THE CONSERVATION AND ANALYSIS OF SMALL ARTIFACTS FROM THE SITE OF USS *WESTFIELD*

A Thesis

by

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ABSTRACT

In the early hours of 1 January 1863, USS *Westfield* grounded hard in the sand off the northeast side of Pelican Spit in Galveston Bay, Texas. The gunboat was building up steam to cut off two Confederate cottonclads before they reached the other Union ships in the bay. Hours later, an explosion ripped through the hull, sinking the vessel in the shallow water. Scuttled by the captain, William B. Renshaw, *Westfield* lay in the sands of Galveston Bay until the remains were excavated in 2009 and 2010 by PBS&J, now Atkins Global, under the supervision of the Texas Historical Commission and the U.S. Navy. The artifacts were brought to the Conservation Research Laboratory on Texas A&M University's Riverside Campus where they were sorted, documented, and conserved.

This thesis begins with a detailed account of *Westfield*'s history, starting with the vessel's use as a New York ferryboat, the conversion to a gunboat and commission in the West Gulf Blockading Squadron, and, finally, the explosion and sinking during the Second Battle of Galveston and subsequent Confederate salvage attempts. Following this is a summary of the conservation methods used for *Westfield* artifacts, including an experiment on the treatment of waterlogged cast iron from the ship. A catalog of the artifacts, providing research on the various types of materials in the collection and a short summary of the artifact types, is also presented.

DEDICATION

This thesis is dedicated to my parents, whose financial and emotional support made my graduate studies possible.

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I would like to thank my committee chair, Donny Hamilton, and my committee members, Kevin Crisman and Robert Warden. Dr. Hamilton provided me with the opportunities to learn conservation in an assistantship and employment at the Conservation Research Laboratory on Texas A&M’s Riverside Campus, which was necessary to complete this thesis and from which will continue to benefit my future career. His strange and eccentric approach to work and life will continue to shape my own endeavors. I would like to express my gratitude to Dr. Crisman for his advice and his time. His seemingly infinite perseverance and devotion to his studies and that of his students has always been an inspiration. I would also like to thank Cemal Pulak for allowing me to study in Bodrum, Turkey over the summers of 2010 and 2011, which gave me to the opportunity to learn how to catalog and record artifacts.

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1.1 Introduction

William Watson (1892:171), in his memoir *The Civil War Adventures of a Blockade Runner*, described the wreckage of the Civil War Union gunboat USS *Westfield*: "[The wreck site was] a formidable looking pile of iron boilers and machinery sticking out of the water which marked the spot where the ill-fated vessel came to her tragical end with some of her officers and crew a short time previously." The quiet night in 1865 when Watson sailed past the wreckage of *Westfield* and into safe harbor in Galveston Bay, reflected little of the noise and chaos that surrounded *Westfield* when the gunboat sank two years previously, in the Second Battle of Galveston on New Year's Day, 1863. *Westfield* ran aground off Pelican Island in the early morning at the start of the battle, when the crew was attempting to defend the Union-held Galveston Bay from an attack by two Confederate 'cottonclads' (Hayes 1974:555-559). For the rest of the battle, the crew aboard *Westfield* was unable to extricate the ship from the sand (Cotham 1998:125-126). The captain, William Bainbridge Renshaw, made the decision to scuttle *Westfield* by detonating the magazine to keep the gunboat from falling into Confederate hands. An accident caused the ship to explode prematurely, resulting in the death of Captain Renshaw, five of the officers, and members of the crew (Burt 1863:455-457). Commodore David G. Farragut, commander of the West Gulf Blockading Squadron (WGBS) which *Westfield* was a part, later blamed the embarrassing defeat at the Battle of Galveston on Captain Renshaw's decision to scuttle *Westfield* (Farragut 1863c:446-447).

The sinking of USS *Westfield* at the Second Battle of Galveston effectively ended the Union's efforts to dominate Texas' coastal waters until the end of the war. The broken remnants of *Westfield* left in the sediment of Galveston Bay were subject to Confederate salvage, dredging efforts at the turn of the 19th century, and almost 150 years of erosion, until the remains of the ship were recovered by the U.S. Army Corps of

Engineers and PBS&J Corporation (now Atkins Global) in 2009. Following initial cataloging, more than 8,000 artifacts were brought to the Conservation Research Laboratory (CRL) at Texas A&M University's Riverside Campus in Bryan, Texas. The collection has been extensively documented and prioritized, and is currently undergoing conservation through January 2015.

1.2 Excavation

The remains of the former flagship of the WGBS stretched across a debris field 164 ft. (50 m) in length and 82 ft. (25 m) in breadth just northeast of Pelican Island (Figure 1.1). As a part of the Texas City Channel Improvement Project, the area was identified as a target in 2005, when the wreck was identified and mapped, and diagnostic artifacts were recorded in 2006 by archaeologists from PBS&J. All but a few fragments of the wooden hull had completely disintegrated, and a thick, 1 ft. (0.3 m), layer of sediment covered most of the remaining artifacts. In 2006, the largest objects were identified and recorded; these include the bearing block, firebox and boiler flues from the vessel's steam engine, and a Dahlgren cannon overlooked by Confederate salvers. These artifacts will be discussed further in a thesis by Andrew Thomson and dissertation by Justin Parkoff.

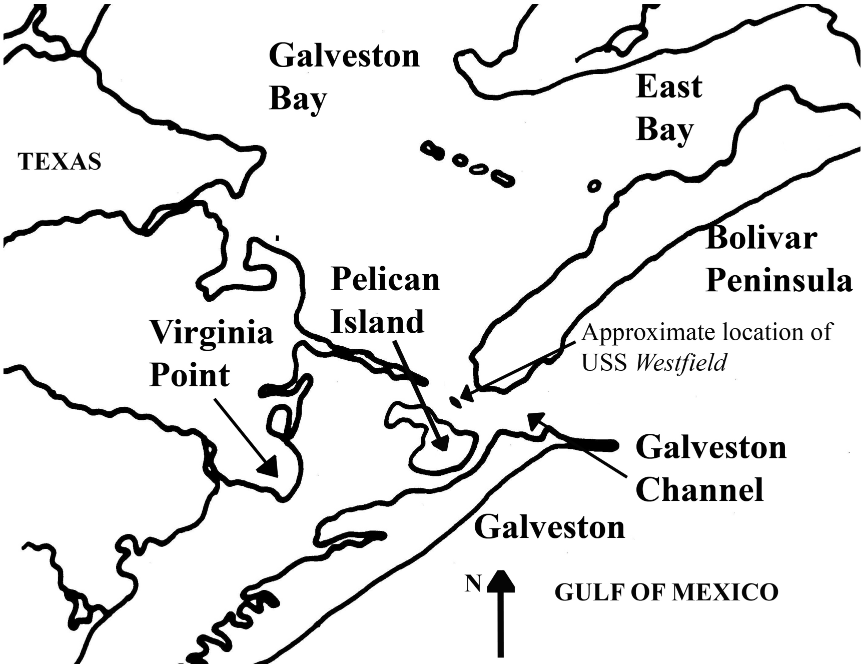


Figure 1.1. Location of the *Westfield* site 41GV151. After McComb (1986:9).

The site was excavated in November and December of 2009. Traditional underwater excavation methods, using divers recording provenience from a grid system, were initially attempted on the *Westfield* project; however due to the heavy currents, poor visibility for divers, and ship traffic, other methods were employed. A large diameter electromagnet, which could pick up iron artifacts, and an environmental clamshell dredge, brought up the majority of remains. In addition to the participation of PBS&J, the excavation was a cooperative effort of commercial divers, archaeologists, commercial dredge operators, and U.S. Armed Services explosive experts under the guidance of then-Texas State Marine Archaeologist Steve Hoyt, and the Underwater Archeology Branch of the Naval History and Heritage Command (NHHC).

The recovery of the artifacts was coordinated by the Navy Supervisor of Salvage (SUPSALV) and their contractor, DonJon Marine Co., Inc. Following excavation, PBS&J archaeologists managed the collection through the process of screening, recording, and cataloging. Three barges were stationed near the site. The first, 120 ft. x

40 ft. (36.58 x 12.19 m), housed a 138-ton crane, a sorting area, and positioning and navigation equipment. The second, 100 ft. (30.48 m) in length, held the 16-ton crane and diving and communications equipment. The last, also 100 ft. (30.48 m) long, contained filter screens for sorting and storage equipment. After the large artifacts and potentially explosive material were excavated, the clamshell dredge removed sediment and artifacts from 15 x 15 ft. (4.57 x 4.57 m) squares, distributed on a virtual grid established over the wreck site using navigation software. Given the time and environmental constraints for the excavation, this recording method gave the most accurate provenience for the artifacts. Each load of the clamshell was placed in a watertight roll-off box, a large metal container containing a series of screens that would allow the artifacts to be sifted and sorted by size. Once sorted, the objects were sent to Freeport, Texas, where 25 archaeologists cataloged, recorded, and photographed every item recovered. This work continued from January into March of 2010 (Borgens and Gearhart 2010:4-5). An excavation report, *Investigation and Recovery of USS* Westfield *(Site 41GV151) Galveston Bay*, was prepared by Amy Borgens, Bob Gearhart, Sara Laurence, and Douglas Jones in 2010.

1.3 Collection Management

The USS *Westfield* artifact collection arrived at Texas A&M University's Conservation Research Laboratory (CRL) in the spring of 2010. Prior to conservation, the artifacts were stored outdoors in large round bins, five-gallon buckets, or large metal storage containers. The buckets contained the small iron artifacts, in addition to cupreous, lead, and organic objects. These were stored in tap water or deionized water to begin the process of desalinization, discussed in Section 3. Tap water filled the large bins which held the larger iron artifacts. A sequestering agent of 2-5% sodium hydroxide was added to the highest priority artifacts before and after the outer corrosion layers of concretion were removed. The largest artifacts, including the boiler flues and firebox, were stored in freight shipping containers filled with tap water.

Due to the state of preservation, the large number of artifacts, and the limited budget, not every artifact recovered from the USS *Westfield* site could be conserved. A prioritization system was developed to determine which artifacts should be kept for conservation or teaching, which would go into permanent wet storage, and which artifacts that would be deaccessioned and reburied. Artifacts were prioritized using a rating system, numbered one through five. Priority 1 artifacts were those that were diagnostic, a well-preserved representative example of important categories of artifacts such as metal fasteners or firebox grates, or unique artifacts. These also included all cupreous artifacts, and the majority of organics, ceramics, and glass. Artifacts were labeled Priority 2 if they were diagnostic but either less well-preserved or more numerous on the site. In addition, some were saved for teaching purposes and conservation training. Priority 3 artifacts included those that were partially preserved common artifacts that still retained some diagnostic features. Fragments of non-diagnostic artifacts were categorized as Priority 4. Priority 5 artifacts included concretion bleeds, or concretions of iron corrosion products that did not contain either artifacts or molds of the original iron that had corroded away. This category also included modern, or post-Civil War era, intrusive artifacts. Priority 1 artifacts were conserved, while Priority 2 and 3 were put into permanent wet storage or reburied in sealed plastic containers. Priority 4 and 5 artifacts had their identifying tags removed and were deaccessioned.

The priority distribution is listed below in Table 1.1. The artifact count shows how many individual artifacts are in each priority, while the lot number count shows how many artifact numbers are in each. Individual lot numbers may contain more than one artifact.

Table 1.1. Artifact Totals by Priority.

		Artifact Count	Lot numbers
Priority 1 artifacts		1,472	903
Priority 2 artifacts		1,139	858
Priority 3 artifacts		1,586	812
Priority 4 artifacts		949	620
Priority 5 artifacts		1328	580
Priority CRL (training)		1676	188
	Total	8133	3922

Prioritization of the iron artifacts required conservators with extensive knowledge of the collection and of artifacts from underwater sites in general. Most of the small ferrous objects were prioritized from the x-ray alone, a process which required long hours of examination under the x-ray viewer. Categorizing larger artifacts was simpler; Priority 1 status was given to highly diagnostic or unique artifacts, well-preserved examples of a particular type of object, or objects which have been selected for planned museum displays. The rest of the large artifacts were labeled Priority 2 or 3. In the winter of 2011-2012, the final prioritization decisions were made, and buckets containing the artifacts were sorted by priority. Each of the over 200 buckets were re-opened, and the artifacts were checked against the database and photographs, before being sorted into a new bucket containing other artifacts of the same priority. At the same time, these buckets were condensed and filled to the brim, saving storage space at CRL and reducing the cost of permanent wet storage, or reburial. The number of buckets was reduced from 200 to fewer than 85.

To determine an artifact's priority, each artifact in the *Westfield* collection required documentation in the form of an artifact catalog and photograph. The catalog form recorded the basic measurements, a sketch, and a short description of each artifact. Initial photographs were extremely useful as a quick guide for identifying artifacts that were mislabeled or lost their identification tags. Most of the initial cataloging and photography took place directly after the excavation; however, prior to conservation, reburial, or de-accessioning, the conservators at CRL confirmed that diagnostic information on each artifact was recorded.

In addition to the catalog and photographs, x-radiographs were taken of the small iron artifacts to aid in the process of identification and prioritization. The majority of the collection consists of iron concretions, or iron artifacts covered in disfiguring corrosion products, discussed further in section 3.2. In order to prioritize these objects, an x-ray was taken to identify the iron artifact underneath the corrosion. Every concretion small enough to fit on the x-ray film, and not identifiable based on appearance, was x-rayed for identification. This was not necessary for the larger or non-ferrous artifacts, due to the lack of thick corrosion products obscuring the artifact underneath. Organized by date taken, the x-ray numbers were listed in the database for easy access. X-rays for Priority 1 artifacts were digitally photographed and available on a computer for quick reference.

Artifact cards detailed each artifact's conservation and included a short description and measurements, treatment plan, and associations with other artifacts. During conservation, in-progress photos were taken to record the conservation process and to identify artifacts after the concretion was removed. Following conservation, every artifact was photographed with a scale and lot number. All data and photographs are stored on CRL computers and copied on backup external hard drives.

With a collection of over 8,000 artifacts, organization was a high priority. Artifacts were cataloged in a Microsoft Excel database organized by lot number. The database included information on the location or status, count, and material of each artifact, as well as a short description, important notes, and priority category. The database proved a useful tool as the artifacts could easily be sorted by each of these categories. The location or status category aided in locating a specific artifact, directing the conservator to a specific location in the laboratory or showing that the conservation was either in progress or completed. The challenge of keeping the database updated required cooperation from all of the labs conservators and constant maintenance, especially when the artifacts were re-sorted by priority. However, this saved considerable time when calculations became necessary to determine how many artifacts were still awaiting conservation or reburial.

Developing consistent descriptions of the artifact categories was necessary in order to group similar types of artifacts; however, this was a gradual process and occasionally became a source of confusion. Within Priority 1 artifacts, many were unique and represented their own category. These were difficult, if not impossible, to group together. In addition, within each type, the artifacts were in varying states of preservation. However, the description categories became especially important when determining if a representative sample or percentage of a specific artifact had been designated Priority 1, while the rest were placed into Priority 2 for reburial or conservation training.

1.4 Conclusion

Due to the size of the *Westfield* collection, the site formation processes and excavation, and the subsequent lack of provenience for the artifacts, documentation of the artifacts is critical for the interpretation of the wreck site. Documentation in the form of photographs, measurements, catalogs, x-radiographs, and a database enabled the conservators to prioritize the collection and determine which artifacts have enough informational and educational value to warrant complete conservation. The prioritization method was necessary in order to provide the maximum information for the lowest cost.

