the assembly as is evidenced on the Memphis drawing.

Underneath the engine cylinder base plate, a channel way carried condensed water from the condenser to the air pump cylinder. Based on the artifacts, this channel way was at least 1 ft. (30.5 cm.) deep and almost rectangular with the exception that it slightly narrowed towards the air pump to accommodate the smaller diameter of the air pump cylinder. No historical information was found regarding the construction of *Westfield*'s air pump and hot well. Recovered fragments indicate that the air pump contained an internal diameter of 40 in. (1.02 m.), while the hot well reservoir above it was 5 ft. 4 in. (1.63 m.) internal diameter. The exact height of the air pump/hot well assembly can only be speculated. On most walking beam engines, this dual assembly generally extended just slightly above both the condenser and the engine cylinder's lower piston bed. Applying this generality to *Westfield*, the height was approximately 6 ft. (1.83 m.) tall. Both the engine cylinder and the air pump/hot well assembly were bolted to a base plate. This base plate was in turn secured to the vessel's bed frames with

massive wrought iron bolts. Cast iron washers lay between the head of these bolts and the base frame.

Westfield's walking beam A-frame measured approximately 40 ft. (12.2 m.) tall. One of the large bearing blocks from the peak of this A-frame was recovered. Molded angles on the lower part of the artifact flared out to 285 and 255 degrees, indicating the angle of the wooden structure that supported the walking beam. The upper components had angles that measured 285 and 245 degrees. The 245 degree measurement indicates the angle for the secondary beams that supported the paddlewheel shaft. The depth of these two components measured 1 ft. 6 in. (45.7 cm.), indicating the thickness of the beams at the highest point of the A-frame. Numerous iron rods secured the A-frame within the hull. These iron rods were tightened using turnbuckles.

Although *Westfield*'s walking beam diamond was not recovered, measurements taken from USS *Clifton*'s surviving diamond indicate that *Westfield*'s once measured 20 ft. (6.10 m.) wide by 9 ft. (2.74 m.) tall. Other missing components were reconstructed based on historical evidence and proportion. *Westfield*'s paddlewheel shaft was historically recorded as 13 in. (33 cm.) in diameter. Based on *Westfield*'s 10 ft. (3.05 m.) engine stroke, the crank arm measured 5 ft. (1.52 m.) center point to center point, and approximately 6 ft. (1.83 m.) long from the edge of paddlewheel shaft to the edge of the connecting hub. Correlating the position of the paddlewheel shaft and crank arm in relation to the reconstructed A-frame and walking beam shows that *Westfield* required a connecting arm approximately 26 ft. 6 in. (8.08 m.) long, center point to center point. On the opposite side of the walking beam, the connecting links that reached down to the

piston rod necessitated a length of 11 ft. 6 in. (3.51 m.) long, also center point to center point. The eccentric arm required an approximate length of 25 ft. (7.62 m.) to reach from the paddlewheel shaft to the rocker arm.

While only one firebox assembly was recovered from the wreck site, historical data indicates that *Westfield* utilized two return flue boilers to create the steam required to power the walking beam engine. This data was substantiated by certain recovered artifacts that were part of a missing boiler. The missing boiler was likely cleared from the site by the USACE's predecessor organization in 1906. Each boiler originally measured 24 ft. (7.32 m.) long and 9 ft. 3 in. (2.82 m.) wide. The firebox consisted of two furnaces, each measuring approximately 6 by 4 ft. (1.83 by 1.22 m.) that were connected to one another and to the outer water jacket by a series of staybolts spaced 8-1/4 in. (2.44 m.) apart horizontally, and 7-1/4 in. (2.14 m.) apart vertically. This arrangement created three water legs, one between the furnaces, and one on each side of the firebox. To access different parts of the water jacket surrounding the firebox, numerous hand holes were placed to permit occasional cleaning. Artifacts from three different sizes of these access holes were recovered. A larger version, known as a man hole permitted human access into the boiler's interior. One of the recovered man holes came from the rear of the boiler. Rounded fragments of another manhole indicate that one was placed on the round top of the boiler barrel, near the back. Inside the firebox, each furnace contained two rows of fire grates, with 12 grates in each row. Perpendicularly placed bearing bars supported these grates from below. The fire doors and ash-pits on the front of each boiler consisted of one opening, narrower at the top,

and wider at the bottom. The opening was separated by a shelf on the forward bearing bar that extended out into the water jacket. To access the firebox, a crewmember lifted a lever on the fire door out of a securing cradle. On the backside of the fire door, a perforated baffle plate helped reduce the amount of heat that faced the firemen. To prevent slipping, the floor of the boiler room was covered with cast iron diamond patterned scuff plates. Another type of diamond panel was utilized above the boiler room, in the upper machinery compartment of the main deck. This diamond panel was open so the heat from below could be vented from the lower engine compartments.

The heat from the furnaces left the firebox area through two large 1-3/4 ft. (4.44 cm.) round diameter flues and two smaller 1 ft. (30.5 cm.) diameter flues that were placed at the central and rear portions of the boiler. These flues entered a rear combustion chamber where the heat was able to rise before returning to the front of the boiler through smaller fire tubes. The flues, combustion chamber, and fire tubes, were all encased in a large water filled-barrel mounted to the back of the firebox. Based on recovered boiler mounts that once supported the barrel, the diameter measured 8 ft. (2.44 m.). To access the combustion chamber for cleaning, a large round door was mounted at the back of this barrel. The fire tubes terminated at the front of the boiler in a large chimney flue chamber situated above the fire doors and the inner furnaces. A single access door for maintaining and cleaning this chamber was found. Spanning the front of the boiler, at least three or four of these doors permitted interior access. From the chimney flue, the heat rose up into the smoke stack and left the vessel. Since the two boilers shared a common smoke stack, the steam drum was comprised of two separate

compartments that surrounded the stack. These compartments were attached using massive staybolts. The division of the steam drum ensured that if one boiler became compromised, the other could continue to operate and deliver steam to the engine.

The boilers were secured within the hull and to each other by large iron straps. Evidence of these straps were found on two artifacts, one from the rear of the boiler barrel and one from the back of the firebox. Below the strap from the firebox, a cupreous pipe flange indicated where water refilled the boilers.

The most abundant recovered boiler artifact consisted of internal staying devices. Due to the extreme pressures within the boiler, the internal structure incorporated many strengthening devices such as a variety of staybolts, girder stays, and longitudinal and vertical supports in the form of crowfoot fasteners.

Westfield's engine powered two side pumps (one was recovered) that refilled the boilers with water. When the engine was not in operation, the boilers instead relied on a smaller, independently-run donkey engine. Evidence of this engine survived in a flywheel that was once fitted with a belt.

Closing

When the excavations first recovered *Westfield*'s artifacts, the assemblage appeared as a non-diagnostic collection of concreted scrap iron. Yet, after conservation efforts removed the marine concretion, the features of numerous machined and complex cast iron and wrought components became visible. Careful observation and study determined that many of the artifacts originated from *Westfield*'s steam machinery.

Despite the incomplete state of the machinery and the lack of original architectural plans of the vessel, the recovered fragments offered a considerable amount of information about proportional sizes and how the artifacts once functioned. In time, enough information was gathered from both the artifacts and the historical record to reconstruct the vessel and the individual components of the steam machinery. These reconstructed components were placed onto a theoretical plan. This process allowed missing components to be identified and restored based on required proportional needs. From the available data, the combined reconstruction in this dissertation represents the most accurate portrayal of how *Westfield* and the vessel's machinery structurally appeared.

In closing, the process that led to this reconstruction proves that even the most fragmentary archaeological resources can be an asset if properly utilized. While *Westfield* is only 150 years old, its design is now largely forgotten or misunderstood. The availability of the collection presented a unique opportunity to examine a rare vessel class, early American steam machinery, and to answer questions about how the individual components operated.