The primary purpose of this thesis is to present the conservation, documentation, and analysis of the highest priority small artifacts. Section 2 includes the history of *Westfield*, the Battle of Galveston, and the ship's sinking. The third section details the general conservation procedures for *Westfield* artifacts and an experiment conducted to develop alternative methods for conserving cast iron. The artifact catalog, Section 4, includes detailed descriptions, measurements, type, and material of the artifacts.

2. HISTORICAL BACKGROUND

“Like the bee, which is held aerodynamically incapable of flight yet flies anyhow, the ferryboats did not understand that they could not go into the open ocean, and steamed obliviously forth.”

A.A. Hoehling (1989:28)

2.1 Introduction

The twisted, jagged pile of metal excavated from the murky waters of Galveston Bay was once a highly efficient and useful gunboat, essential to the Union Navy for navigation along the coast of the Gulf of Mexico. *Westfield* played a number of roles in her short life; first as a ferryboat in New York, next as a gunboat in David Porter’s Mortar Flotilla, and finally as Captain William Renshaw’s flagship in the West Gulf Blockading Squadron’s (WGBS) expedition to the Texas coast. The importance of the historical events that surrounded *Westfield* is often overlooked in history books. The Union dominated the Gulf of Mexico for much of the Civil War, but suffered a major setback when Galveston and *Westfield* were lost.

Much of *Westfield*’s story is found in archival records and other contemporary documentary sources. These historical records provide details of the events and people involved that the archaeological data cannot. The main source for information on the history of *Westfield* comes from letters of the WGBS in *The Official Records of the Union and Confederate Navies in the War of the Rebellion*, Volumes 18 and 19. Newspaper articles from the *New York Times* and the *Houston Telegraph* provide contemporary accounts of the important events of *Westfield*’s career as both a ferryboat and navy ship. Personal accounts include Henry O. Gusley’s journal published as *The Southern Journey of a Civil War Marine*, and William Watson’s *The Civil War Adventures of a Blockade Runner*. Secondary sources such as Edward T. Cotham’s *Battle on the Bay*, Spencer C. Tucker’s *Blue and Gray Navies: The Civil War Afloat,* Jack D. Coombe’s *Gunfire Around the Gulf: The Last Major Naval Campaigns of the*

Civil War, and A.T. Mahan's *Navy in the Civil War, Vol. 16: The Gulf and Inland Waters* fill in the gaps and provide a retrospective analysis.

2.2 Industrialization: Shipbuilding and the U.S. Navy

The process of industrialization in the 19th century transformed urban shipbuilding industry in two respects. Shipbuilding became more standardized and specialized. This resulted in greater labor division, with less training for apprentices, who were taught only one specific part of the shipbuilding process rather than many different skills. Other skills were learned on the apprentice's own time, based on personal ambition. Industrialization also produced a revolution in the technology of shipbuilding. New developments in dry docks and marine railways made ship repairs, the most profitable function of the ship yard, easier and faster (Thiesen 2006:65,69).

Experimentation in shipbuilding prior to the American Civil War led to numerous technological innovations. Developments in Britain and France included steam and screw propulsion, iron hulled vessels, and innovations in weaponry, such as the armored batteries and an increased use of rifled artillery and barrels and explosive shells. The United States started experimenting with iron hulled ships as early as the 1840s and 1850s in order to remain competitive (Hackemer 2001:67-68). The Civil War and the advent of steam-powered warships also brought significant changes in naval logistics. Steamships required vast amounts of coal and elaborate facilities for repairs compared to wooden vessels.

By 1860, the United States Navy was suffering from neglect by politicians and the American people, who were focused on the presidential election and the possibility of war. The newly elected Abraham Lincoln wanted to maintain the Union while attempting to avoid the outbreak of war (Roberts 2002:9,11). However, events leading to the Battle of Fort Sumter in April of 1861 changed his strategy. On 19 and 27 of April, Lincoln issued proclamations calling for a blockade of the Southern states' coasts, harbors, and inlets, counting on the lack of a developed transportation system in the South. Known as the "Anaconda plan", the Northern strategy involved a blockade of Southern ports, constricting trade on the Mississippi River, followed by an advance upon the river. Many shallow draft steam vessels were needed to execute the blockade along the 180 navigable harbors and inlets and the 3,549 mi. (5,712 km) of coastline around the Southern states (Hackemer 2001:68-69; Roberts 2002:9-11).

The U.S. Navy had 42 commissioned vessels in 1861, stationed between New York and Japan. There were another 29 decommissioned vessels in navy yards. Of the 42, only 30 were steam warships, some with only one gun. On the eve of war, naval officials lacked experience in wartime management and were distracted by disloyalty within the officer corps. Established during peacetime, the official process for acquiring ships for the Navy was slow (Roberts 2002:9-10). The *New York Times* quoted an article from the London Times published on 24 January 1862:

> As the emergency was pressing, the Federal government at once resolved on purchasing a whole fleet of vessels from the mercantile marine. They spent on this service about a million and a half in money, and bought up apparently every floating thing at hand that would carry a gun or two. They did not even confine themselves to steamers, but snapped up old sailing brigs, barks, and schooners, ferry-boats, and so “reconstructed” their navy. That navy, therefore, which six months ago consisted of half a dozen serviceable frigates and twice as many serviceable sloops, now comprises, in addition, 35 steamers, 43 screw steamers, 13 ships, 18 boats and 43 schooners all picked up in the various Federal ports since July last (*New York Times* 1862a).

The Navy began building their resources by purchasing any vessel available that was capable of supporting weaponry. The blockade had to be initiated immediately, without time wasted on building ships. Because several months were needed to build new warships, a system of increased oversight and strict contract requirements was initiated. The Navy relied on private contractors for purpose-built warships and armored vessels, realizing early the government lacked the necessary resources (Hackemer 2001:66,83,97). Officials quickly gained the authority and funds to start construction.

Six months after Fort Sumter, a sense of urgency had fallen upon the U.S. Navy (Roberts 2002:10).

The lack of ships, however, was not a result of deficiencies in the naval shipyards. On the contrary, with private contractors and financial support from the federal government, U.S. Navy yards moved to the forefront of shipbuilding technology. The facilities contained large, well-ventilated buildings with mold lofts, specialized shops, and new iron timber sheds for drying. Naval yards used railway networks to move supplies, a technology that private companies could not afford. Starting in the early 19th century, the navy was the first to make use of ship houses, which allowed for year round construction. In 1851, a land based dry dock was completed in the New York City Navy Yard which cost two million dollars and took 10 years to complete. The naval yards did not lack manpower, as political appointments supplied so many men that the navy was slow in replacing them with the new, more efficient steam-powered machinery (Thiesen 2006:73-74).

2.3 USS *Westfield*

Westfield was built by Jeremiah Simonson of Brooklyn, New York in the spring and summer of 1861. At 891 tons, the vessel was 214 ft. (65.2 m) in length, 34 ft. (10.4 m) in breadth, and 12 ft. 11 in. (3.9 m) in depth. The vertical walking beam engine and the machinery were built by Morgan Iron Works of New York. The piston cylinder had a 10 ft. (3 m) stroke and was 50 in. (1.3 m) in diameter.[1] *Westfield* was originally commissioned by Cornelius Vanderbilt for the Staten Island and New York Ferry Company. Starting on 10 July 1861, *Westfield* joined *Southfield* and ran the Staten Island route, between Whitehall Street, New York and Staten Island, including Tompkinsville, Stapleton, and Vanderbilt's Landing, today known as Clifton, Staten Island (Figure 2.1). Five months later, the U.S. Navy purchased the ferryboat for $90,000 (Heyl 1965:335). The vessel was heavily armed and clad in iron along the bulwarks for its conversion to a gunboat. The iron plates were thin compared to other Civil War ironclads, measuring 0.31 inches (0.79 cm) and only capable of stopping small shot (Justin Parkoff 2012, pers. comm.). Her main deck was fitted with compartments, a galley, and water closets, along with accommodations for the officers and crew, and her upper deck was removed entirely (Copeland 1861a, 1861b).

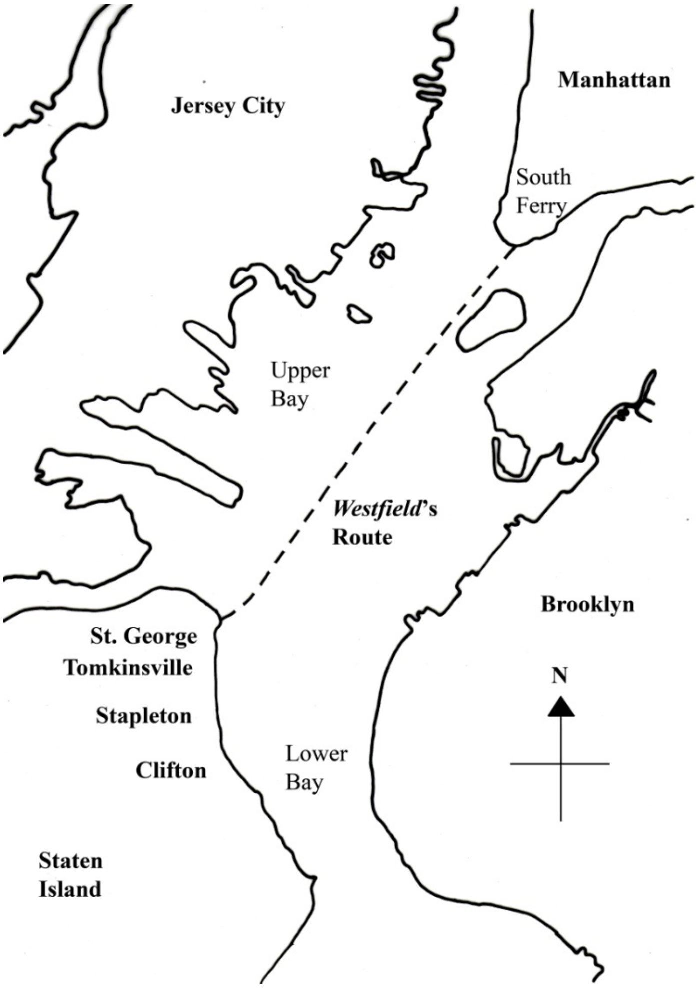


Figure 2.1. *Westfield*'s route during service as a Staten Island ferryboat. After Hilton (1964).

USS *Westfield* was commissioned in the U.S. Navy on 13 February 1862. Lieutenant Commander William B. Renshaw served as captain and would remain in that position until *Westfield*'s sinking, despite a failed attempt in July of 1862 to place Acting

Lieutenant Townsend as captain while Renshaw took command of USS *Miami* (*New York Times* 1862d; Renshaw 1862c:99). C.W. Zimmerman became the Acting Master and Executive Officer and other Acting Masters included Gustav Vassalo, F.L. Miller, and Leonard D. Smalley. The officers of *Westfield* are listed below in Table 2.1 (*New York Times* 1862d).

Table 2.1. Officers of USS *Westfield* (*New York Times* 1862d).

Position	Officer
Captain	William Bainbridge Renshaw
Acting Master and Executive Officer	C.W. Zimmerman
Acting Master	Gustav Vassalo
	F.L. Miller
	Leonard D. Smalley
Acting Assistant Surgeon	E.H. Allis
Acting Assistant Paymaster	Charles C. Walker
Second Assistant Engineer	William K. Green
Third Assistants	Charles W. Smith
	John Van Hogan
	George S. Baker
Master’s Mates	John P. Arnett
	William L. Babcock
	David Harvey

2.4 Union Strategy in the Gulf of Mexico

At the start of the American Civil War, the Union’s strategy in the Gulf of Mexico was to blockade Southern ports, most importantly at Apalachicola and Tallahassee, Florida, Galveston, Texas, New Orleans, Louisiana, and Mobile, Alabama. Realizing the necessity of the Mississippi to the Confederacy, the Union sought to divide and conquer by working their way up from the gulf and down from the river’s upper waters (Mahan 1885:2-4,8). Control of the Mississippi River meant control over communication, transportation, and resources for the Confederacy. At the base of the 3,710 mi. (5,971 km) long river was New Orleans, the first target of the Union’s new strategy (Coombe 1999:6). Credit for the logistics behind the attack on New Orleans was attributed to the Navy Department, according to Gideon Welles, the Secretary of the Navy during the Civil War. However, both David D. Porter, Commander of the WGBS's Mortar Flotilla, and Gustavus V. Fox, the Assistant Secretary of the Navy, claimed the idea, with the former much more outspoken in his claims. Regardless, in late 1861, Welles, Fox, Porter, and Abraham Lincoln convened at the house of General George G. McClellan to discuss plans for the attack on New Orleans. David Porter was placed in charge of the mortar flotilla, of which *Westfield* was a part (Dufour 1960:135-136,138,149). Fox and Porter selected David G. Farragut, Porter's half brother, to take command of the expedition and the WGBS. Porter claimed Farragut had, "undoubted courage and energy" (Stiles 1995:79).

The WGBS was given jurisdiction over the waters of the Gulf of Mexico from Pensacola, Florida to the Rio Grande. David G. Farragut took command of the WGBS on 21 February 1862 and led the expedition to New Orleans (Soley 1883:123). Under Farragut's command, Porter commanded the mortar flotilla, which included the steamers listed below in Table 2.2.

Table 2.2. Mortar steamers in David D. Porter's mortar flotilla (Welles 1862:25 and Dufour 1960:155).

Westfield	Commander W.B. Renshaw	Converted Staten Island ferryboat
Clifton	Acting Lieutenant C.H. Baldwin	Converted Staten Island ferryboat
John P. Jackson	Acting Lieutenant S.E. Woodworth	Converted Staten Island ferryboat
Owasco	Lieutenant John Guest	New gunboat, 507 tons
Miami	Lieutenant A.D. Harrel	New side-wheel steamer
Harriet Lane	Lieutenant J.M. Wainwright	Porter's flagship, 600 tons
R.B. Forbes	Acting Volunteer Lieutenant William Flye	Wrecked during storm on 25 February 1862

2.5 *Westfield* in the Mississippi

2.5.1 Preparations for New Orleans

As Captain David Farragut assumed command of the WGBS, on 22 February 1862, USS *Westfield* left Staten Island in fair weather and headed southward (Cotham 2006:43). *Westfield, John P. Jackson, Clifton,* and *Forbes* sailed for rendezvous with Captain David D. Porter's Mortar Flotilla and Farragut's WGBS. The ships arrived at Port Royal, South Carolina three days later (shown in Figure 2.2; *New York Times* 1862e, 1862f). Off Cape Hatteras, North Carolina, the ships encountered strong gale winds which caused damage to *Westfield*; some planks from her bow were torn off. In a *New York Times* article reporting the event, naval officers stated that New York ferry boats, "are not the nest of sea boats", blaming inadequate construction for *Westfield*'s lack of seaworthiness and subsequent damage from the storms (*New York Times* 1862g, 1862h; Borgens et al. 2010:27).

After repairs at Port Royal, on 8 March USS *Westfield* headed to Fort Taylor in Key West, Florida. Fort Taylor was the largest fort belonging to the Union in the Southern states, mounting over 200 guns. Henry Gusley described the enjoyable Southern weather as he and the rest of the crew waited for the arrival of *Westfield*'s sister ship, USS *Clifton*, which was separated during the storm. After *Clifton* rejoined *Westfield*, both vessels traveled to Apalachicola, Florida and remained there until leaving for Pass á l'Outre at the mouth of the Mississippi River on 17 March.