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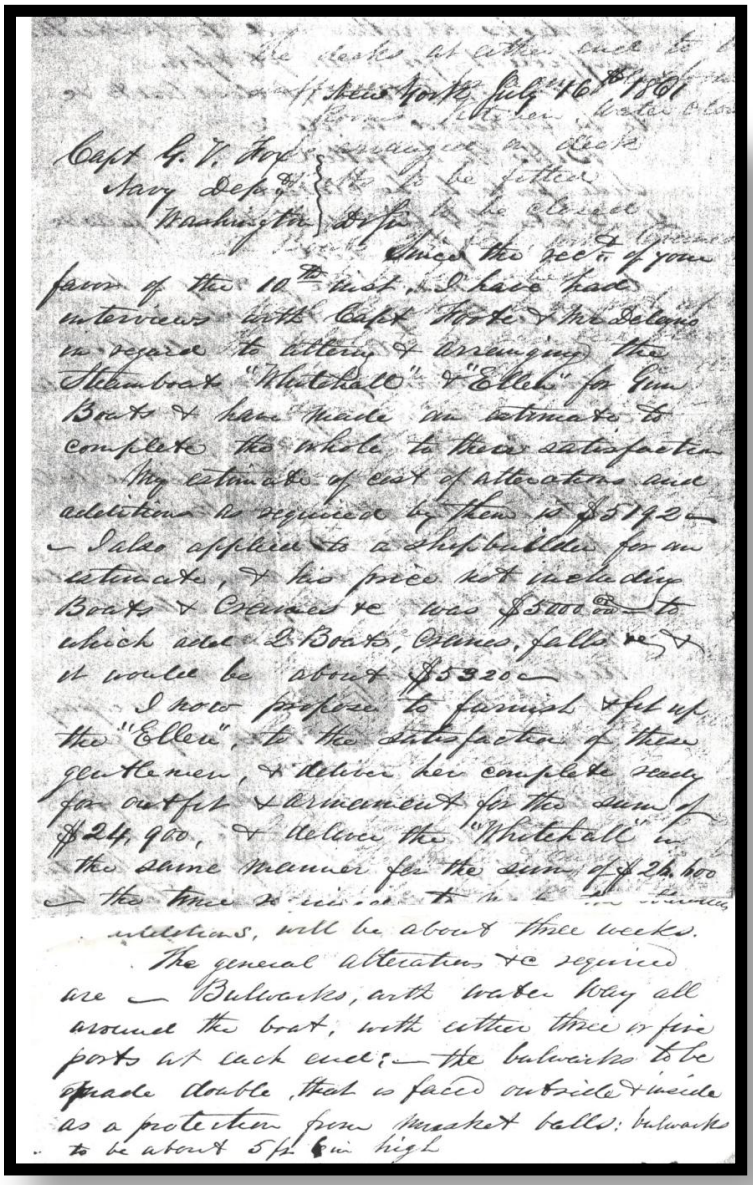
APPENDIX

HISTORICAL DOCUMENTS



New York July 16th 1861

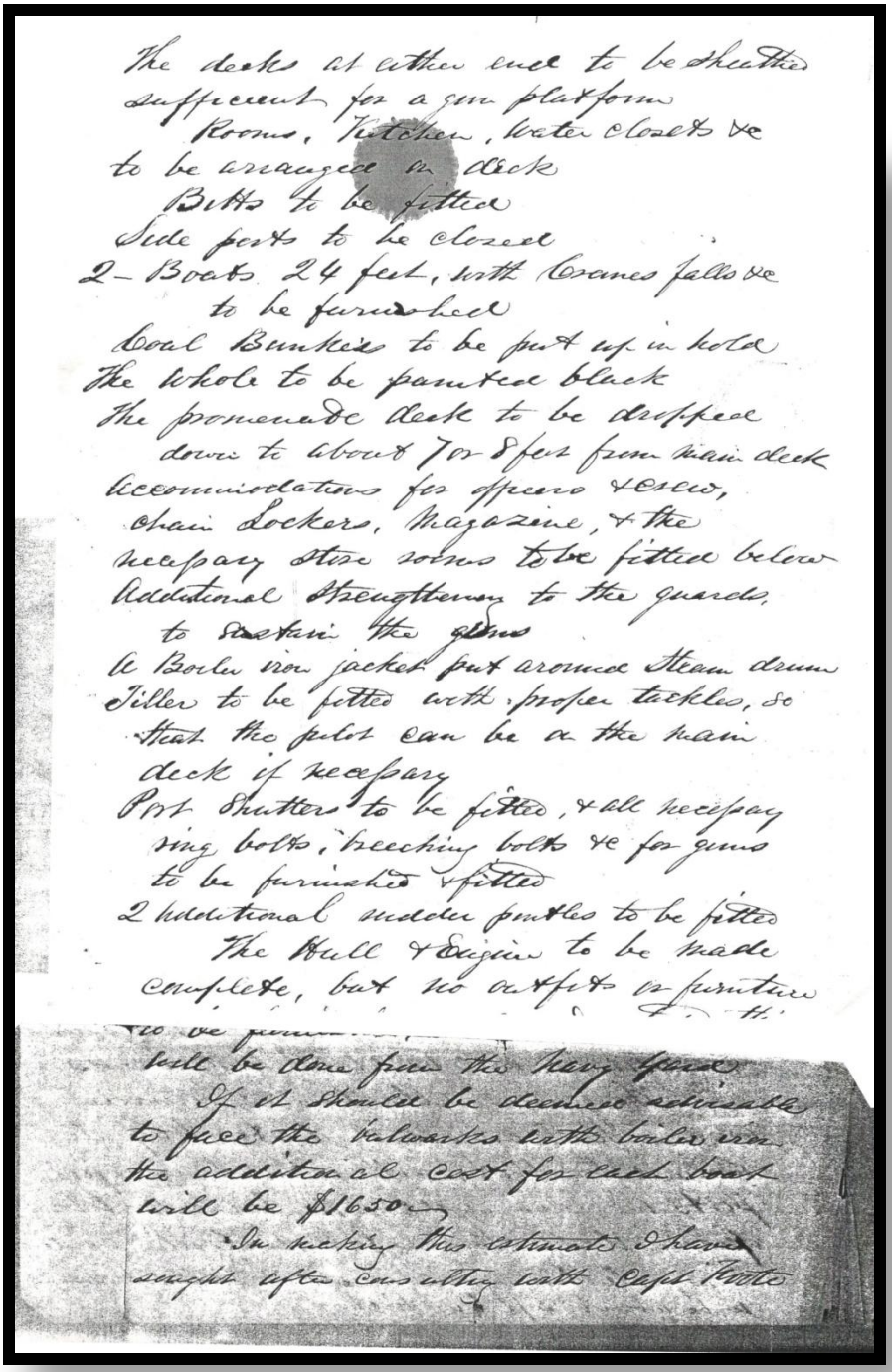
Capt G. V. Fox
Navy Dep't
Washington D.C.

Since the rec't of your favor of the 10th inst. I have had interviews with Capt Rowe & the Delano in regard to fitting & arranging the Steamboats "Whitehall" & "Ellen" for Gun Boats & have made an estimate to complete the whole to their satisfaction. My estimate of cost of alterations and additions as required by them is $5192— I also applied to a shipbuilder for an estimate, & his price not including Boats & Cranes &c was $5000— to which add 2 Boats, Cranes, falls &c & it would be about $5320—

I now propose to furnish & fit up the "Ellen", to the satisfaction of these gentlemen, & deliver her complete ready for outfit & armament for the sum of $24,900, & deliver the "Whitehall" in the same manner for the sum of $24,100 — the time required to make the alterations, will be about three weeks.

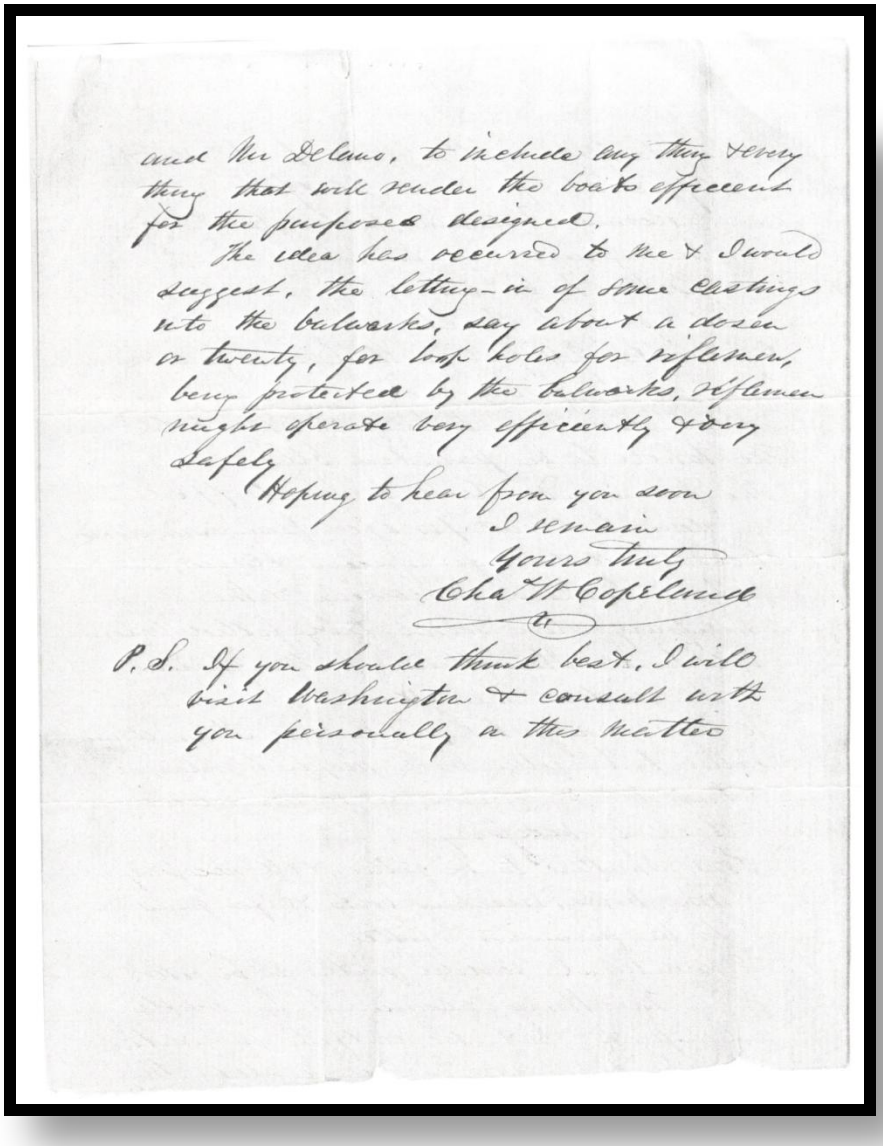
The general alterations &c required are — Bulwarks, with water ways all around the boat, with either three or five ports at each end;— the bulwarks to be made double, thick is faced outside & inside as a protection from musket balls: bulwarks to be about 5 ft 6 in high

Figure 191. Chars W. Copeland letter; 16 July 1861: page 1
(Image courtesy of the New York Historical Society; Reference: Gustavus V. Fox Papers, Box 1).



The decks at either end to be sheathed
sufficient for a gun platform
Rooms, Kitchen, Water Closets &c
to be arranged on deck
Bitts to be fitted
Side ports to be closed
2 - Boats 24 feet, with Cranes falls &c
to be furnished
Coal Bunkers to be put up in hold
The whole to be painted black
The promenade deck to be stripped
down to about 7 or 8 feet from main deck
Accommodations for officers & crew,
Chain Lockers, Magazine, & the
necessary store rooms to be fitted below
Additional Strengthening to the guards,
to sustain the guns
A Boiler iron jacket put around Steam drum
Tiller to be fitted with proper tackles, so
that the pilot can be on the main
deck if necessary
Port Shutters to be fitted, & all necessary
ring bolts, breeching bolts &c for guns
to be furnished & fitted
2 additional sudden ports to be fitted
The Hull & Engine to be made
complete, but no outfits or furniture
&c &c

will be done from this Navy Yard
If it should be deemed advisable
to face the bulwarks with boiler iron
the additional cost for each boat
will be $1650
In making this estimate I have
sought after consulting with Capt Porter



and Mr Delano, to include any thing & every thing that will render the boats efficient for the purposes designed.

The idea has occurred to me & I would suggest, the letting-in of some castings into the bulwarks, say about a dozen or twenty, for loop holes for riflemen, they protected by the bulwarks, riflemen might operate very efficiently & very safely

Hoping to hear from you soon

I remain

Yours truly

Chas W Copeland

P. S. If you should think best, I will visit Washington & consult with you personally on this matter

Figure 193. Chars W. Copeland letter; 16 July 1861: page 3
(Image courtesy of the New York Historical Society; reference: Gustavus V. Fox Papers, Box 1).

Transcription of 16 July 1861 Copeland Letter

New York July 16th 1861

Capt G.V. Fox
Navy Dept (?)
Washington

Difu (?)

Since the receipt of your favor of the 10th ___. I have had interviews with Capt Woode and Mr. Delano in regard to altering and arranging the Steamboats "*Whitehall*" & "*Ellen*" for Gun Boats and have made an estimate to complete the whole to their satisfaction.

My estimate of cost of alterations and additions as required by them is $5192-- --I also applied to a shop builder for an estimate, and his price not including Boats & cranes xe was $5000 (?)-- to which add 2 Boats, cranes, falls xe & it would be about $5320 --

I now propose to furnish & fit up the "*Ellen*," to the satisfaction of these gentlemen, and deliver her complete ready for outfit and armament for the sum of $24,900, and deliver the "*Whitehall*" in the same manner for the sum of $26,600

--The time [illegible] [illegible] to (letter torn and not legible)------- [illegible] --- --[illegible] ----[illegible] ----[illegible] make the alterations [illegible] and additions will be about three weeks.

The general alterations and [illegible] required are -- Bulwarks with water way [illegible] all around the boat, with either three or five ports at each end:--the bulwarks to be attached [illegible] double, that is faced outside and inside as a protection from musket balls: bulwarks to be about 5ft 6in high.

(Page 2)

The decks at either end to be sheathed sufficient for a gun platform.
Rooms, Kitchen, water closets xe to be arranged on deck.
Bolts to be fitted.
Side ports to be closed
2-Boats 24 feet, with Cranes fall xe to be furnished
Coal Bunkers to be put up in hold. The whole to be painted black
The promenade deck to be dropped down to about 7 or 8 feet from main deck accommodations for officers & crew, chain lockers, magazine, & the [illegible] store rooms to be fitted below additional strengthening to the guards, to sustain the guns
A Boiler iron jacket put around Steam [illegible] drum
Tiller to be fitted with proper tackles, so that the pilot can be on the main deck if necessary
Port shutters to be fitted, and all necessary rain bolts, breaching bolts and for guns to be furnished and fitted
2 additional rudder pintles [illegible] to be fitted
The hull and engine to be made complete, but no outfits as [illegible] furniture
To be [illegible] [illegible] [illegible] understated [illegible] this will be done from the Navy yard
If it should be deamed advisable to face the bulwarks with boiler iron the additional cost for each boat will be $1650

In making this estimate I have sought after (c[illegible]) [illegible] with Capt Woode

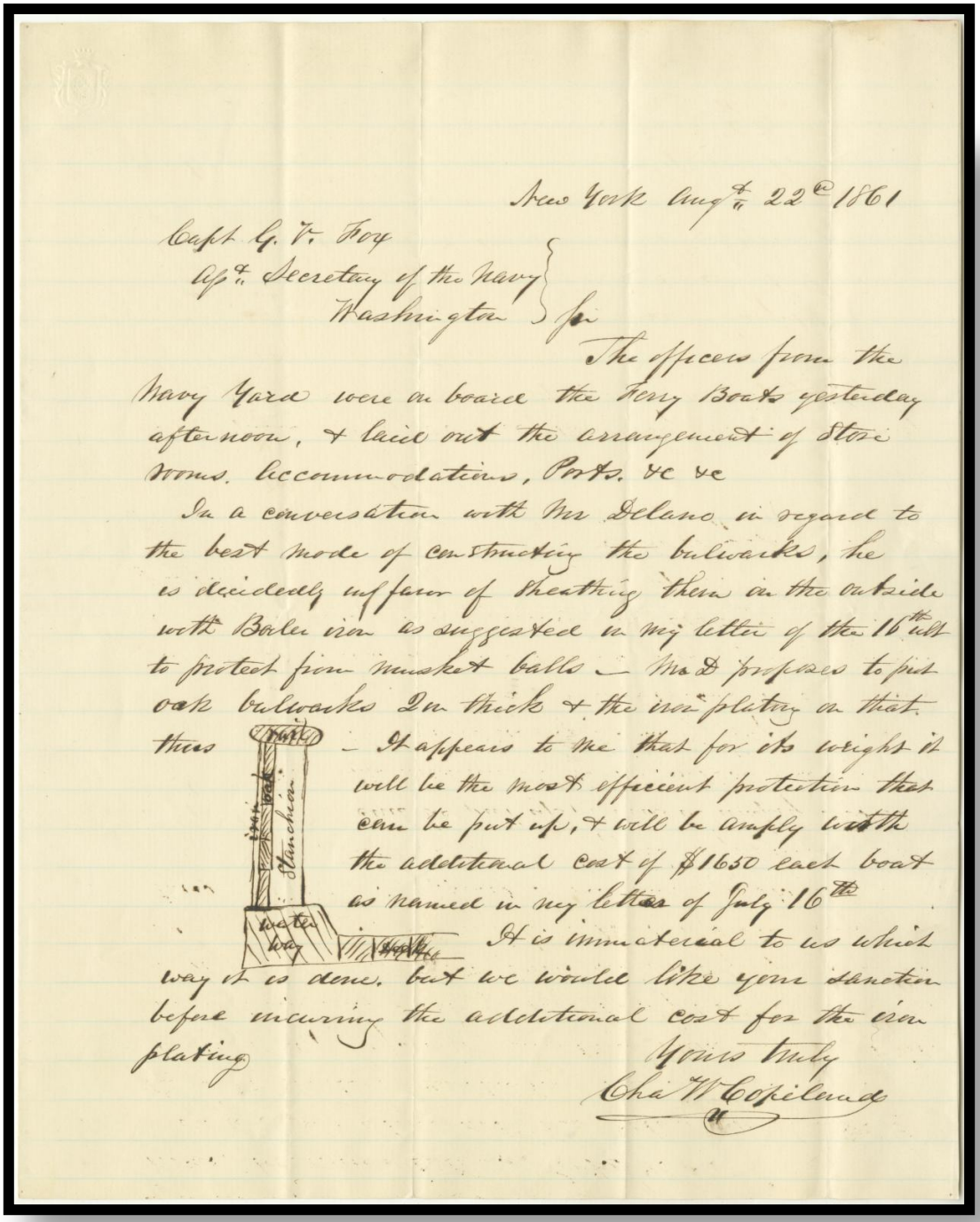
and Mr Delano, to include anything & everything that will render the boats efficient for the purposes designed.