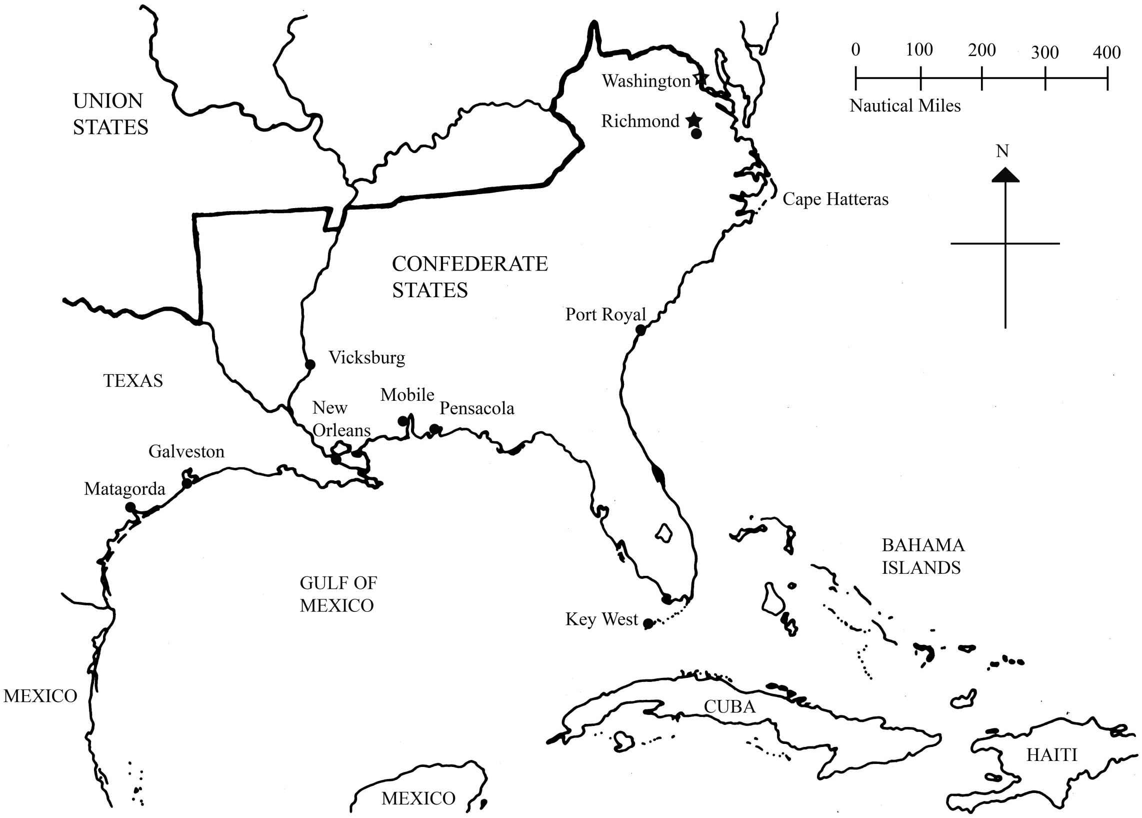


Figure 2.2. Map of the places visited by USS *Westfield*. After Symonds (2009:39).

Immediately upon *Westfield*'s arrival, the sailors aboard were employed in assisting the larger ships of the WGBS over the sand bar, a shallow build-up of sediment which blocks the entrance into the Mississippi River, a common characteristic of Gulf Coast rivers (*New York Times* 1862i; Cotham 2006:43,45). The Mississippi Delta has four main entrances; Northeast Pass, South Pass, Southwest Pass, and Pass á l'Outre (Figure 2.3). On 18 March, 20 mortar schooners, and 6 gunboats began to enter the easternmost branch, Pass á l'Outre (Mahan 1885:53; Coombe 1999:46). The mortar schooners are listed below in Table 2.3.

Table 2.3. West Gulf Blockading Squadron's mortar schooners and their tonnage (Dufour 1960:152).

Name	Tonnage	Name	Tonnage
Norfolk Packet	349	*Sarah Bruen*	233
Horace Beals	296	*Sophronia*	217
T.A. Ward	284	*Matthew Vassar*	216
Sea Foam	264	*C.P. Williams*	210
Henry Janes	260	*Arletta*	200
Racer	252	*Para*	200
Sidney C. Jones	245	*Oliver H. Lee*	199
John Griffeth	240	*William Bacon*	183
Maria J. Carlton	178	*Adolph Hugel*	275
Orvetta	171	*George Mangham*	275
Dan Smith	150	Total	21 vessels

The crew of *Westfield* and the other mortar steamers spent two weeks towing the rest of the sailing ships over the sand bar and through the passes, shown below in Table 2.4 (Cotham 2006:43,45). In addition to those listed, three deeper draft vessels were sent to the Mississippi, and only two, *Pensacola* and *Mississippi*, were able to cross the bar at Southwest pass with the aid of *Westfield* and the other gunboats. The two vessels scraped over the bar with difficulty, delaying the entire Union fleet for 12 days (Stiles 1995:80). During this period, David Porter offered great praise for Captain Renshaw and *Westfield*, citing *Westfield* and *Clifton* as most effective vessels (Porter 1862a:72).

Table 2.4. The sailing ships of the West Gulf Blockading Squadron (Stiles 1995:80).

Sailing Vessels	**Armament**	**Commander**
Hartford	25 guns	Commander Richard Wainwright
Brooklyn	24 guns	Captain T.T. Craven
Richmond	26 guns	Commander James Alden
Mississippi	9 guns	Commander Melancton Smith
Pensacola	24 guns	Captain H.W. Merrit
Cayuga	6 guns	Lt.-commanding N.B. Harrison

Table 2.4 Continued.

Oneida	9 guns	Commander S.P. Lee
Varuna	10 guns	Commander Charles S. Boggs
Katahden	4 guns	Lt.-commanding George N. Ransom
Wissahickon	4 guns	Lt.-commanding A.N. Smith
Winona	4 guns	Lt.-commanding F.T. Nichols
Itasca	4 guns	Lt.-commanding Pierce Crosby
Kennebec	4 guns	Lt.-commanding John H. Russell
Iroquois	9 guns	Commander John De Camp
Sciota	4 guns	Lt.-commanding Edward Donaldson
Total	**177 guns**	
	15 ships	

The vessels of the WGBS rendezvoused at Pilot Town, Louisiana (Figure 2.3) once all managed to make their way into the Mississippi River. Henry Gusley, a marine aboard *Westfield*, wrote that there were a total of 47 ships, with 440 guns of large caliber in the fleet. At Pilot Town, the ships prepared for battle. The topmasts of the sailing vessels were removed and branches were attached to disguise them as masts in the trees. Bows were cleared for guns and all unnecessary equipment, down to the chronometers, was removed and stored at Pilot Town. Chain cables from sheet anchors, secured along the sides of the ships, acted as armor for the engines. Mississippi mud, painted along the outer hull, disguised the hulls and blended in with the water (Mahan 1885:57,71; Cotham 2006:47). Decks and gun carriages were whitewashed so they stood out and were more visible to the crew at night (Coombe 1999:81). The ships were trimmed to the head, moving the ballast forward so the bows sat lower in the water, so that any grounding would occur forward on the ship. If a ship grounded aft, the vessel might swing around in the river and capsize. Ships were to always try to keep their bows upstream (Mahan 1885:56-57).

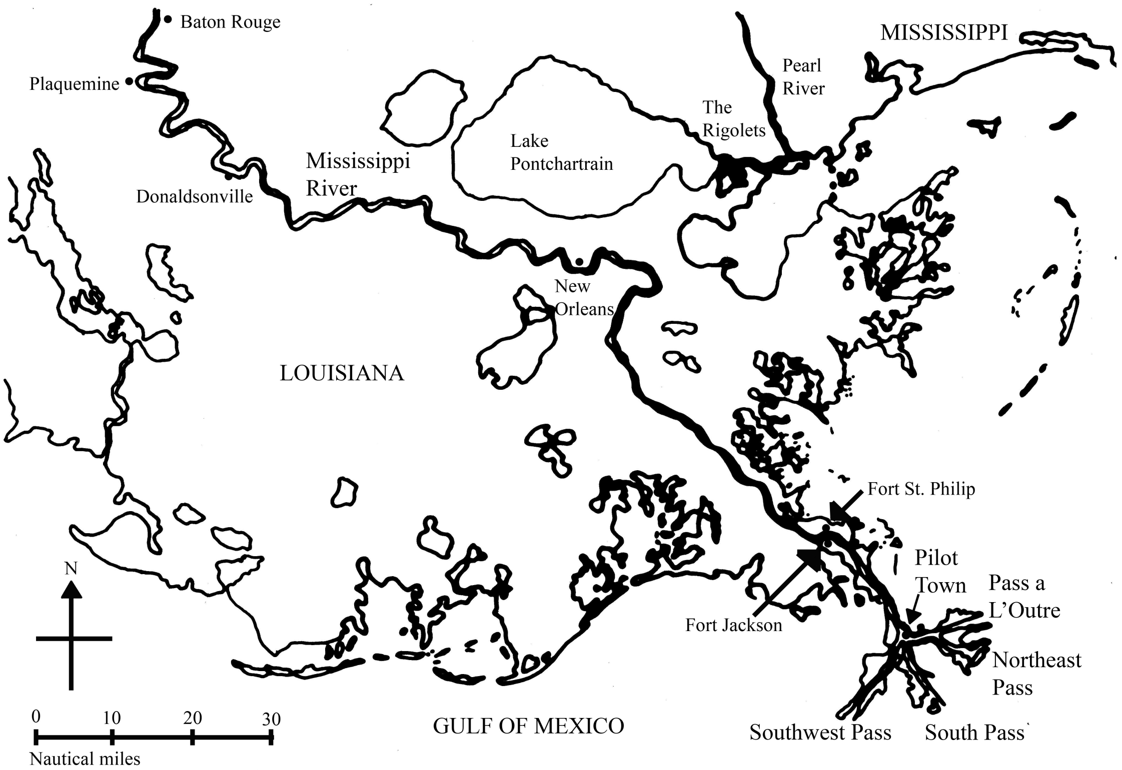


Figure 2.3. Mississippi River Delta region. After Symonds (2009:60).

Confederate defenses at New Orleans were concentrated at Forts Jackson and St. Philip. The forts were located 90 mi. (145 km) south of New Orleans and 20 mi. (32 km) north of the passes at Plaquemine Bend, with Fort Jackson on the southwest side and Fort St. Philip on the northeast. The area was cleared of trees, so that Union ships could not hide from the forts and the forts' guns would have a clear field of fire. Named for General Andrew Jackson, Fort Jackson was built between 1823 and 1832 for a cost of $554,000. The brick fort was built in the shape of a pentagon with 20 ft. (6.1 m) thick walls rising 25 ft. (7.6 m) high on a foundation of cypress logs. Fort St. Philip was built in 1769 by the Spanish governor Baron de Carondelet. Built of brick and earth, Fort St. Philip was in the shape of a five pointed star. The walls were 17 ft. (5.2 m) high and 20 ft. thick (6.1 m). Fort St. Philip also had two water batteries, adjacent to the main structure. Seized by the Confederacy on 8 January 1861, the forts had 109 guns combined, 56 of which were heavy 24 pounders (Mahan 1885:58-59; Coombe 1999:84-85).

Additionally, the Confederates had 12 ships with 39 guns under the command of John K. Mitchell (Stiles 1995:81). CSS *Louisiana,* an armored vessel with 16 guns, had not yet been finished and was secured to the river bank during the battle. Other notable vessels include *McRae*, with seven guns, *Jackson*, with two, *Manassas*, with one 32-pounder carronade, and two sea going steamers, *Governor Moore* and *General Quitman*, each with two guns (Mahan 1885:61-62).

During preparations, reconnaissance missions were sent to observe Confederate forces. Commander Farragut sent USS *Kennebec* and USS *Wissahickon* to discover what obstacles had been placed in the river by the Confederates. Heavy chains had been stretched between both forts and secured with cypress logs. Ship hulks, eight in all, were moored in line across the river; their rigging dismantled and left floating in the water to entangle passing ships (Mahan 1885:65-65; Stiles 1995:80). *Westfield* was sent along with *Harriet Lane, Clifton*, and *Owasco* to observe the forts. The Union ships exchanged fire with two rebel steamers which were chased back up the river (Cotham 2006:47). A shot from *Westfield*'s rifled gun ripped through the shaft of one of the rebel gunboats, CSS *Defiance*, and she was sunk (Renshaw 1862a:389).

2.5.2 The Battle of New Orleans

Capturing New Orleans was vital for Union control over the lower Mississippi River. The Union's strategy began with a naval attack of Forts Jackson and St. Philip, shown in Figure 2.4, from the south, using mortar schooners. Mortar schooners, or "chowder pots", were unable to move on their own, requiring fast moving, shallow steamers, such as *Westfield*, to tow them into position. Mortar schooners averaged a 200 ton displacement and were reinforced with heavy keels to support their guns. The Union would use their ammunition advantage in a low position close to the shore, below the range of Confederate guns high in the forts (Stiles 1995:79; Coombe 1999:75-76).

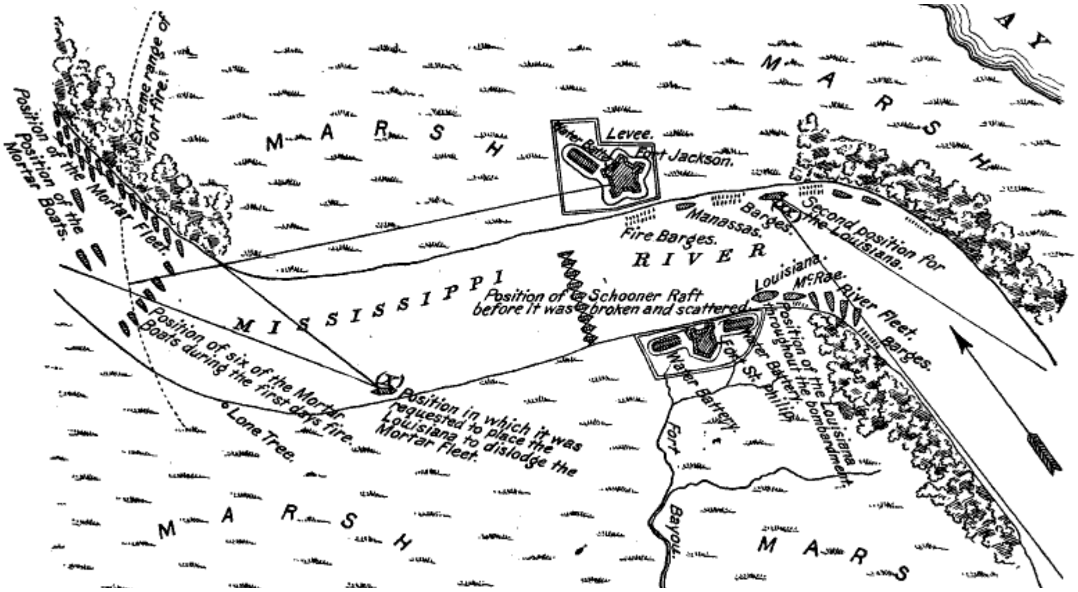


Figure 2.4. Map depicting the location of Forts Jackson and St. Philip relative to the Union vessels during the Battle of New Orleans (Official Records of the Navies of the War of the Rebellion 1905a:277). Courtesy of Cornell University Library, Making of America Digital Collection.