The idea has occurred to me & I would suggest, the letting--in of source castings into the bulwarks, say about a dozen or twenty, for look holes for riflemen, being protected by the bulwarks, riflemen might operate very efficiently & very safely

Hoping to hear from you soon

I remain
Yours truly
Chars W. Copeland

P.S. If you should think best, I will visit Washington & consult with you personally on this matter



New York Augt 22d 1861

Capt G. V. Fox
Asst Secretary of the Navy
Washington

Sir

The officers from the Navy Yard were on board the Ferry Boats yesterday afternoon, & laid out the arrangement of Store rooms. accommodations, Ports &c &c

In a conversation with Mr Delano in regard to the best mode of constructing the bulwarks, he is decidedly in favor of sheathing them on the outside with Bales iron as suggested in my letter of the 16th ult to protect from musket balls — Mr D proposes to put oak bulwarks 2in thick & the iron plating on that thus

— It appears to me that for its weight it will be the most efficient protection that can be put up, & will be amply with the additional cost of $1650 each boat as named in my letter of July 16th

It is immaterial to us which way it is done. but we would like your sanction before incurring the additional cost for the iron plating

Yours truly
Chas W Copeland

Figure 194. Chars W. Copeland letter; 22 August 1861
(Image courtesy of the New York Historical Society; reference: Gustavus V. Fox Papers, Box 1).

Transcription of 22 August 1861 Copeland Letter

New York August 22nd 1861

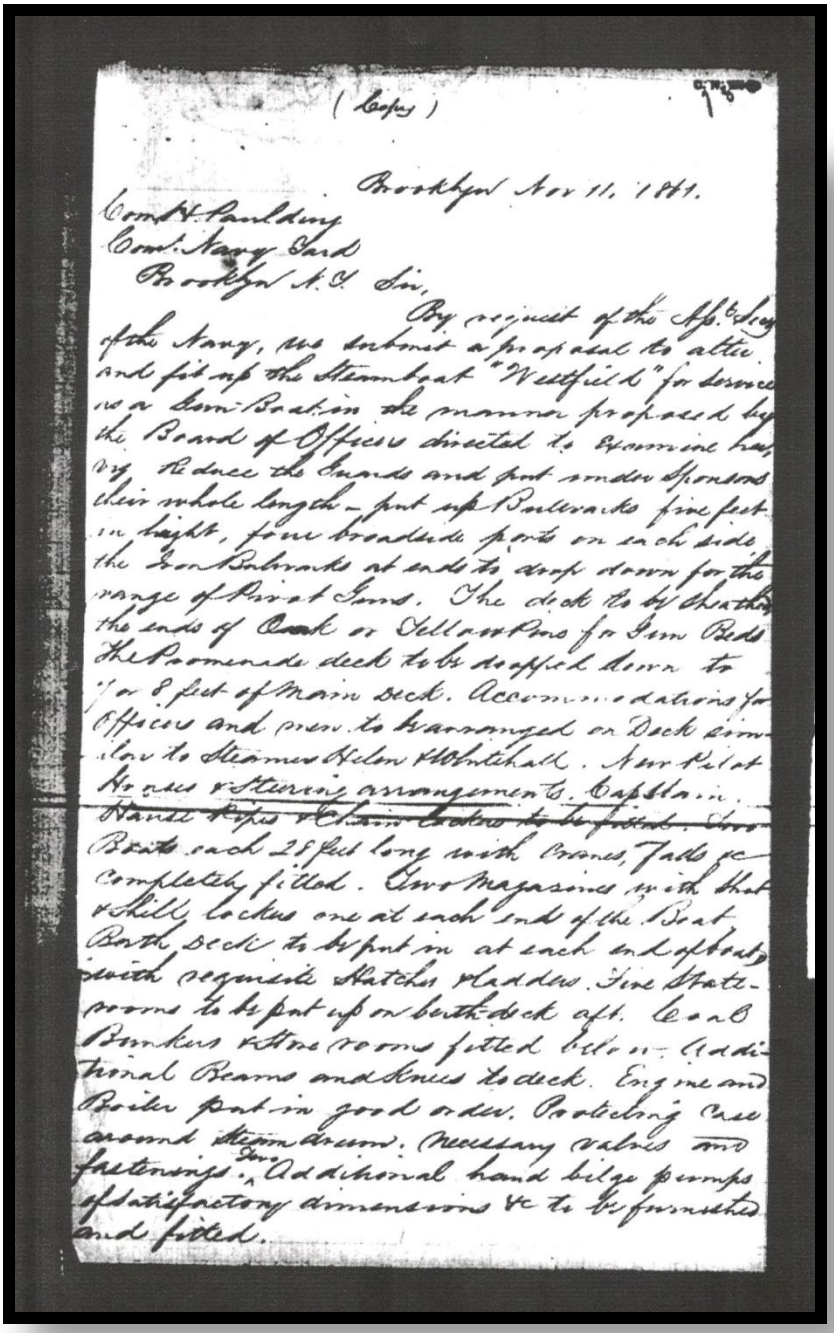
Capt G.V. Fox
Assistant Secretary of the Navy
Washington
} for

The officers from the Navy Yard were on board the ferry boats yesterday afternoon, & laid out the arrangement of store rooms, accommodations, ports, xe xe.

In a conversation with Mr. Delano in regard to the best mode of constructing the bulwarks, he is decidedly in favor of sheathing them on the outside with Boiler iron as suggested in my letter of the 11th July to protect from musket balls -- Mr. D proposes to put oak bulwarks 2in thick & the iron plating on that.

Thus -- It appears to me that for its weight it will be the most efficient protection that can be put up, and will be amply worth the additional cost of $1650 each boat as named in my letters of July 16th. It is immaterial to us which way it is done, but we would like your sanction before incurring the additional cost for the iron plating.

Yours truly
Chars W. Copeland



(Copy)

Brooklyn Nov 11. 1861.

Com.t H. Paulding
Com.r Navy Yard
Brooklyn N.Y. Sir,

By request of the Sec.y of the Navy, we submit a proposal to alter and fit up the Steamboat "Westfield" for service as a Gun Boat in the manner proposed by the Board of Officers directed to examine her, viz. Reduce the Guards and put under Sponsons their whole length - put up Bulwarks five feet in height, four broadside ports on each side, the Iron Bulwarks at ends to drop down for the range of Pivot Guns. The deck to be sheathed the ends of Oak or Yellow Pine for Gun Beds. The Promenade deck to be cut off down to 7 or 8 feet of Main deck. Accommodations for Officers and men to be arranged on Deck similar to Steamer Hetzel & Whitehall. A new Pilot House & steering arrangements. Capstan. ~~Hand Pipes & Chain Cables to be fitted.~~ Two Boats each 28 feet long with Cranes, Falls &c completely fitted. Two Magazines with shot & shell lockers one at each end of the Boat. Both decks to be put in at each end of boat with requisite Hatches & Ladders. Five State-rooms to be put up on berth deck aft. Coal Bunkers & Store rooms fitted below. Additional Beams and Knees to deck. Engine and Boiler put in good order. Protecting Case around steam drum. Necessary valves and fastenings. Additional hand bilge pumps of satisfactory dimensions &c to be furnished and fitted.

Figure 195. Chars W. Copeland and James Howe letter; 11 1861: page 1
(Image courtesy of the National Archives and Records Administration reference: Microfilm 124, Roll 390).

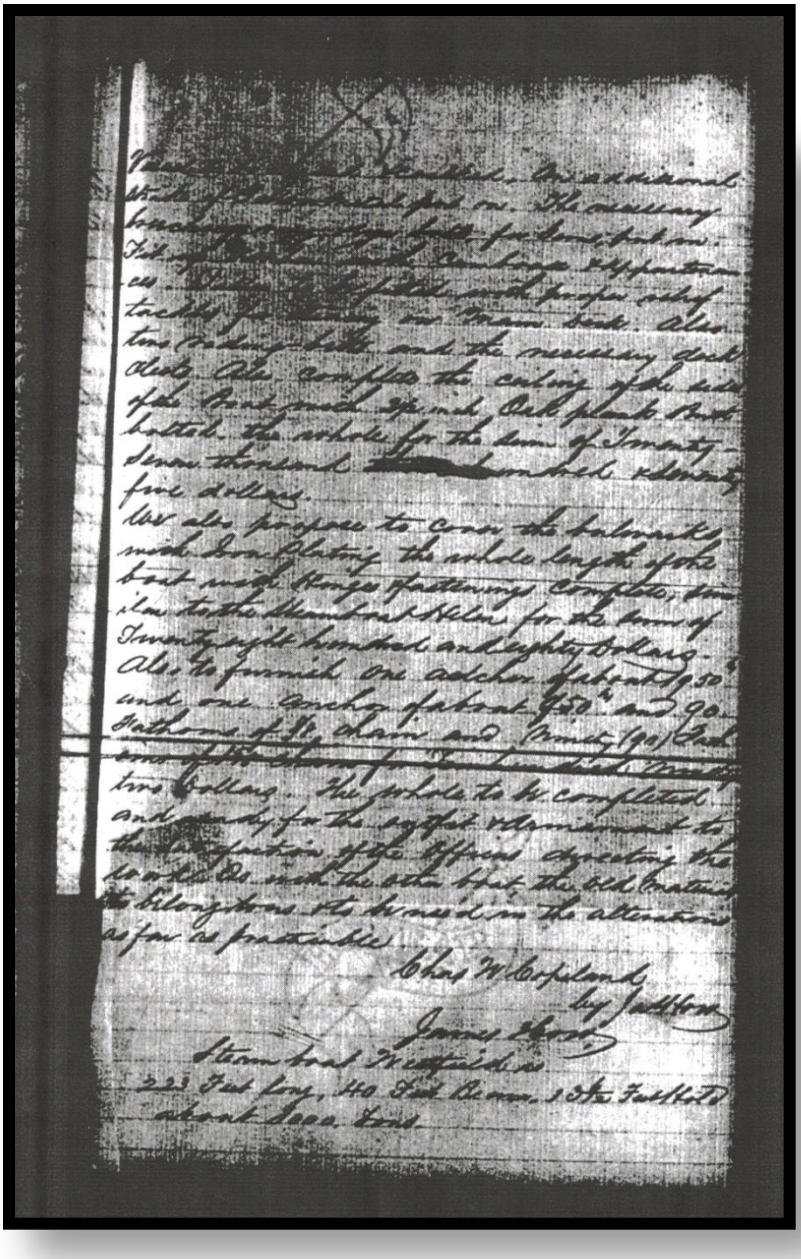


Figure 196. Chars W. Copeland and James Howe letter; 11 1861: page 2
(Image courtesy of the National Archives and Records Administration reference: Microfilm 124, Roll 390).

Transcription of 11 November 1861 Copeland and Howe Letter

Brooklyn Nov 11th 1861

Com H. Paulding
Com Navy Yard
Brooklyn N.Y.

Sir,

By request of the Asst Secretary of the Navy, we submit a proposal to alter and fit up the steamboat "*Westfield*" for service as a steamboat in the manner proposed by the Board of Officers directed to examine her, viz Reduce the guards and post under sponsons their whole length-put up bulwarks five feet in height, four broadside ports on each side, the iron bulwarks at ends to drop down for the range of pivot guns. The deck to be sheathed, the ends of oak or yellow pine for gun beds. The promenade deck to be dropped down 7 or 8 feet of main deck. Accommodations for officers and men to be arranged on deck similar to steamer Helen and Whitehall. New pilot houses & steering arrangements. Capstan, hause pipes & chain lockers to be fitted. Two boats each 28 feet long with cranes, falls & completely fitted. Two magazines with shot & shell lockers one at each end of the boat. Berth deck to be put in at each end of boat, with required hatches and ladders. Fine state rooms to be put up on berth deck aft. Coal bunkers & store rooms fitted below. Additional beams and knees to deck. Engine and boiler put in good order. Protecting case around steam drum. Necessary valves and fittings. Two additional hand bilge pumps of satisfactory dimensions & to be furnished and fitted.

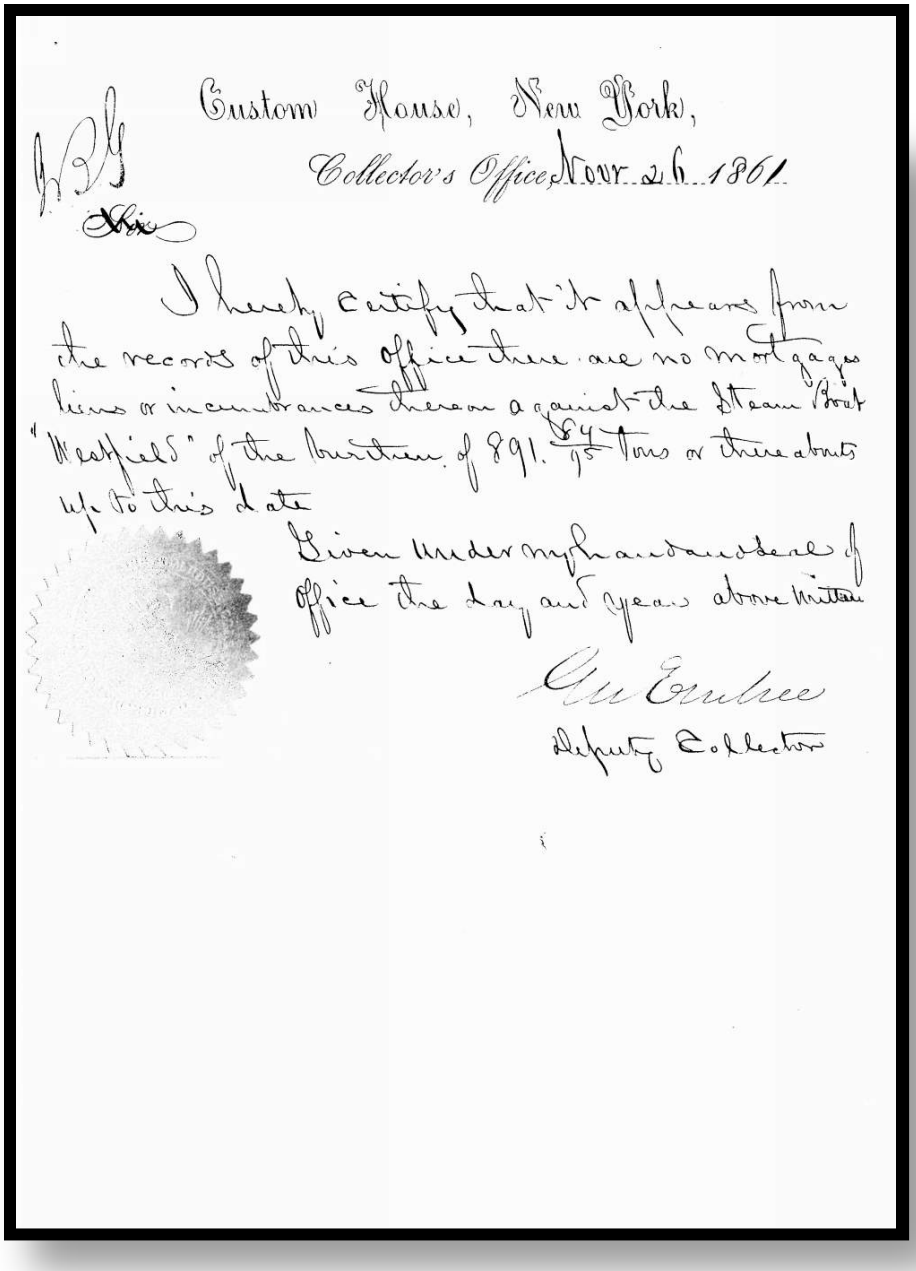
Vessel to be docked and caulked, an additional strake of yellow metal put on. The necessary breeching ring, eye bolts for guns, put on. Fit up kitchen with camboose & appurtenances. Tiller to be fitted with proper relief tackles for steering on main deck. Also two riding bitts and the necessary deck cleats. Also complete the ceiling of the

sides of the boat 2 ½ inch oak planks butt bolted. The whole for the sum of twenty-seven thousand [marked out word] hundred & seventy five dollars.

We also propose to cover the bulwarks with iron plating the whole length of the boat with hinges and fastenings complete, similar to the steamboat Helen for the sum of twenty-eight hundred and eighty dollars. Also furnish one anchor of about 1950 and one anchor of about 950 and 90 fathoms of [illegible]/8 chain and ninety (90) fathoms of 1 5/8 chain for five hundred and ninety two dollars. The whole to be completed and ready for the outfit & armament to the satisfaction of the officers directing the work. As with the other boat, the old materials to belong to us & to be used in the alterations as far as practicable.