On 18 April, the mortar schooners were moved into position while the men aboard the gunboats exchanged fire with riflemen in the trees and guns from the forts. Bombardment of the forts began at 10 A.M. and continued until 6 P.M., with mortars firing one shot every 10 minutes, or 168 shells every 4 hours. As darkness fell, flames were spotted over Fort Jackson, whose citadel and outbuildings were on fire. Although exhausted, the crews of the mortar schooners redoubled their efforts when they realized that every shot reached the inside of the forts. As night progressed, the men were allowed to rest, and the guns were only fired once every half hour (Mahan 1885:62-63; Dufour 1960:231; Stiles 1995:82-83).

At night, the Confederates sent fire rafts down the river to throw the Union ships into confusion and distract them from the bombardment of the forts. Fire rafts, referred to by the Union as “weak inventions of the enemy”, were flatboats filled with pine knots and other flammable material (Mahan 1885:65; Stiles 1995:81). Commander Farragut instructed the ships to keep the rafts in the center of the river channel and use their guns to punch holes in the rear of the rafts in order to flood the incendiary materials (Coombe 1999:81). Captain Renshaw reported the use of *Westfield*'s force pumps to throw water onto the flames of the rafts (Renshaw 1862a:389). A description in the *New York Times* depicted the scene vividly:

> The men had an opportunity to test in a practical manner their means for destroying fire rafts, and they proved to be an admirable success. A turgid column of black smoke, arising from resinous wood, was seen approaching us from the vicinity of the forts. Signal lights were made, the varied colors of which produced a beautiful effect upon the foliage of the river bank, and rendering the darkness [more intense] by contrast when they disappeared; instantly a hundred boats shot out toward the raft, which now was blazing fiercely and casting a wide zone of light upon the water. Two or three of the gunboats then got under way and steamed boldly toward the unknown thing of terror. One of them, the Westfield, Capt. Renshaw, gallantly opens her steam valves, and dashes furiously upon it, making the sparks fly and timbers crash with the force of her blow. Then a stream of water from her hose plays upon the blazing mass (*New York Times* 1862j).

However, fighting fire rafts was not always a gallant task. One night during the battle, *Westfield* accidently ran into USS *Iroquois*. Ten of *Iroquois'* crew jumped overboard but were quickly picked up (Palmer 1862:800).

On 20 April, USS *Pinola* and USS *Itasca* dismantled the massive chain and line of schooner hulks that blocked the Union ships from traveling above the forts and gaining the advantage. Mortar schooners helped to defend the two ships, which were under fire from the forts. Three days after the successful removal of the barrier, at 2 A.M. on 24 April, the noise of clicking capstans and chain cables grating against their hawse holes alerted the Confederates that the Union fleet was again on the move. Commander Farragut sent the heavy vessels, *Hartford, Brooklyn, Richmond, Pensacola*, and *Mississippi*, to defend the rest of the fleet from any incoming Confederate vessels from the north. Porter and his mortar schooners followed, distracting the forts by firing upon the water batteries, while shells from the forts could only pass overhead. In the final attack, the Union ships passed under the forts and up river to meet the Confederate vessels (Porter 1862b:367; Mahan 1885:64,66-77; Stiles 1995:79).

The battle lasted nearly an hour. *Westfield* concentrated fire on Fort Jackson at a distance of 600 yd. (549 m) away, conserving ammunition as much as possible. While the Union had more supplies than the Confederacy, the fleet was far from a friendly port and still lacked the ammunition, fuel, and medical supplies than was needed. After six days of bombardment, the Confederate batteries on either side of the river were quickly silenced during a final attack (Renshaw 1862a:389-390; Mahan 1885:57,85-86). In the ensuing battle, nine Confederate ships were destroyed, including CSS *Manassas* and the unfinished CSS *Louisiana* and CSS *Mississippi*. The ram *Manassas* was run ashore and set on fire. Riddled with shot from USS *Mississippi*, *Manassas* dislodged from the shore and exploded near the forts. The only Union ship to be nearly lost, USS *Varuna*, ended up in the middle of the Confederate ships. She went unnoticed until she fired upon the surrounding rebel ships. *Varuna* was run aground on the bank of the river to avoid sinking, and the captain and crew were rescued by *Oneida*. The battle was practically won once the larger Union ships defeated the Confederate ships and passed above the forts (Mahan 1885:85-86; Dufour 1960:335-338; Stiles 1999:86,88-89).

Westfield continued firing on Fort Jackson until 27 April. General Benjamin Butler landed a large force behind Fort St. Philip and effectively cut off the Confederate forces on three sides. The forts officially surrendered on 28 April 1862 to Commodore Porter. The marines on *Westfield* were ordered to land and take possession of Fort Jackson (Cotham 2006:51-52). Commodore Farragut went to take command of New Orleans where the citizens were busy setting the city's coal, cotton, steamboats, and ships on fire (Mahan 1885:86). The forts were New Orleans' primary defense, as the town was surrounded by marshes and the Mississippi. When the forts fell, New Orleans fell also. In nine days, the Union captured the lower Mississippi. On 29 April, *Westfield* headed for New Orleans and remained there until 1 May when the crew sailed down to Pilot Town at the mouth of the river to prepare for the attack on Mobile (Cotham 2006:51-52).

The fall of New Orleans was a major victory for the Union. Control over the lower Mississippi River meant cutting Texas, Arkansas, and most of Louisiana off from the other Southern states, which included the loss of Texas beef and salt from Louisiana. The Confederacy also lost the machine shops of New Orleans and a port of entry for supplies from Europe. The Confederate Navy lost two great warships, *Louisiana* and *Mississippi*, either of which could have destroyed the wooden ships of the Union blockade. In addition, Fort Jackson sustained heavy damage. The fall of New Orleans also convinced the French emperor, Napoleon III, to forego recognizing the Confederacy as a nation. The victory weakened confidence in the Confederacy's leadership, was a boost to Union morale, and weakened the power of those who desired peace. In addition, the lower Mississippi provided a naval base for conducting war on the rest of the southern ports. From that position, the Union navy could flank any Confederate force in the west (Mahan 1885:86,89; Dufour 1960:335-338).

2.5.3 Mobile, Alabama

Westfield was again employed in dragging mortar schooners out of the mud and fighting off mosquitoes in the Mississippi River at the beginning of May 1862, returning to Ship Island, Mississippi for coal. By 7 May, *Westfield* was anchored near Fort Gaines and Fort Morgan at Mobile, Alabama with *Harriet Lane, Clifton, Jackson*, and *Miami*. On the ships' approach to Mobile, three Confederate gunboats were spotted outside the forts, and the Union ships gave chase. The rebel gunboats ran behind the forts to safety. Henry Gusley felt that they were on the eve of another battle and imminent victory like New Orleans. After two days of blockading Mobile, a reconnaissance mission was conducted with *Clifton*, which became stuck in the mud within range of the forts and was fired upon. On 9 May, a blockade runner passed through the blockade during the night. The following day, *Westfield*, *Clifton*, and *Jackson* were ordered back to Ship Island, and in a friendly race, *Westfield* proved the fastest of the three (Cotham 2006:37-38,52,55-56).

2.5.4 Lake Ponchartrain, Pearl River, and the Rigolettes

By 14 May 1862, *Westfield* was anchored off the mouth of Pearl River, which empties into the Rigolettes at the outlet of Lake Ponchartrain (see Figure 2.3 above). Pearl River has three outlets; the deepest has very little current and creates part of the border between Louisiana and Mississippi. Here, Captain Renshaw desired to rid the area of Confederate steamships and rebels who ambushed ships from the shore. Pearl River is full of extreme bends and curves. *Westfield* could not continue up the river after about 70 mi. (113 km) and sent the much smaller *Sachem* on further, accompanied by *Westfield*'s boat. *Sachem* ran aground in a bend with a "tremendous crash" and was extricated from the trees using a hawser tied to a tree on the opposite bank. A rebel ambush fired upon *Sachem* and *Westfield*'s boat from the bank of the river. The vessels soon returned to where *Westfield* was anchored in Lake Borne, at the outlet of the Rigolettes. During the night, *Westfield* ran aground, and, without cause, the ship's armorer, Jacob Snukel, apparently threw himself overboard and drowned. *Westfield* returned to Ship Island, where Henry Gusley and the other marines aboard hoped to be home by July (*New York Times* 1862l; Cotham 2006:58-62).

2.5.5 Vicksburg, Mississippi

The following month, between the end of May and mid-June 1862, was uneventful as *Westfield* traveled between Pensacola, Florida, New Orleans, and Rodney, Mississippi before traveling to Vicksburg, Mississippi (Cotham 2006:63-74). Vicksburg sits 400 mi. (644 km) above New Orleans and was the Union's next step in the efforts to control the Mississippi. The bluffs around Vicksburg rose high enough for Confederate batteries to be out of range of shipboard guns (Mahan 1885:93-94). In the days before the attack commenced, *Westfield* was once again positioning mortar schooners in the Mississippi River as she was fired upon by Confederate shore batteries (Craven 1862:762). Figure 2.5 shows the positions of the Union and Confederate Navy boats.

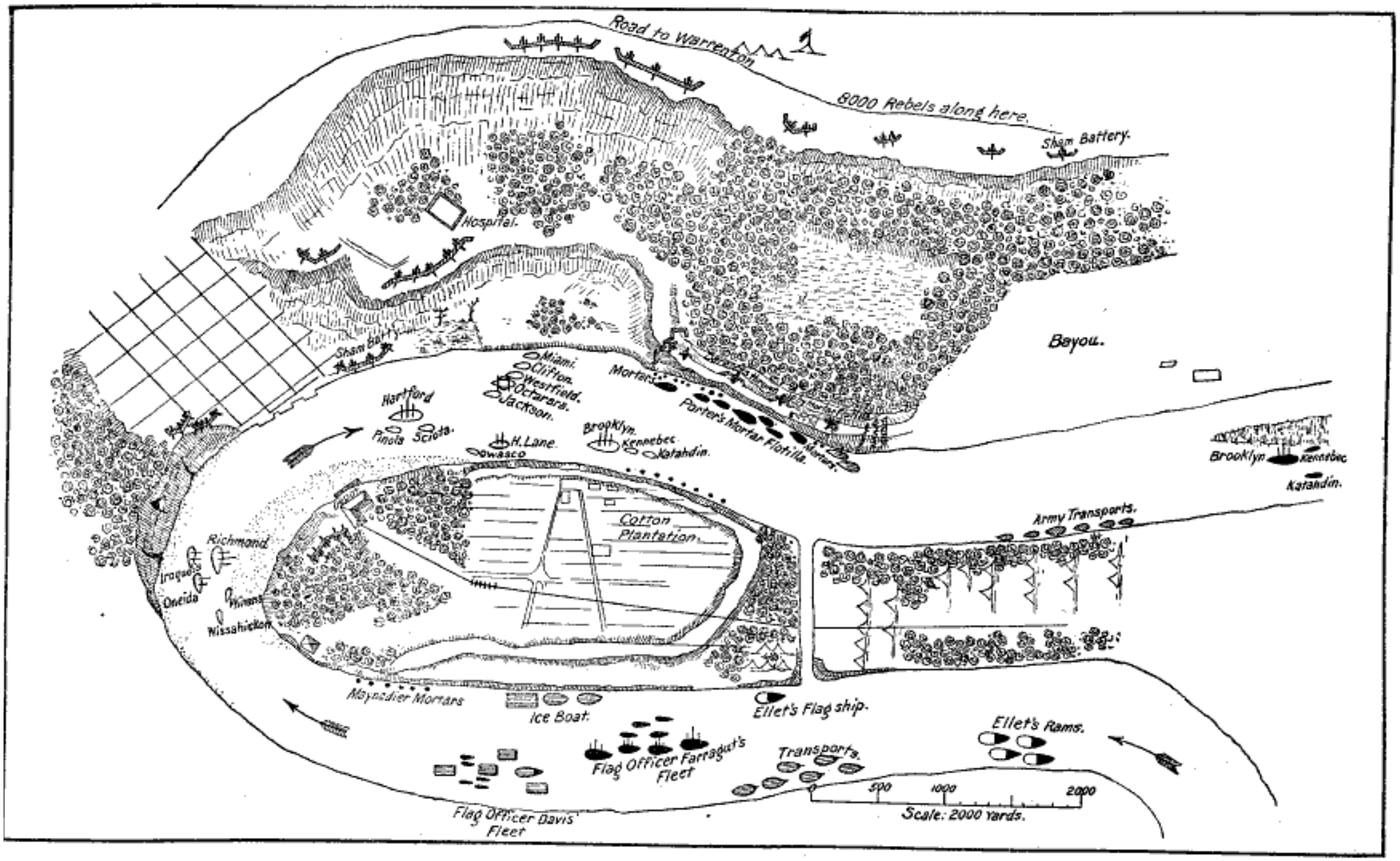


Figure 2.5. Position of Union and Confederate Navy vessels at Vicksburg (Official Records of the Navies of the War of the Rebellion 1905b:646). Courtesy of Cornell University Library, Making of America Digital Collection.

The attack on Vicksburg began at 3 A.M. on 28 June 1862. The Union steamers, including *Westfield* and *Clifton*, assaulted the town and batteries for two hours at a range of 1,200 yd. (1,097 m) (Baldwin 1862:643). The *New York Times* said that, "the air was literally filled with projectiles" during the attack. The siege of Vicksburg was slower and less effective than at New Orleans, due to the natural strength of the Confederate positions, and the Union fleet sustained more damage in the process. *Jackson* became disabled, and *Clifton* attempted to come to her rescue. *Clifton* received a shot through her boiler, killing 7 men, while 20 jumped overboard. *Westfield* came to the aid of both ships, and in doing so, received a shot through her wheel house, cutting the arm of the wheel, close to the steam chest. The shot rolled across the deck and was picked up and saved as a trophy (*New York Times* 1862m; Cotham 2006:79,82).

On 7 July, two Confederate regiments were spotted attempting to leave the town. The Union raked the woods with shot and picked up three rebel prisoners. Three days later, marines from the Union steamships landed at Vicksburg, but victory still eluded them. On 15 July, the rebel ram *Arkansas* made her way through the upper Union fleet and anchored off Vicksburg (Cotham 2006:81-83). Down the river at the lower Confederate batteries, *Westfield,* the Union steamers, and mortar schooners were engaged with the battery and preparing for the possibility of an attack by *Arkansas.* Captain Renshaw heard firing from Farragut and Davis' fleets a few miles above Vicksburg as *Arkansas* attempted to make her way down the river. The mortar schooners were moved into position, all except one. *Sidney C. Jones* had grounded on the river bank. Renshaw instructed her captain to be prepared to blow her up if he spotted *Arkansas.* Some miscommunication occurred, and *Jones* was fired prematurely, before the Confederate ram was seen. The source of the miscommunication was never found. The final battle at Vicksburg lasted two hours until the Confederate batteries were silenced, the town was fired, and the fleet returned to New Orleans. The health of the fleet's crew had much deteriorated during the siege, with 20 cases of fever and more than 20 cases of scurvy aboard *Westfield* (Renshaw 1862b:29-31, 1862c:98-99; Cotham 2006:83-84).

2.5.6 Baton Rouge, Plaquemine, Donaldsonville, and Pensacola

Between the siege at Vicksburg and the Battle of Baton Rouge, *Westfield* was again pulling mortar schooners across Pass á l'Outre at the mouth of the Mississippi River. In New Orleans on 7 August, Captain Renshaw received news that rebels had attacked Union troops at Baton Rouge, and Farragut again engaged *Arkansas*. *Westfield* did not play a large role in the battle, but she was present with Commander Farragut's fleet, lying 30 mi. (48.2 km) below Baton Rouge. The marines aboard *Westfield* later heard that 6,000 rebels under General Mansfield Lovell had attacked the Union forces of 2,500. The Union lost 250 men and the Confederates 800. The Union forces remained in control of the city. *Arkansas* was blown up by the Confederates to avoid capture, and General Lovell's legs were shot off and he died after he was captured.

On 8 August, *Westfield* left Baton Rouge on the way to Pensacola, Florida. On their way out of the Mississippi, Captain Renshaw was ordered to inform the citizens of Plaquemine and Donaldsonville to evacuate, as Commander Farragut intended to burn both cities. Plaquemine was eventually spared; however Donaldsonville was "razed to the ground". *Westfield* arrived in Pensacola on 12 August, where she remained through September (Cotham 2006:82-98).

2.6 Gone to Texas

2.6.1 Galveston

The Texas coast was a weakness in the Union's blockade in the Gulf of Mexico. The many bays and inlets along the coast provided hiding holes for blockade runners and Confederate ships. After the failed attempt to capture Vicksburg, Commander David Farragut desired to close those holes. He sent a portion of his fleet, consisting of David Porter's mortar flotilla gunboats *Harriet Lane*, *Owasco, Clifton,* and *Westfield*, to the Texas coastal waters, in order to secure bases in the major harbors at Galveston, Corpus Christi, Sabine Pass, and Port Lavaca (Cotham 1998:57-59; Tucker 2006:323).

Throughout the 19th century, Galveston was considered the most important of those Texas towns (shown in Figure 2.6). Located 50 mi. (80.5 km) south of present-day Houston, the barrier island of Galveston stretches approximately 30 mi. (48 km) long and averages around 3 mi. (4.8 km) wide. Galveston Bay (shown in the map below in Figure 2.6) is about 35 mi. (56 km) long and ranges between 12 and 18 mi. (19 and 29 km) wide and was considered the best harbor in Texas (New York Herald 1863). A natural current in the bay created the harbor that formed behind the sand barrier, a horseshoe shaped outer bar that stretches four miles (6.4 km) between Galveston Island and Bolivar Peninsula to the east. The bay varies in depth, averaging approximately seven to eight feet (2.1-2.4 m). Named after Count Bernardo de Gálvez who commissioned a chart of the Texas coast in 1785, the city of Galveston was established by the Galveston City Company and Michael B. Menard, the city's founder, in 1838 (McComb 1986:5-6,8,43).

In 1860, the town's population of over 7,000 lived in a city which contained a market hall, a town hall, eight churches, and several hotels. Control over the harbor and town meant control over Texas' second largest city, largest seaport, and almost all exported sugar and Texas cotton, approximately 200,000 bales in 1860. Cotton was shipped to Galveston and Sabine Pass from locations across the Confederacy to be sent to ports in the Caribbean, including Cuba, Mexico, and to Europe. Imports focused around arms and ammunition, which were lacking in the agricultural-based Southern economy (New York Herald 1863; McComb 1986:6; Tucker 2006:323). Galveston created a base from which the Union could secure the border with Mexico and discourage commerce between Texas and Mexico. The Union could also monitor cotton exports and access the interior of Texas for military invasion.

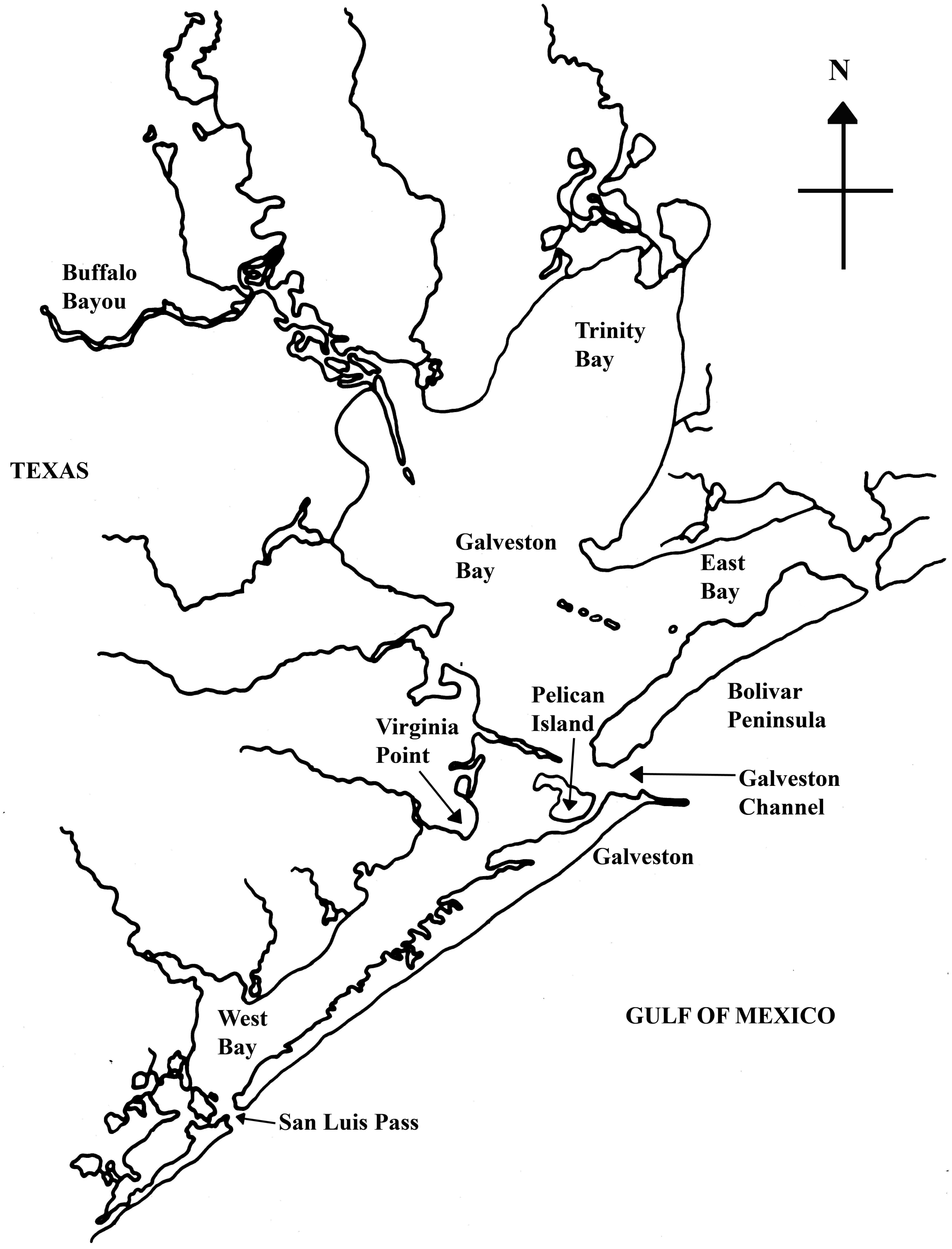


Figure 2.6. Map of Galveston Bay, Texas. After McComb (1986:9).

While the blockade of Galveston began in July of 1861, Union forces did not attempt to capture the city until 4 October 1862. The primary reason for this was the lack of resources in the area and what appeared to be a "formidable battery" located on Pelican Island, just north of the town. However, in October of 1862, the gunboats of Porter's mortar flotilla finally provided the resources Farragut needed to take control Galveston (Tucker 2006:323-324). On 2 October, the steamers *Westfield*, the flagship under Captain Renshaw, *Harriet Lane*, under Commander Jonathan M. Wainwright, *Owasco*, captained by Commander John Guest, *Clifton*, under Lieutenant-Commander Richard L. Law, and, the schooner *Henry Janes,* under Acting Master L.W. Pennington, anchored just outside the sandbar at the mouth of Galveston Bay (Renshaw 1862d:254; Cotham 2006:104). In the early morning two days later, *Harriet Lane* entered Galveston Harbor under a flag of truce with the intention of demanding the surrender of the city. After receiving a shot across her bow, *Harriet Lane* anchored and waited for a Confederate boat to approach. When one did not appear, Captain Wainwright sent out a boat with the executive officer. The officer sent the request for the Confederate's surrender to Colonel Joseph Cook, who immediately set off for the city of Galveston to dispatch a boat with a response. The small sailboat, whether unintentionally or on purpose, required more time than expected by Captain Wainwright on the journey back to *Harriet Lane.* Captain Renshaw reported strong winds in the harbor, which could have delayed the small boat; however, Captain Wainwright took great offense to the boat's leisurely progress. Wainwright and *Harriet Lane* steamed out of the harbor to reconvene with the other Union ships before the small sailboat's mission was completed (Cook 1862:262; Renshaw 1862e:255).

Not wanting to delay the imminent capture of Galveston any further, Renshaw ordered the entire force over the bar and into the harbor (Renshaw 1862e:256). *Westfield* led the force into the harbor, with *Clifton* towing No. 19 mortar schooner on her right, *Harriet Lane* on *Westfield*'s left, and *Owasco* at the center, behind. A shot by a Confederate 10-inch Columbiad was fired on the vessels from Fort Point, at the most northeastern part of Galveston Island near the entrance of the harbor (Figure 2.7). The

Union's rapid reply caused the rebel forces at Fort Point, and the slowly approaching sailboat, to retreat quickly. Henry Gusley states that the crew aboard *Westfield*, "turned [their] long [Parrott] rifle on the retreating rebels, considerably accelerating their before remarkable speed." The apparently formidable Confederate battery at Galveston was now discovered to contain mostly guns of the 'Quaker' variety, those made of logs painted to look like cannon (Renshaw 1862d:255; Cotham 2006:104). As the Union force weighed anchor in front of the city, *Westfield* was fired upon by two 24-pounders set up in the east side of Galveston city. Renshaw reported to Farragut, that although the shot fell short, he was reluctant to take out the battery with *Westfield*'s guns because he wanted to avoid firing into the populated city, under the nose of the foreign consuls. Although warranted, this fear of offending foreign consuls and humanitarians was to shape Renshaw's future decisions regarding Galveston.

Firing ceased as the small, yet determined, sailboat once again turned back to complete the mission of relaying the Confederate response to Renshaw. Renshaw had requested the immediate surrender of Galveston, lest the city should be burned to the ground. Colonel Joseph Cook and other rebel officers had been sent on the Confederate sailboat to inform Captain Renshaw that the Confederates would not surrender, due to the numbers of women, children, and foreign consul still living in the city. Cook stated that Renshaw would indeed be blamed for the destruction of the city and the lives lost. While still determined to capture Galveston, Renshaw changed his mind when Cook and the rebel officers reported, whether truthfully or not, the existence of yellow fever amongst the city's residents. Cook requested four days to remove the women and children before the Union took control, and Renshaw reluctantly agreed so long as the Confederates did not change their defenses on the island. With this requirement, Renshaw intended that the Confederates were not to increase or decrease their defenses, while Colonel Cook understood the agreement to concern only the increase. The agreement was sealed with a handshake (Cook 1862:262-263; Renshaw 1862e:256-257).

Coinciding with the meeting aboard *Westfield*, marines were sent off to spike the battery at Fort Point and inspect the rebel barracks on Pelican Spit, across the entrance to the bay from Fort Point. Here, the marines discovered the Quaker guns and were so impressed by the ruse of the Confederates, that one was mounted on the hurricane deck of *Westfield*. The gun can be seen in the Memphis drawing (Appendix Figure A-1). Two days after the arrival of the Union fleet, marines accompanied by Captain Wainwright of *Harriet Lane*, landed at the city and were warmly welcomed to the mayor's office to formally receive the key to the city (Cotham 2006:106).

The Confederates realized Galveston could not be defended as they gazed at the Union ships a mile off the wharf, counting approximately 40 guns aboard them. They had a large battery of 12 to 20 guns at Virginia Point, on the mainland across a railroad bridge, five miles (8 km) northwest of the city (Figure 2.7 below). Here, the rebel army of 3,000 to 5,000 sat waiting, believing that the Union was planning to send a large force to invade Texas. But the Union forces, with the light mortar schooners and the shallow draft of *Westfield*, would not have a problem accessing Virginia Point on their own. Galveston lacked fresh water and was in constant need of supplies. The Confederate commanders decided to evacuate to Virginia Point in the hopes of preventing a landing by the Union, protecting the railroad, and saving the city. All supplies, machinery, and county records were removed to Virginia Point. Those people who chose to stay would no longer receive protection or supplies from the Confederates. A small force was left on the Galveston side of the railroad bridge, to evacuate once the Union took control (Cook 1862:262-263; Debray 1862a:261, 1862b:261; Renshaw 1862e:259).

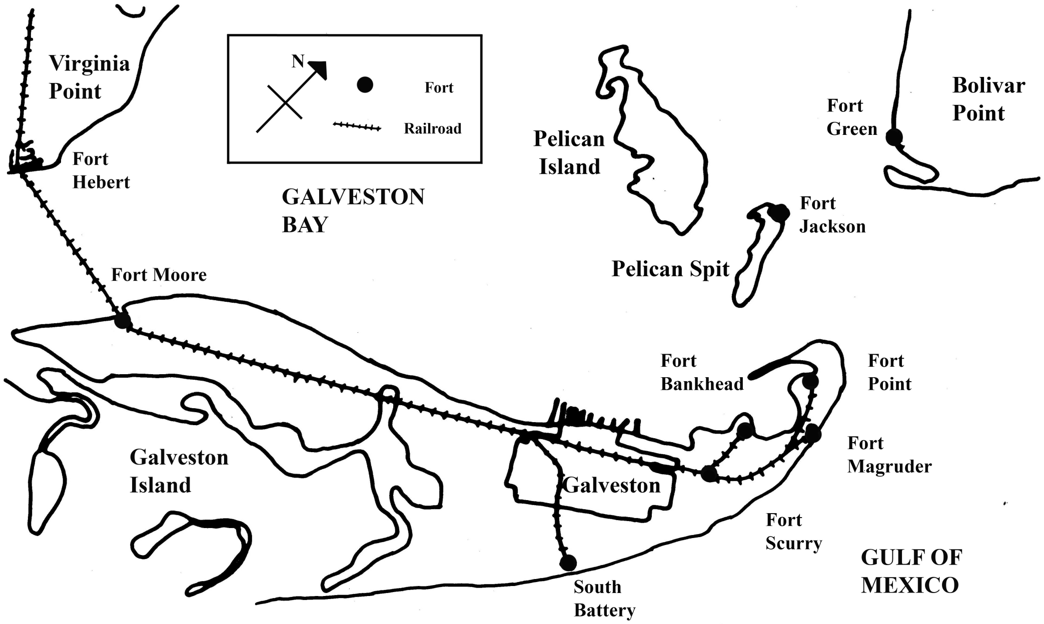


Figure 2.7. Galveston, showing locations of forts and railroads. After Cotham (1998:19).