Chars W. Copeland
By James Howe

James Howe



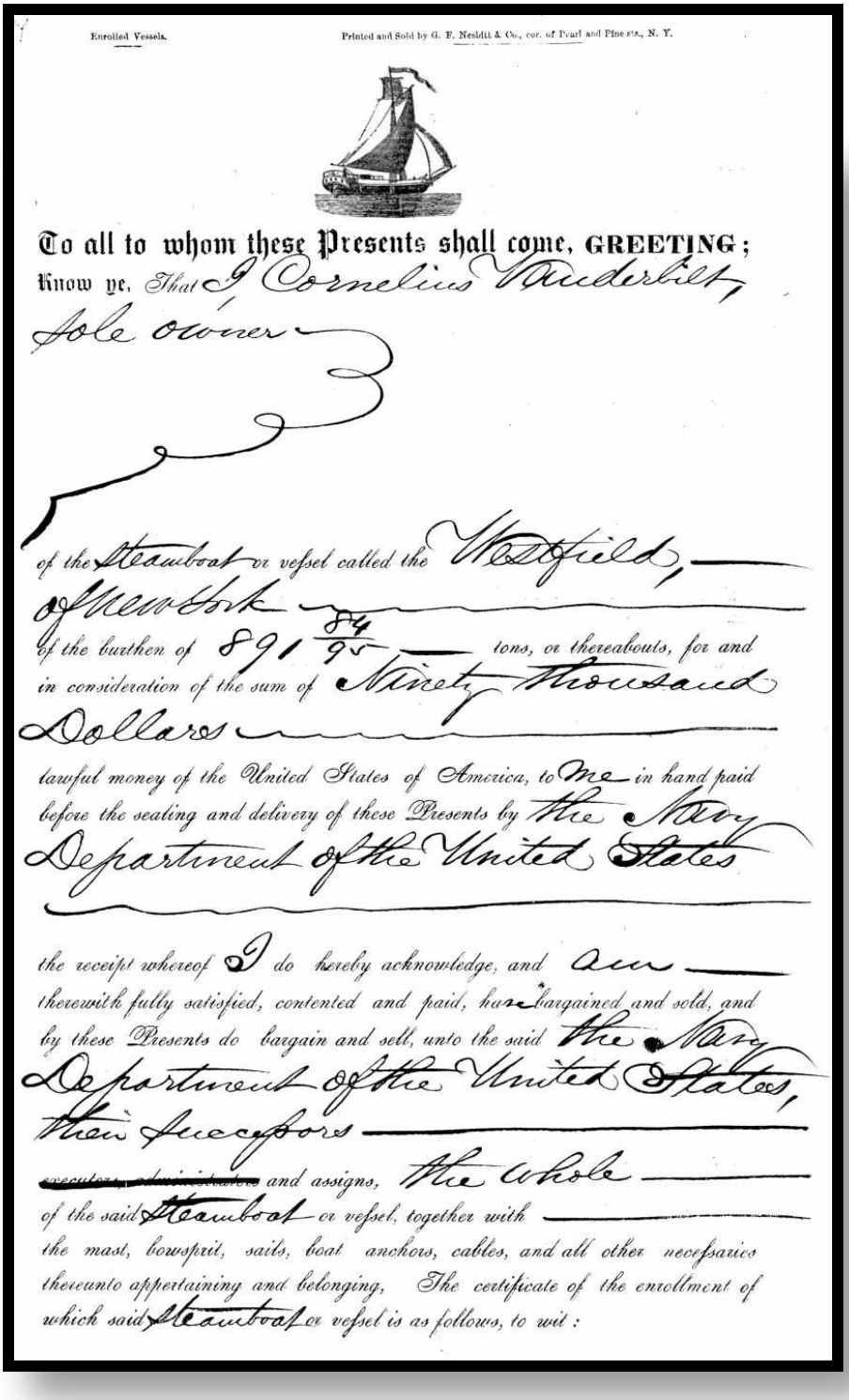
Custom House, New York,
Collector's Office Nov. 26 1861

I hereby certify that it appears from the records of this office there are no mortgages liens or incumbrances thereon against the Steam Boat "Westfield" of the burthen of 891 64/95 Tons or there abouts up to this date

Given under my hand and seal of office the day and years above written

Geo Embree
Deputy Collector

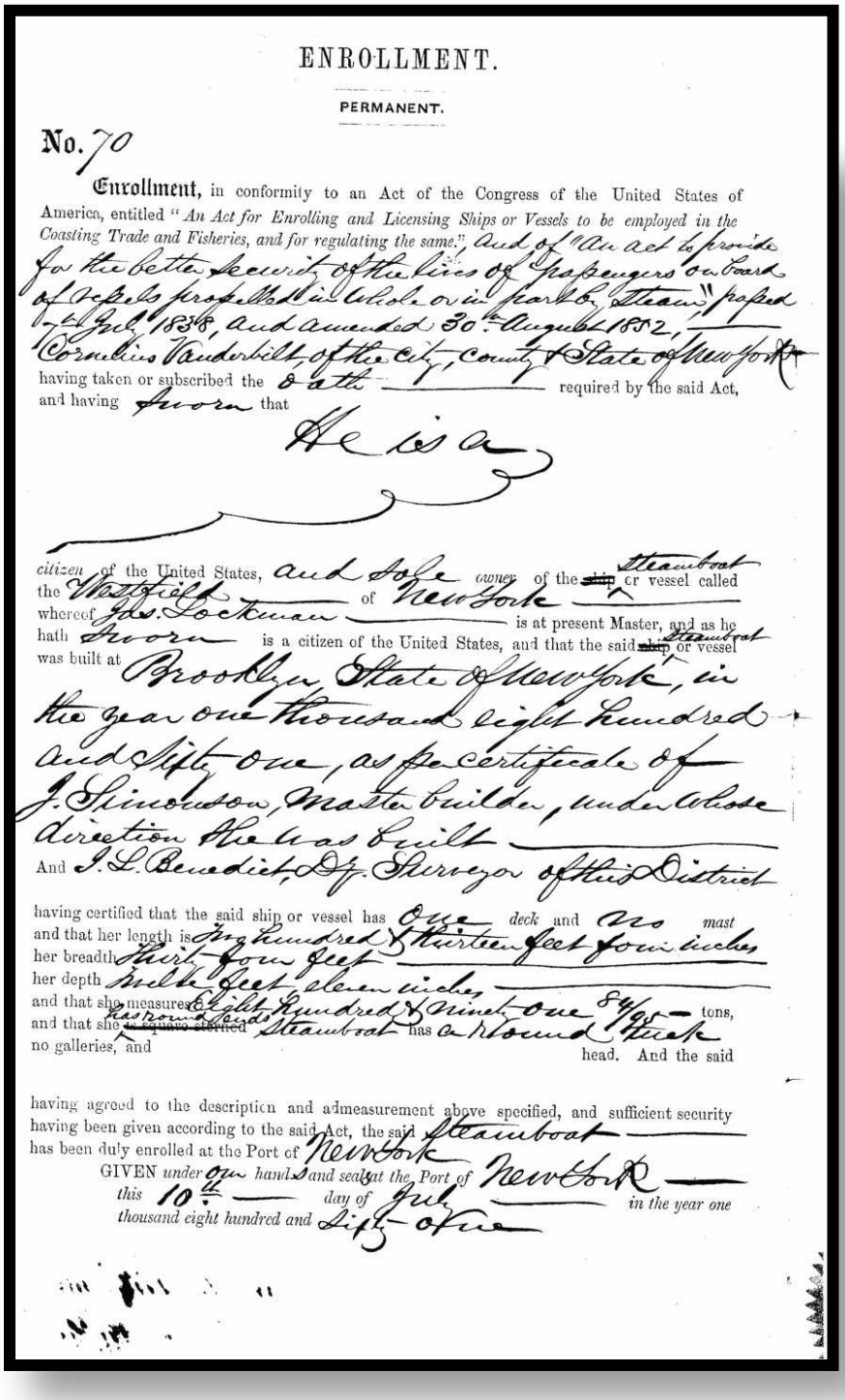
Figure 197. *Westfield* enrollment and license: page 1
(Image courtesy of the Nation Archives and Records Administration; reference: Subject File, U.S. Navy, 1775-1910, RG45: Box 128, Folder AY, Purchase of Merchant Vessels. Bill of sale, etc. Part I).



Enrolled Vessels. Printed and Sold by G. F. Nesbitt & Co., cor. of Pearl and Pine sts., N. Y.

To all to whom these Presents shall come, GREETING;
Know ye, That I Cornelius Vanderbilt,
sole owner
of the Steamboat or vefsel called the Westfield,
of New York
of the burthen of 891 84/95 tons, or thereabouts, for and
in consideration of the sum of Ninety Thousand
Dollars
lawful money of the United States of America, to me in hand paid
before the sealing and delivery of these Presents by the Navy
Department of the United States
the receipt whereof I do hereby acknowledge, and am
therewith fully satisfied, contented and paid, have bargained and sold, and
by these Presents do bargain and sell, unto the said the Navy
Department of the United States,
their Successors
executors, administrators and assigns, the whole
of the said Steamboat or vefsel, together with
the mast, bowsprit, sails, boat anchors, cables, and all other necefsaries
thereunto appertaining and belonging, The certificate of the enrollment of
which said Steamboat or vefsel is as follows, to wit:

Figure 198. *Westfield* enrollment and license: page 2
(Image courtesy of the Nation Archives and Records Administration; reference: Subject File, U.S. Navy, 1775-1910, RG45: Box 128, Folder AY, Purchase of Merchant Vessels. Bill of sale, etc. Part I).



ENROLLMENT.

PERMANENT.