The Confederates also took the liberty of removing four guns from their defenses at Galveston during the night (Cook 1862:263). The guns were two old-fashioned 24-pounders, one 80-pound rifle, and another unknown gun. When informed, Renshaw aimed to ignore the Confederate breach on their agreement. He wanted to avoid what he called a "long consular controversy" and exposure to yellow fever. Captains Law and Wainwright thought differently. They confronted the Confederate officers in Galveston, demanding the guns be returned under the threat of hostilities. Offended, the rebel officers disputed the claim that the agreement prevented the removal of the guns, and answered that if Renshaw were to attack Galveston during the four day truce, he would be in breach of the agreement. Not wanting to be accused of violating the agreement, Renshaw backed down.

Captain Renshaw had other concerns to attend to. A visit from an English consul living in Galveston informed him that the rebels would sooner destroy the town than surrender to the Union, tipping Renshaw off that hostilities in the area were far from over. In addition, Captain Renshaw was concerned over the number of deserters looking for protection and supplies from the Union forces. While the wealthy and influential citizens had evacuated the town for mainland Texas, the middle and lower classes remained, with Union sympathies and a lack of provisions. Captain Renshaw also did not have the men to occupy the town for a substantial amount of time. Despite what the Confederates believed, a large Union force was not on its way to hold the town and attack Texas. As a result, Renshaw could only land a small party, raise a flag above the customs house for a half hour or so, and retreat back to the ships in the harbor. In a report to Commander David Farragut, he requested provisions and 200 to 300 men with six pieces of artillery in order to defend Fort Point or Pelican Island (Renshaw 1862e:258-260). The latter request was refused. Farragut had neither the troops nor the guns to send to Renshaw. He instructed Renshaw to leave Galveston in the hands of a single gunboat and to head south toward the next major city on the Texas coast (Farragut 1862b:260).

During this time, Henry Gusley and the other marines were stationed at the abandoned Confederate barracks on Pelican Island. The month of October was spent in picket duty, digging earthworks to defend Pelican Island, and dispersing rebel cavalry on the bridge at Virginia Point with *Westfield*'s 100-pounder rifle gun. Other days were spent in rowing matches and oyster bakes (Cotham 2006:107-109). During one rather extensive oyster bake, Captain Renshaw called the marines back on board *Westfield*, and the Union steamships quickly set sail for Matagorda Bay.

2.6.2 Matagorda Bay

Westfield and *Clifton* arrived in Matagorda Bay on 23 October 1863 (shown in Figure 2.8 below). The bay had been blockaded by Union ships since the previous winter, and the inhabitants of Indianola and Lavaca had long been expecting to see Union ships in the bay. Crossing the channel at Pass Cavallo, *Westfield* and *Clifton* both ran aground on the sand bar, extricating each other in turn. Meanwhile, Confederates at Fort Esperanza, on the western end of Matagorda Island near the pass, did their best to ward off the Union ships using the guns from the fort. They were no match for the Union guns, which pummeled the fort until the Confederate soldiers “concluded that discretion was the better part of valor and retreated to Indianola before they could be cut off” (Malsch 1988:162,167; Cotham 2006:110-111).

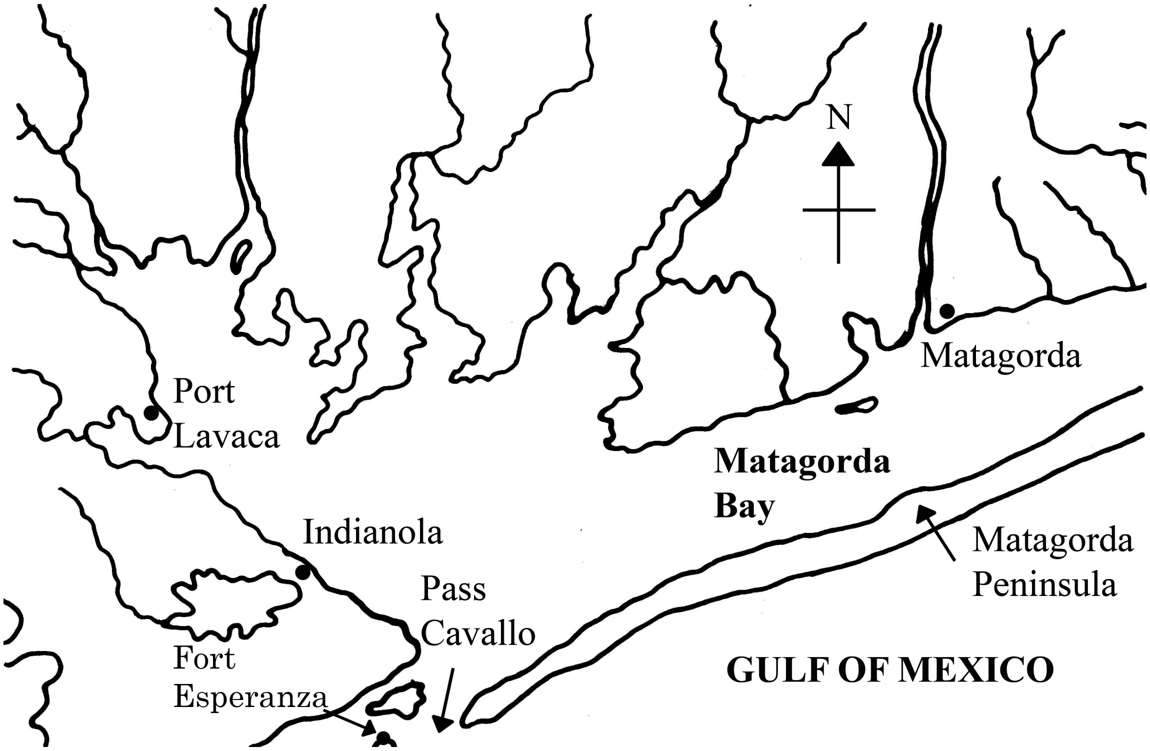


Figure 2.8. Matagorda Bay. After Cotham (2006:112).

The two Union ships, along with *Lecompte*, a captured blockade runner, anchored off Indianola on 26 October. *Westfield* was tied to the wharf and Renshaw sent a flag of truce to the town, demanding a representative to discuss the fate of Indianola. H.B. Cleveland, T.D. Woodward, and Captain Henry Sheppard met with Captains Renshaw and Law aboard *Westfield*. Renshaw stated that he had three rifled guns and six nine-inch guns with which he could command the entire bay, but he offered to provide freedom to bring small boats with supplies and people in and out of the town in exchange for the opportunity to land a few men to buy supplies. His offer was refused by the stout Confederates, who opted to have their town burned rather than help the enemy. Captain Renshaw ordered the women and children to evacuate before bombardment began. The town was demolished, and although only one Union and two Confederates were killed, many were wounded (Malsch 1988:137-138). The crew aboard *Westfield* obtained their supplies, hunting geese, duck, and capturing cattle at Indianola (Cotham 2006:114).

Westfield and *Clifton* traveled further up the bay to Port Lavaca, and, in the same pattern as at Indianola, Renshaw sent a flag of truce on shore requesting a meeting. Major Daniel D. Shea and four citizens of the town met with Renshaw and refused his demand for surrender. Captain Renshaw provided an hour and a half to evacuate the women, children, and sick, due to the epidemic of yellow fever in the town (Malsch 1988:168). As the Union ships fired at Port Lavaca, the town fired back with four batteries, totaling eight to ten guns. There were no lives lost in the shelling; however, considerable damage was done to the town, after the Union ships had fired 252 shot and shells. Both *Westfield* and *Clifton* received damage, and the 100-pounder Parrott rifle aboard *Westfield* burst, wounding three men. On the evening of 31 October, the Union ships anchored out of range of Lavaca's batteries. Bombardment continued the next morning for two and a half hours, until the Union ships ran low on ammunition and returned to the channel at the mouth of Matagorda Bay (Cotham 2006:115).

The Union ships left Matagorda Bay after capturing and looting Indianola and bombarding Lavaca. USS *Kittatinny* and her captain C.W. Lawson were left to defend the Union holdings. However, she was unable to cross the bar at Pass Cavallo, drawing one too many feet (0.3 m) to cross. Her inability to enter the bay allowed the Confederates to reoccupy Fort Esperanza after *Westfield* and *Clifton* returned to Galveston (Malsch 1988:169-170).

2.6.3 Back at Galveston

Westfield and the Union ships left Matagorda Bay and arrived back at Galveston early on the 5 November 1862. On their arrival, the Union ships found a rather dismal scene. *Owasco*, left to defend the Union hold on the bay, was aground on the sand bar (Cotham 2006:116). Galveston's population was cut in half, and with only ten percent of businesses left open, and the remaining population still subsisted on Union rations (McComb 1986:72-75). In addition, there were rumors of a rebel ram discovered at the head of Galveston Bay. This rumor seemed to have been proven true, and after almost a week in Galveston, the crews aboard the steamers were told to be on the alert. Henry Gusley recalled the foreshadowing speech Captain Renshaw made on the occasion:

> My lads, I have called you together to tell you that there is a rumor afloat that an attempt will be made some of these nights to drive us from the harbor, by some rebel steamers, and I have reason to believe there is some truth in the rumor. Now what I want to impress on you is that you must keep your eyes wide open, to prevent a surprise; be ready at your guns at the first alarm. I know I have a good crew- I couldn't wish a better set of men; but here in an enemy's country I can't impress it upon your minds too strongly to be vigilant. If we are attacked at all it will be by boats drawing very little water, and they may come upon us without coming through the channel; and their object will be to board us. So you must keep your eyes all around you; for if they get alongside before we are ready to receive them, or before our anchor is up, they may stand a pretty good job of succeeding; but if we are under weigh, I know- with the good stout engine of the *Westfield* and her gallant crew- we can sink and destroy a good half-dozen of them (Cotham 2006:116-119).

Few events transpired in November of 1862 for *Westfield*. A small crew from *Owasco* landed to obtain supplies and was fired upon in an ambush. Almost all of the men were wounded, and only two escaped, while the rest were taken prisoner by the Confederates. HBM *Greyhound*, a British war steamer, arrived during a particularly rough storm, and after a visit from her captain Sir Henry D. Hickley, the Yankee sailors on the captured blockade-runner *Lecompte* struggled to return him to his vessel. Henry

Gusley was never informed of the purpose of the British ship's visit; only that she was bound for Mexico. In preparation for a possible Confederate attack, Gusley and the crew of *Westfield* practiced drills to see how fast the men could beat to quarters. All could be ready for battle in three and a half minutes. On 20 November, a blockade running sloop with over 60 bales of cotton attempted to escape the harbor in between the Union ships. She was set aflame by her captain when capture seemed imminent but was saved before too much damage was done. The sloop was sent to New Orleans to be sold.

At the end of November and through December of 1862, there were increasing signs of a Confederate presence in the area. On 29 November, a rebel ram was spotted coming down the bay and heading towards *Westfield*, anchored alone in Bolivar Channel. The crew moved quickly to clear the decks, weigh anchor, and move into position. As *Westfield* headed toward the ram, the vessel turned and steamed back up into Galveston Bay. *Westfield* could not follow due to the shallowness of the water. On 1 December, the Union-supporting inhabitants living on the lower wharves at Galveston were attacked by the Confederates. The Union ships were able to defend the inhabitants and disperse the rebels. Two days later, another foraging party from *Westfield* landed at Bolivar Point. Fearing a similar fate as what awaited the crew of *Owasco* in the preceding month, an eight-inch shell was fired into the bushes before the crew landed, and the trip was successful in procuring a small portion of beef.

Into December, the marines aboard *Westfield* heard more rumors of impending rebel attacks. Captain Renshaw received a report concerning an imminent attack on Sabine Pass from several rebel steamers and a ram. *Clifton* was sent to aid the Union ships there. Nothing amounted of the rumor. Upon *Clifton*'s return, a nine-inch Dahlgren was transferred from her deck to that of *Westfield*. The 100-pounder which exploded in Matagorda Bay was stowed below decks until the gun was removed from the ship on 21 December. *Harriet Lane* and *Owasco* moved closer to the city for a better view and to prevent the rebels from approaching the city. The Union residents of Galveston were informed that communication across the railroad bridge between Virginia Point and Galveston was going to be cut off, and the residents needed to move or be left disconnected from supplies and protection. Renshaw most likely aimed at destroying the railroad bridge and offered the Union sympathizers free passage to New Orleans aboard *Island City*, a coal bark. On 13 December, gunners aboard *Westfield* were sent to Fort Point to disable the Confederate gun abandoned there and burn the magazine. Soon thereafter, 24 and 25 December saw the arrival of 400 soldiers of the 42nd Massachusetts regiment aboard USS *Saxon*. The additional soldiers were needed to hold the city, but no plans for an attack had been made by Captain Renshaw and the Union ships. The Confederates were already making plans to retake the city. As the players took the stage for the Battle of Galveston, *Westfield* took on board the last of her new guns, a long 32-pounder rifle. The last to arrive were *Sachem* from Corpus Christi, *Lecompte* from Matagorda, and a man-of-war schooner from further along the coast of Texas. At the end of December, rain and a cold "norther", a fierce wind from the north, swept over the island. On the night of 30 December, the rebels burned the lighthouse in preparation for their attack the following night. Henry Gusley cursed the Texas guerillas for destroying not only the useful structure but government property (Cotham 2006:120-127).

Gusley's account of Captain Renshaw's speech, quoted above, ended with a foreshadowing statement:

> I am fully determined not to be driven from here, and I know you will stand by me to the last to prevent such a thing. I have not the least doubt of your bravery; I have had sufficient proofs of that, but what I want to impress upon you is to be, if possible, more vigilant. As I said before, if they catch us napping they may succeed, but if we are wide awake when they come, I'll be damned if they will" (Cotham 2006:118-119).

Within two months of this speech, Captain William Renshaw kept his promise. His death prevented him from being driven out of the bay; however, his fleet was to retreat without him. The Confederates had caught them napping, and succeeded in recapturing Galveston.

2.6.4 The Battle of Galveston

At the end of December 1862, *Westfield, Clifton, Harriet Lane, Owasco,* and *Corypheus*, were stationed in Galveston Bay. Troops on shore consisted of 260 men commanded by Colonel I.S. Burrell of the 42nd Massachusetts Volunteers (Palmer et al. 1863:447). The Confederate ships, under the command of Major Leon Smith, were hidden in the northern portion of the bay, near Buffalo Bayou. CSS *Bayou City*, a packet ship under Captain Henry Lubbock, had been seized by the state, converted to a gunboat, and armored with a 12-pounder rifled gun on her bow deck. The bulwarks were built up with cotton bales and the ship could hold 100 men. Another packet, *Neptune*, was fitted as a gunboat on 26 December and also guarded with cotton bales. She was armed with two howitzer guns and captained by W.H. Sangster. Two tenders accompanied the ships; CSS *Lucy Gwinn*, under Major Andrew McKee, and CSS *John F. Carr*, under Captain John Y. Lawless. As the Confederate boats lay waiting for orders, the men watched the Union ships in the bay (Doran 1862:2; *Houston Telegraph* 1863a:2).

The Confederates got their chance in the very early morning on New Year's Day 1863. All four ships, lined up two by two, were spotted by *Clifton* and *Westfield* in the bright moonlight at 1:30 A.M. coming down from Buffalo Bayou (*The Daily Delta* 1863:1; Palmer et al. 1863:447-448). Major Leon Smith, searching on land for a signal from the land forces that the battle was underway, found no such sign. He ordered his ships back up the bay, to avoid damage from the Federal ships. At 3 A.M., the Confederate forces on land were seen and heard firing on the Union soldiers. Major Smith, aboard *Bayou City,* abruptly turned around and headed back down the bay, feeding the boiler fires with resin to create enough speed to compensate for the time already lost (*Houston Telegraph* 1863a:2; Jones 1961:322). Major William L. Burt, Aid-de-Camp to Brigadier-General Charles S. Hamilton was on board the transport ship, USS *Mary A. Boardman,* which was lying at anchor near *Westfield*. He reported spotting the four rebel gunboats coming down the bay at 3 A.M. Soon after this, the moon set, and the sky became hazy and dark (Burt 1863:455). Signal rockets warned the other Union ships and the troops on shore of the oncoming Confederate attack (Tucker

2006:325). By daybreak, the Confederate ships were within a mile (1.6 km) of *Harriet Lane* (*Houston Telegraph* 1863a:2).

The naval attack began with an attempt by *Bayou City* to ram the *Lane*, succeeded only in knocking off part of the *Lane*'s wheelhouse. A second attempt resulted in a large hole in *Harriet Lane*'s side. The *Lane* responded by ramming her bow into *Bayou City* and giving her an ineffective broadside. A bystander on land called out to Captain Wier on *Bayou City*, encouraging him to give the Yankees another New Year's present. As Wier shouted, "Well here goes your New Year's present!", the Confederate 32-pounder rifled gun he was directing exploded, killing Captain Weir and wounding several of the crew. *Neptune* also headed straight for *Harriet Lane*, ramming her bow into the Union ship's side, aiming for the wheel house but missing by approximately 10 ft. (3 m). *Neptune* was badly damaged in the collision, and Captain Sangster was forced to run her into the sand, where she sank in eight feet (2.4 m) of water. The Confederate sharpshooters on board were still above the waterline, however, and continued firing at the Union ships. *Bayou City* rammed into *Lane*'s side a second time, locking the two ships together. Soldiers began to board *Harriet Lane* as she careened over. She could no longer move as *Bayou City* was stuck under her port wheel, and her anchor was accidentally deployed after her cathead was knocked away (Jones 1961:322; Cotham 1998:125-126).

Harriet Lane did not stand much of a chance. The report by Jas. S. Palmer, Melancton Smith, and L.A. Kimberly (1863:448) stated that *Bayou City* had 200 Confederate troops, cotton bales stretching 20 ft. (6 m) above the waterline, and the 68-pounder rifled gun, that exploded during the attack. *Neptune* was quoted to have 160 men and was also fortified with cotton bales. As the Confederate crew from *Bayou City* boarded *Harriet Lane*, the Union crew attempted to repel them. In the process, both commanders of *Harriet Lane*, Captain Wainwright and Commander Edward Lea were killed (Palmer et al. 1863:448). The Farmer's Cabinet (1863:1) in Amherst, New Hampshire reported that a "pistol ball passed in one of [Captain Wainwright's] eyes and out at the back of his head. He was wearing his spectacles at the time and the officer who was paroled took them to Commodore Renshaw. One of the glasses was shot out, while the other was covered with blood and flesh." In total, 5 Union men were killed, 5 wounded, and 110 taken prisoner on *Harriet Lane*.

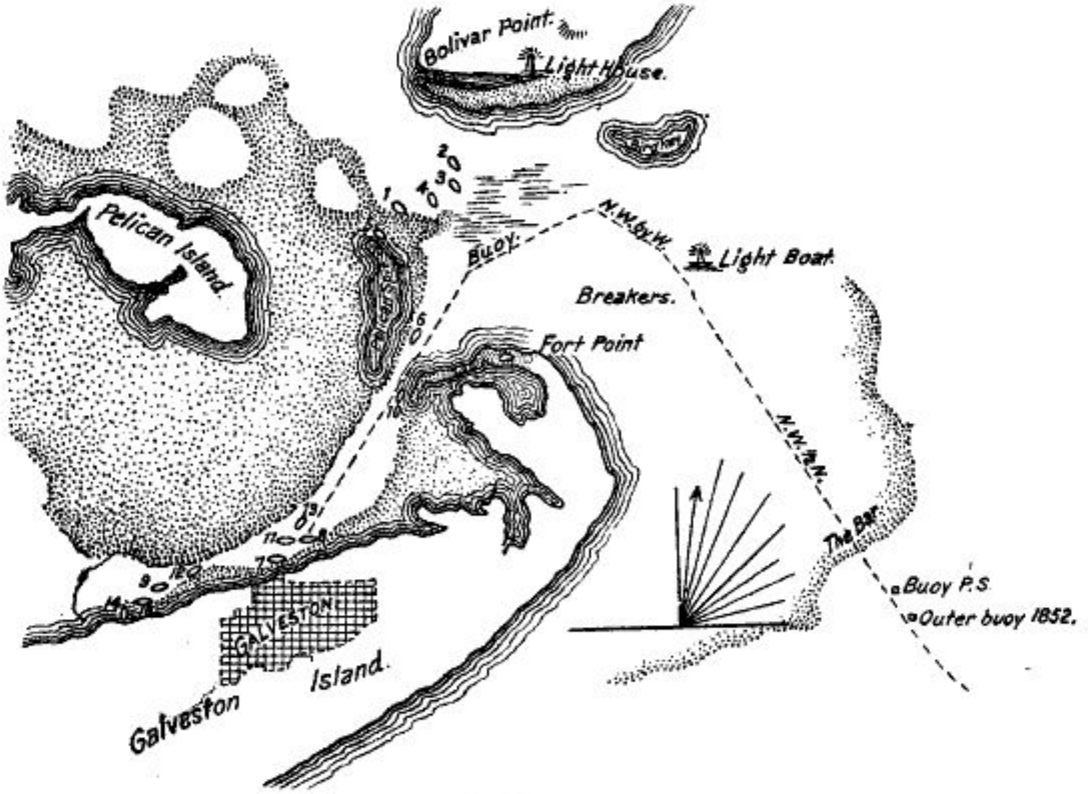
Owasco was below Galveston coaling when the Confederate ships attacked. She quickly moved to aid the troops on shore against the rebel artillery. *Harriet Lane* was soon observed under attack, and *Owasco* attempted to come to her aid. She grounded several times, only sporadically firing at the rebel ships with her nine-inch gun. As *Harriet Lane*'s guns turned on her fellow Union ship, *Owasco* realized *Lane* was lost and quickly retreated to join *Corypheus* and *Sachem* near the wharf (Palmer et al. 1863:448).

As *Owasco* rounded Fort Point, at the entrance to the channel between Pelican Island and Galveston (shown in Figure 2.9 below), she received fire from three Confederate guns at the fort. *Owasco* headed for Kuhn's Wharf, just east of Fort Point and directly in front of the main market place in Galveston, The Strand. The infantry of the 42nd Massachusetts regiment was stationed here, attempting to keep the Confederate forces at bay (Cotham 1998:115-116).

In the early morning of 1 January 1863, the Confederate land forces of 3,000 troops of 4 to 5 regiments and 20 pieces of artillery snuck across the 2 mi. (3.2 km) bridge crossing from Virginia Point to Galveston (Davis 1863:458; *Houston Telegraph* 1863a:2). The bridge had not been destroyed by either side, and rebel control of the bridge was later blamed for the Union defeat at Galveston (Burt 1863:457). The troops had to pull the guns over themselves, as the mules refused to cross the bridge. After crossing, the Confederates still had to make their way into Galveston. As the moon still shone brightly, their route diverged from a straight path into town, delaying them further. Edward T. Cotham (1998:113-114) supposed that the early arrival of the Confederate 'cottonclads' in the bay actually distracted the Union ships from the approach of the troops. Under the direction of General J. Bankhead Magruder, three 30-pounder rifled Parrott guns were moved to Fort Point, a 32-pounder was placed at a cotton press, just opposite of *Harriet Lane,* and the rest were placed at the warehouse near Kuhn’s Wharf and the Strand, approximately a quarter mile (0.4 km) from the Union troops (Davis 1863:458; *Houston Telegraph* 1863a:2; Palmer et al. 1863:448).

The Battle of Galveston officially began at 3:00 A.M. on 1 January, as General Magruder fired the first shot from inside the city, directly in front of the wharf. Magruder’s plan of attack at Kuhn’s Wharf was two-fold. Two guns were placed in the second story of the warehouse, and aimed directly at the wharf (Jones 1961:321). Confederate sharpshooters were placed in the buildings and on roofs around the wharf. Magruder also knew that they would never take the wharf from a position directly in front of it. He ordered 500 troops to wade in the water and approach the wharf from underneath and to the sides. Equipped with ladders and protected by Confederate artillery on the parallel wharves on either side of the Union troops, the soldiers approached Kuhn’s Wharf, only to discover that their ladders were too short. Union fire rained down upon the retreating soldiers as they waded back to land. A diagram of Galveston during the battle is shown below in Figure 2.9.

As the sun rose over the island, the Union vessels *Corypheus, Owasco*, and *Sachem*, already bombarding the city and causing a significant amount of damage, stepped up their efforts. Damage from one of *Owasco*’s shells can still be seen on the Hendley Building, located along the seafront on The Strand (Figure 2.10). The show of force from the Union ships caused the Confederate troops to retreat to the safety of the surrounding buildings. Magruder felt defeated, but his attitude soon changed when he was informed of the capture of *Harriet Lane* (Cotham 1998:116-122).



1. The steamer Westfield aground where she blew up.
2. The transport steamer Saxon.
3. Steamer with commissary stores for army. } Got underway and went to sea after the engagement.
4. U. S. schooner Velocity.
5. Coal bark Elias Pike. } Taken possession of by rebel steamers after we left.
6. Coal bark Cavallo.
7. U. S. steamer Sachem. } While engaging the rebel batteries on shore.
8. U. S. schooner Corypheus.
9. U. S. steamer Harriet Lane during the engagement.
10. U. S. steamer Owasco, anchored on seeing signal "enemy on shore."
11. U. S. steamer Owasco, while engaging shore batteries and after firing into steamers and after capture of Lane.
12. U. S. steamer Owasco engaging shore batteries and the steamers (ran aground).
13. U. S. steamer Clifton came and anchored after capture of Harriet Lane.
14. }
15. }
16. } Enemy's steamers when first seen and while engaging Lane and on running aground, etc.
17. }
18. }

Figure 2.9. Map of Galveston during the Battle of Galveston (Official Records of the Navies of the War of the Rebellion 1905c:450). Courtesy of Cornell University Library, Making of America Digital Collection.

Figure 2.10. Hendley Building, showing damage caused by a shell from USS *Owasco*. Photograph by Jessica R. Stika.

Three Union units, companies D, G, and I, of the 42nd Massachusetts arrived on Christmas Eve and landed at Kuhn's Wharf Christmas Day, 1863. Colonel Burrell was assured by Captain Renshaw that the wharf was perfectly safe and in easy reach of the Union ships (Burt 1863:455; Davis 1863:457). The troops were entirely dependent on the ships for defense or an escape route (*Farmer's Cabinet* 1863:1). As the Confederates advanced at 3:00 A.M., the troops signaled to the gunboats for help. Firing from both sides lasted until a flag of truce was spotted on the Union vessels. Colonel Burrell sent Lieutenant Charles Davis to *Owasco* to inquire about the flag of truce and have the gunboats remove the men from shore. The Confederates simply outnumbered the Union troops and were too strong for the defense of Kuhn's Wharf to continue. Aboard *Owasco* during the truce, Davis watched the troops marched off as prisoners. Commander Law informed Davis that the gunboats would proceed immediately to the wharf, so Davis remained on *Owasco.* He was the only man of the 42nd Massachusetts not taken prisoner (Davis 1863:458).

Law agreed to a three hour truce that dictated neither side would move any vessels. However, this truce did not extend to the forces on shore, nor were they informed of the truce. Colonel Burrell agreed to a truce lasting 30 minutes, just enough time to communicate with the navy ships. *Clifton* did not move to the shore to evacuate the troops following the truce, and Colonel Burrell was forced to surrender his entire command to the Confederates (Tucker 2006:355).

When the Confederate ships emerged from the northern part of the bay at approximately 4:00 A.M., Captain Renshaw ordered his crew to weigh anchor and cut off the Confederate ships before they reached the troops on shore. In his haste, *Westfield* grounded hard in the sand to the northeast side of Pelican Spit. Renshaw signaled to *Clifton* for assistance. Despite great efforts from the sailors aboard both ships, *Westfield* remained stuck (Burt 1863:455; Jones 1961:323; Tucker 2006:325,354). As the moon set, flashes of light shone from the town as Magruder and his soldiers fired upon the 42nd Massachusetts located on Kuhn's Wharf. *Clifton* sailed immediately to their aid, leaving the crew of the stuck *Westfield* to fend for themselves (Palmer et al. 1863:448).

With the capture of *Harriet Lane*, Major Leon Smith hoisted a flag of truce and sent a boat to *Clifton* demanding the surrender of the Union ships. He required all crew to be transferred to one ship which was to leave the harbor. Otherwise, Smith would attack the gunboats one by one. Lieutenant Commander Law aboard *Clifton* brought the proposal to *Westfield* for deliberation. At this time, Renshaw watched as the troops on shore were marched away as prisoners, *Harriet Lane* was towed up to the wharf, and the rebels moved more artillery into position (Jones 1961:323; Palmer et al. 1863:448).

Captain Renshaw knew that the current situation in Galveston would be a great embarrassment to him and the navy. He had demonstrated his concern for the navy's reputation in his letter to Command David Farragut where he explained his reasoning behind what Farragut believed to be generous allowances made to the Confederates and the citizens of Galveston, in October of 1862 (Renshaw 1862e:258). Renshaw was aware of Farragut's disapproval, and the loss of Renshaw's flagship would solidify Farragut's opinion. Later, Farragut would write in a letter to Captain James Alden, "Why he destroyed his vessel no one can tell." However, Renshaw decided to scuttle the ship rather than face the Confederates and the larger, better armed *Harriet Lane*. Farragut later stated in his letter, "If the *Lane* gets out [of Galveston Bay], she will be as bad as the [CSS] *Alabama*" (Farragut 1863b:490).

USS *Mary E. Boardman* was signaled to remove the crew and supplies from *Westfield* (*New York Times* 1863a). Boats from *Westfield*, two cutters and a gig, transferred 130 men and their supplies in 15-20 minutes. Supplies thrown into the boats included hammocks, officers' trunks and seamen's chests, cutlasses, swords, rifles, fowling pieces, blankets, clothing, looking glasses, and important papers, including the pay roll and papers from the safe. The ship had been recently supplied with provisions and clothing from USS *Tennessee* (*Houston Telegraph* 1863b:1; Allis 1863:441). Major William L. Burt (1863:456) of *Mary Boardman* later reported attempting to dissuade Renshaw from abandoning his ship, claiming that *Westfield* was too valuable with her shallow draft and heavy guns.