No. 70

Enrollment, in conformity to an Act of the Congress of the United States of America, entitled "*An Act for Enrolling and Licensing Ships or Vessels to be employed in the Coasting Trade and Fisheries, and for regulating the same.*" And of "An act to provide for the better security of the lives of Passengers on board of Vessels propelled in whole or in part by Steam," passed 7th July 1838, and amended 30th August 1852,

Cornelius Vanderbilt, of the city, county & State of New York

having taken or subscribed the Oath required by the said Act, and having sworn that

He is a

citizen of the United States, and sole *owner* of the ~~ship~~ Steamboat or vessel called the Westfield of New York whereof Jas. Lockman is at present Master, and as he hath sworn is a citizen of the United States, and that the said ~~ship~~ Steamboat or vessel was built at Brooklyn State of New York, in the year one thousand eight hundred and fifty one, as per certificate of J. Simonson, Master builder, under whose direction she was built

And J. L. Benedict, Dy. Surveyor of this District

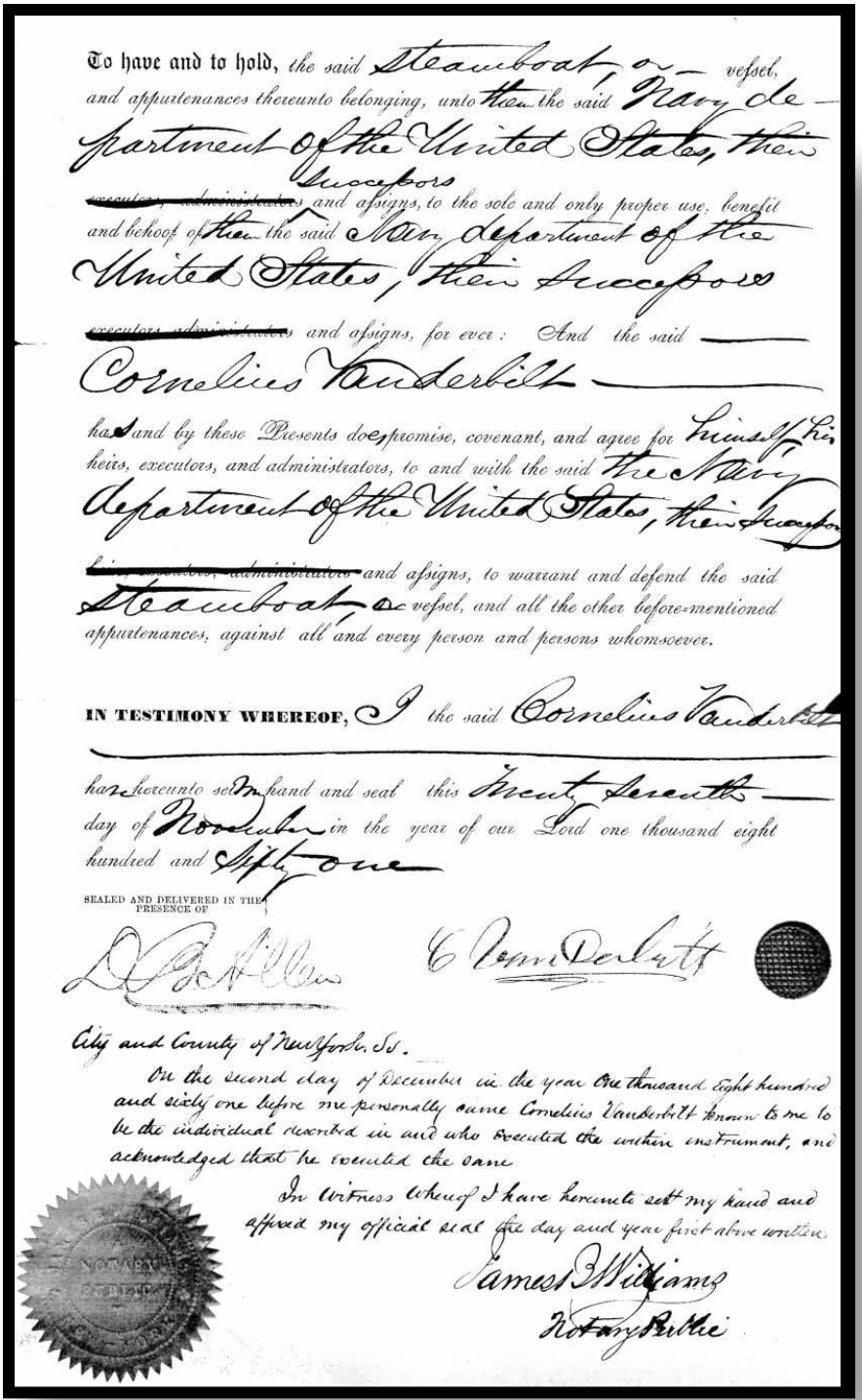
having certified that the said ship or vessel has one *deck* and no *mast* and that her length is Two Hundred & Thirteen feet four inches her breadth Forty four feet her depth Twelve feet eleven inches and that she measures Eight Hundred & Ninety one 89/95 tons, and that she ~~is square stemmed~~ has a Round Stern Steamboat has a Round Stern no galleries, and head. And the said

having agreed to the description and admeasurement above specified, and sufficient security having been given according to the said Act, the said Steamboat has been duly enrolled at the Port of New York

GIVEN *under* our *hands and seal at the Port of* New York

this 10th day of July *in the year one thousand eight hundred and* fifty one

Figure 199. *Westfield* enrollment and license: page 3
(Image courtesy of the Nation Archives and Records Administration; reference: Subject File, U.S. Navy, 1775-1910, RG45: Box 128, Folder AY, Purchase of Merchant Vessels. Bill of sale, etc. Part I).



To have and to hold, the said Steamboat, or vessel, and appurtenances thereunto belonging, unto them the said Navy Department of the United States, their successors ~~executors, administrators~~ and assigns, to the sole and only proper use, benefit and behoof of them the said Navy Department of the United States, their successors ~~executors, administrators~~ and assigns, for ever: And the said Cornelius Vanderbilt has and by these Presents do promise, covenant, and agree for himself his heirs, executors, and administrators, to and with the said the Navy Department of the United States, their successors ~~executors, administrators~~ and assigns, to warrant and defend the said Steamboat or vessel, and all the other before-mentioned appurtenances, against all and every person and persons whomsoever.

IN TESTIMONY WHEREOF, I the said Cornelius Vanderbilt have hereunto set my hand and seal this twenty seventh day of November in the year of our Lord one thousand eight hundred and sixty one

SEALED AND DELIVERED IN THE PRESENCE OF

L. B. Allen

C. Vanderbilt

City and County of New York, ss.

On the second day of December in the year One thousand eight hundred and sixty one before me personally came Cornelius Vanderbilt known to me to be the individual described in and who executed the within instrument, and acknowledged that he executed the same

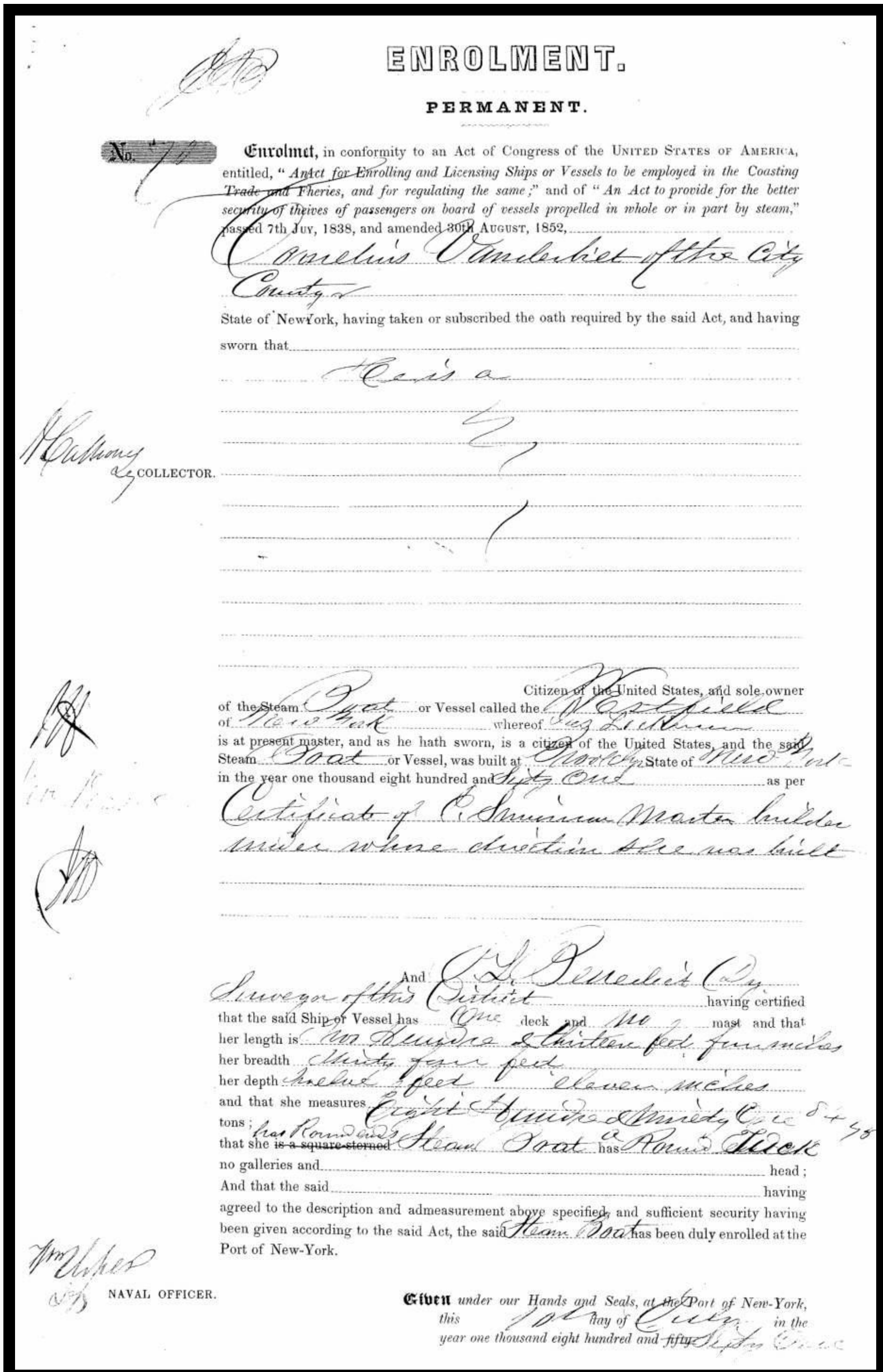
In Witness Whereof I have hereunto set my hand and affixed my official seal the day and year first above written.

James D. Williams

Notary Public

NOTARY PUBLIC

Figure 200. *Westfield* enrollment and license: page 4
(Image courtesy of the Nation Archives and Records Administration; reference: Subject File, U.S. Navy, 1775-1910, RG45: Box 128, Folder AY, Purchase of Merchant Vessels. Bill of sale, etc. Part I).



ENROLMENT.

PERMANENT.

No. 7

Enrolmet, in conformity to an Act of Congress of the UNITED STATES OF AMERICA, entitled, "An Act for Enrolling and Licensing Ships or Vessels to be employed in the Coasting Trade and Fisheries, and for regulating the same;" and of "An Act to provide for the better security of the lives of passengers on board of vessels propelled in whole or in part by steam," passed 7th July, 1838, and amended 30th August, 1852, Cornelius Vanderbilt of the City County of

State of New-York, having taken or subscribed the oath required by the said Act, and having sworn that He is a

COLLECTOR.

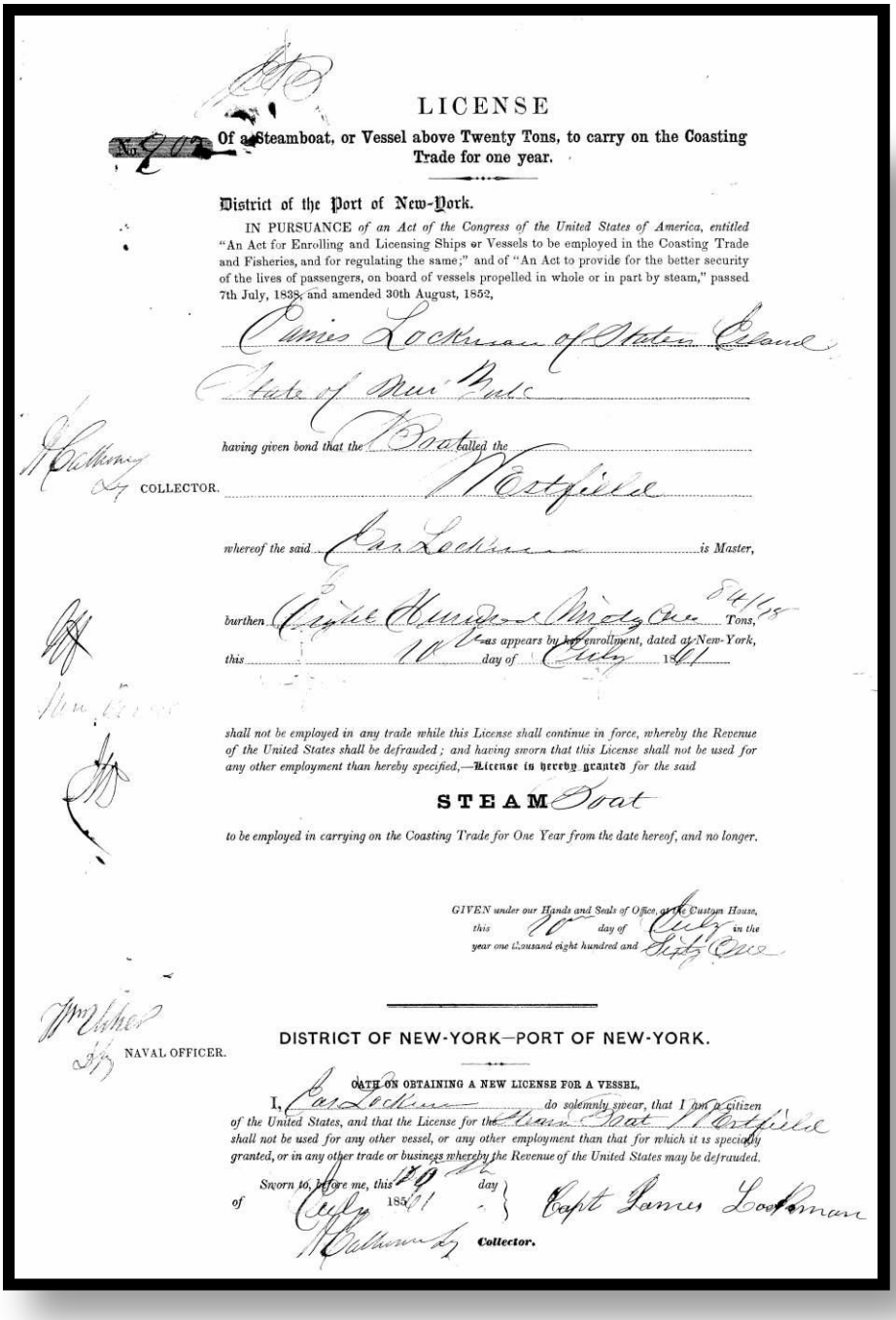
Citizen of the United States, and sole owner of the Steam Boat or Vessel called the Westfield of New York whereof [illegible] is at present master, and as he hath sworn, is a citizen of the United States, and the said Steam Boat or Vessel, was built at [illegible] State of New York in the year one thousand eight hundred and fifty one as per Certificate of C. Simonson Master builder under whose direction she was built

And [illegible] Surveyor of this District having certified that the said Ship or Vessel has One deck and no mast and that her length is two hundred & thirteen feet four inches her breadth thirty four feet her depth twelve feet eleven inches and that she measures Eight hundred and ninety one [illegible] tons; that she has Round stern Steam Boat has Round Deck no galleries and head; And that the said having agreed to the description and admeasurement above specified, and sufficient security having been given according to the said Act, the said Steam Boat has been duly enrolled at the Port of New-York.

NAVAL OFFICER.

Given under our Hands and Seals, at the Port of New-York, this 10th day of July in the year one thousand eight hundred and fifty [illegible]

Figure 201. *Westfield* enrollment and license: page 5
(Image courtesy of the Nation Archives and Records Administration; reference: Subject File, U.S. Navy, 1775-1910, RG45: Box 128, Folder AY, Purchase of Merchant Vessels. Bill of sale, etc. Part I).



LICENSE

Of a Steamboat, or Vessel above Twenty Tons, to carry on the Coasting Trade for one year.

District of the Port of New-York.

IN PURSUANCE *of an Act of the Congress of the United States of America, entitled* "An Act for Enrolling and Licensing Ships or Vessels to be employed in the Coasting Trade and Fisheries, and for regulating the same;" and of "An Act to provide for the better security of the lives of passengers, on board of vessels propelled in whole or in part by steam," passed 7th July, 1838, and amended 30th August, 1852,

James Lockman of Staten Island

State of New York

having given bond that the Boat *called the* Westfield

COLLECTOR.

whereof the said Jas Lockman *is Master,*

burthen Eighty Seven *Tons,* 87/95 *as appears by her enrollment, dated at New-York,*

this 10 *day of* July 1861

*shall not be employed in any trade while this License shall continue in force, whereby the Revenue of the United States shall be defrauded; and having sworn that this License shall not be used for any other employment than hereby specified,—***License is hereby granted** *for the said*

STEAM Boat

to be employed in carrying on the Coasting Trade for One Year from the date hereof, and no longer.

GIVEN under our Hands and Seals of Office, at the Custom House, this 10 *day of* July *in the year one Thousand eight hundred and* Sixty One

NAVAL OFFICER.

DISTRICT OF NEW-YORK—PORT OF NEW-YORK.

OATH ON OBTAINING A NEW LICENSE FOR A VESSEL.

I, Jas Lockman *do solemnly swear, that I am a citizen of the United States, and that the License for the* Steam Boat Westfield *shall not be used for any other vessel, or any other employment than that for which it is specially granted, or in any other trade or business whereby the Revenue of the United States may be defrauded.*

Sworn to, before me, this 10 *day of* July 1861

Capt James Lockman

Collector.

Figure 202. *Westfield* enrollment and license: page 6
(Image courtesy of the Nation Archives and Records Administration; reference: Subject File, U.S. Navy, 1775-1910, RG45: Box 128, Folder AY, Purchase of Merchant Vessels. Bill of sale, etc. Part I).