At 10:00 A.M., Captain Renshaw and his officers returned to *Westfield* and made preparations to fire the ship. The safety valves on the boiler were chained down and the magazines were opened. Turpentine was splashed over the deck and forward magazine, and Renshaw lit the match (Burt 1863:456; *New York Times* 1863a; Tucker 2006:326). Sometime between Renshaw's movement from the deck of *Westfield* to his foot stepping into the awaiting gig lying adjacent to the gunboat, *Westfield* exploded with a terrible force. Primary sources, including special correspondents from the *New York Times* (1863a) and letters in the *Official Records of the Union and Confederate Navies in the War of the Rebellion* (Burt 1863:456; Palmer et al. 1863:449), agree that *Westfield* exploded prematurely. Other accounts hold to a delayed explosion, stating Renshaw and the officers returned to *Westfield* to confirm the match had lit, and the ship exploded while their boat was near (Cotham 1998:129).

The forward magazine exploded with such force that the bow was torn to pieces, which shot into the air in a cloud of black smoke. The Captain's gig lay floating empty. In their preparation to engage the Confederate ships, the guns had been loaded and they began to discharge in every direction. Quartermaster Charles Burrell aboard USS *Saxon* observed Renshaw, "rapidly ascending, and then coming down in small pieces" (*New York Times* 1863a; Cotham 1998:129). Those officers killed in the explosion are listed below in Table 2.5.

Table 2.5. Officers and crew who died in the explosion of *Westfield* on 1 January 1863 (Cotham 2006:130).

	Seamen
Officers	Henry Bothke
Commodore William Bainbridge Renshaw	Rodolphus C. Hibbard
Lieutenant Charles W. Zimmerman	Peter Johnson
Engineer W.R. Green	Mathew McDonald
Gunner's Mate John Callahan	**Firemen**
Quartergunner Sam P. King	George E. Cox
Coxswain W. Easer Esser	William Reeves
	High McCabe

As the smoke cleared around the exploded *Westfield*, the situation looked bleak for the Union forces. The 42nd Massachusetts had surrendered. Further attempts to communicate with the forces on land, if considered, were not conducted (Burt 1863:457). *Harriet Lane* was damaged and under Confederate control. The only remaining ships fit for battle was *Clifton* and *Owasco*. The rebels were observed installing more guns upon Fort Point. Before the explosion, Renshaw ordered the remaining Union ships out of the harbor. Without another option, Commander Law immediately moved to retreat out into the Gulf of Mexico (*New York Times* 1863a;

Palmer et al.1863:449-450; Tucker 2006:326). L.D. Smalley took charge of *Mary Boardman* as pilot, and the ships moved towards the bar. All the flags of truce had been removed from the ships, and the Confederates fired on the vessels as they left. With the extra weight of the crew and supplies from *Westfield*, the *Boardman* could not pass over the bar, and all of the supplies were tossed overboard, excluding the personal possessions of the crew. The ship eventually crossed the bar, hitting the sand heavily as she went. At 1:00 P.M., all of the Union vessels had followed and were stationed outside the bay. The coal barks *Cavallo* and *Elias Pike* were left for the Confederates (Burt 1863:456-457; *New York Times* 1863a). At 8:00 P.M., the Union ships left Galveston for New Orleans, where they arrived three days later (Palmer et al. 1863:449-450; Cotham 2006:130). Galveston was left completely unprotected, and any Union claim on the island or bay was lost (Burt 1863:457).

2.6.5 After the Battle

Twenty-four hours after the fall of Galveston, General Magruder reported the capture of *Harriet Lane*, one heavy rifled gun, and 350 prisoners. He also promised the salvaging of guns from the sunken *Westfield* (Magruder 1863:465). Confederate salvagers quickly recovered the upper works, steam stack, and two guns. The paddlewheel shafts were raised and bored out for guns. Five months later in May of 1863, four men were employed in diving and recovering any items of value. The forward decks were found to be burned off, the stern about 180 feet (54.9 m) from the main section of the wreck. Six guns were salvaged, two with carriages still attached (Borgens et al. 2010:44). These were found, well preserved, 30 ft. (9.1m) from the wreck. The Houston Telegraph (1863c:1) praised the divers, citing the great “rapidity of the current” and the “difficulty in keeping the stall in proper position”. A summary of the items recovered are listed below in Table 2.6.

Table 2.6. Items salvaged from the wreck of USS *Westfield* by Confederates. From the Confederate Prize Commission Records (Borgens et al. 2010:44,46).

Ammunition	**Rigging and ship supplies**	**Raw material**
1- 9-inch Dahlgren	1 brass wheel	>1,400 lbs (635 kg) of brass
1- Dahlgren carriage and portion of chassis	6 coils of sisal rope (540 ft (245 m) each)	>10,000 lbs (4,356 kg) of iron
1- 6-inch rifled gun	2 lifting rods	
90 shells for rifled gun	2- 8-inch gun carriages (damaged)	
4- 8-inch shell guns	3,300 lbs (1,497 kg) of boiler plate	**Items for crew**
>120- 8-inch shells	4 in. (10.16 cm) diameter hawser	36 pairs of handcuffs
Complete tackle for 6 guns	1 coppered rudder and 2 pintels	5 barrels of meat
6 gun tackle for ship carriages	2 wheel shafts (10,000 lbs (4,356 kg) each)	1 barrel of beans
Conical shot	4 launches	
21- 13-inch shells		
1 fighting bolt (attaches barrel of portable howitzers to the carriage)		

The Battle of Galveston was considered one of the greatest defeats of the Union Navy during the Civil War. Commander Farragut believed there was no justification for *Westfield*'s destruction or the abandonment of *Harriet Lane*. Farragut provided little respect or words of praise following the death of William B. Renshaw (Farragut 1863c:447). With Renshaw no longer alive to take the full blame for the disaster, Commander Law became the scapegoat. He was court-martialed and removed from his position for three years (Cotham 1998:133).

The wreck of *Westfield* continued to rot away in the years after Battle of Galveston. William Watson, owner of the blockade runner *Rob Roy*, called the wreck, "a formidable looking pile of iron boilers and machinery sticking out of the water" (Watson

1892:171). By 1906, *Westfield*'s formidable pile of boilers and machinery had become a nuisance to local fishing boats. The engine shaft was still upright and 4 ft. (1.2 m) from the surface of the water. A snag boat was used to remove the majority of the wreck (McComb 1986:78-79,82-83). Most of the hull had rotted away, and a majority of the wreckage was broken up through dynamiting (Borgens et al. 2010:48).

2.7 Conclusion

Westfield was a part of a small class of Union gunboats converted from New York ferryboats at a time when the U.S. Navy was desperate for shallow craft that could easily navigate the rivers and bays of the Southern states. Because of this feature, the gunboat was useful during many naval engagements in the Civil War, including the Battle of New Orleans, the attack on Matagorda Bay, and the capture of Galveston. On 1 January 1863, *Westfield* ran aground in her attempt to destroy two Confederate 'cottonclads' advancing on the Union ships in Galveston Bay. Unable to shift the vessel off the sand, *Westfield*'s captain, William B. Renshaw, scuttled the gunboat. The premature explosion killed Renshaw and all of *Westfield*'s officers, after which, the remaining Union ships retreated from the bay. After extensive salvaging by the Confederates, the wreckage of *Westfield* lay in the mud for almost 150 years until her excavation.

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[1] The diameter of the cylinder was confirmed by the author to be the outer diameter of the cylinder. After the concretion was removed from a known piece of the cylinder, the inside depth and width measurements were taken, and an inner diameter of 48.6 in. (123 cm) was calculated. Adding the wall thickness of 0.75 in. (2 cm), the diameter of 50 in. (127 cm) was confirmed. After verifying the historical account, diameters of other artifacts could be measured to prove they were once part of the cylinder. In the case of the hot well pump, 132-017, the diameter was too small, at approximately 40 in. (102 cm), and the discovery was made by Justin Parkoff that the pump was not part of the cylinder but originally attached to the hot well.

3. CONSERVATION

3.1 Introduction

Conservation treatments of artifacts from marine sites, while time-consuming, are necessary for the post-excavation study and the curation and display of the artifacts in a museum. The removal of disfiguring concretions and biological growth, only completed during the conservation phase, can reveal important details that may compensate for the lack of exact provenience, as is the case for most of the artifacts from USS *Westfield*. With a collection as large as that of *Westfield*, artifacts are also available for conservation experiments and student training. Conservation of the *Westfield* artifacts at Texas A&M University's Conservation Research Laboratory is predicted to continue until January of 2015. This section is intended as a discussion of the various methods applied to *Westfield* artifacts and not as a step-by-step guide for conservation.

3.2 Iron

Iron comprises the majority of artifacts preserved in the collection of USS *Westfield*. The iron machinery, including the boiler and firebox, and the plates that lined the outer hull, comprise a significant portion the finds in terms of weight and size.

3.2.1 Iron Corrosion

Only two primary types of iron existed before 1900, cast or wrought iron (Pearson 1987:212). Wrought iron is essentially pure iron, containing less that 0.2% carbon by weight, in the form of slag inclusions. The slag is beaten out of the iron as much as possible while the metal is worked in the forging process. The slag corrodes along the contact surface with the iron, causing longitudinal striations which have the appearance of wood grain. The corrosion occurs from the surface down to the center, parallel to the original surface. The iron ions are then deposited as iron oxides or carbonates, and the metal dissolves into the water. The original surface is generally not preserved as metal but may still exist in the corrosion products as a mold of the original artifact (Pearson 1987:77; Cronyn 2001:182-183). Wrought iron also has a tendency to corrode differentially in localized areas, or spots, resulting in a scattered, friable surface (MacLeod 2002:710).

Alloys added to iron can produce different properties, resulting in significant differences in corrosion. Cast iron contains a small percentage of carbon, approximately 2-6% by weight, added through carburization, a process that is both time consuming and expensive. The higher carbon content in cast iron will have more anodic voltages and a less negative electropotential than wrought iron. As cast iron corrodes in sea water, the outer surfaces undergo graphitization. The carbon, in the form of graphite, acts as the noble or cathodic part of a galvanic corrosion cell. Pearlite in the iron acts as the anode and corrodes, which causes the artifact to lose density and mechanical strength. Flakes of graphite survive in a three-dimensional matrix that contain iron oxides and iron carbonates, causing the corroded surface to become soft. This graphitized zone creates an outer shell, covering the corrosion that travels to the center of the artifact. Closer to the iron core, cementite needles appear in the graphite, followed by a layer of pearlite underneath. Layers of ferrite form below the pearlite and nearer to the surface of the intact metal. Until the graphite matrix overtakes the entire cast iron artifact and breaks down, cast iron will remain in a solid form at the core, even if the iron is totally corroded and covered in corrosion products. The graphitized zone has a very light weight and is very unstable, which can cause this outer zone to rapidly break down after excavation. Because cast iron's complex nature, it is much more difficult to conserve, being more sensitive and time-consuming than wrought iron (Pearson 1987:77,79; Hamilton 1996:46; Cronyn 2001:176,185; Selwyn et al. 2001:110; MacLeod 2002:706).

The majority of cast iron artifacts excavated from *Westfield* are preserved in a transition phase. The graphitized zone is still intact but fragile. The smallest artifacts cast iron artifacts have completely corroded, leaving a mold of the original artifact which can be cast. The difficulty arises in the artifacts that still contain the original iron core, yet the surrounding original surface has completely converted into corrosion products. For these cases, the cavities are filled with epoxy resin gradually as they are cleaned. Once the concretion is removed, the half-epoxy, half-iron artifact is molded and then cast to create an entirely epoxy cast. This complete epoxy cast is necessary because the iron will continue to corrode and separate from the epoxy sections.

The basic electrochemical reaction that iron undergoes as corrosion occurs is the same for wrought and cast iron. During the corrosion process, electrons are released from the iron atom as the metal breaks down, and the atom forms a ferrous ion, or a positively charged cation. This process requires oxygen, hence the name oxidation. The production of iron ions occurs at anodic areas.

$Fe \rightarrow Fe^{2+} + 2e^-$

Reduction occurs at the cathode and involves the consumption of the loose electrons. The rate of this consumption controls the rate of corrosion at the anode, as both reactions must occur at the same rate to maintain neutrality in the charges. The surrounding environment provides the oxygen and water molecules that can act as the cathode to form a hydroxyl ion. If no oxygen is present, the hydrogen accepts the electrons to form stable hydrogen molecules.

$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

These reactions form a current called the corrosion cell and is summarized below:

$4Fe + 2H_2O + 3O_2 \rightarrow 4FeO(OH)$

In addition, any remaining iron ions react with ions in the seawater to make corrosion products such as carbonates, oxides, hydroxides, and sulfates which are deposited on the surface of the iron. These form a hard concretion and block the seawater from contact with the original surface, stifling further corrosion in a process called passivation (Pearson 1987:68-69; Cronyn 2001:166-168).

The types of corrosion products present in the concretion greatly depend on the environment and the type of iron. For marine artifacts, the majority of the concretion is calcium carbonate, generally located on the outer layers of the concretion (Selwyn et al.

2001:110). The outer layers also contain high proportions of magnesium carbonate, hydroxides, siderite, and iron (III) sulfate, which create a concrete-like substance around the artifacts. The inner layers of the iron concretion consist of iron oxides and hydrated oxides. Both concretion layer types can sometimes cover an entire deposit or can trap non-ferrous metals or organic material (Cronyn 2001:171-172,179,181).

Corrosion can continue underneath the corrosion products. The electrons produced during the oxidation reaction flow from the anodic to cathodic areas through the metal. Any resistance in the iron will slow this movement. Electrons build up at the anode, causing the electro-potential (E_{corr}) of the anode to become more negative while the cathode becomes more positive. Cations are created at the anodes during the release of the electrons and anions are generated at the cathodes. The diffusion of cations to the cathodic areas and anions to the anodic areas happens easily in seawater that has high ionic conductivity and a supply of dissolved oxygen (Pearson 1987:68,69,74).

However, chlorides in the seawater are more aggressive and can pass through the concretion and continue to attack the metal. This reaction does the greatest damage to archaeological iron (Hamilton 1996:44).

$$Fe^{2+} + 2Cl^{-} \rightarrow FeCl_2$$

Chloride ions may account for up to 13% weight of iron and cause iron ions to precipitate out as iron oxides and iron oxyhydroxides in the concretion, as opposed to on the surface of the iron. For cast iron, chloride ions are dispersed in the graphitized areas, while for wrought iron, the ions congregate around exposed areas on the metal surface and the slag. Once the concretion is removed, chloride ions will migrate and diffuse off the original surface (Selwyn et al. 2001:110).

3.2.2 Corrosion Rates

Each iron object is subjected to varying conditions which result in varying amounts of corrosion. Factors that influence the corrosion of iron include the composition, temperature, and pH of the water, the composition and depth of burial in the seabed, marine growth, water movement, and proximity to other objects. For example, the cathodic reaction is controlled by oxygen reduction, and the availability of oxygen will vary depending on temperature. Estuarine environments, like Galveston Bay, or polluted waters will have lower levels of dissolved oxygen due to increased biological activity (Pearson 1987:68,69,74). Wooden objects have an adverse affect on iron and were commonly found near or concreted to iron artifacts found on *Westfield*. Wood takes up the dissolved oxygen and creates an anaerobic environment around the iron. As a result, sulfate-reducing bacteria grow using the wood as nourishment and create hydrogen sulfite as a by-product, which reacts with the iron and increases the corrosion rate (Hamilton 1998). Other metal artifacts can influence corrosion rates through galvanic coupling. The metal with the lower, or more negative E_{corr}, or electropotential, will have an increased rate of galvanic corrosion while the higher or less negative E_{corr} will experience galvanic protection (Pearson 1987:72). For example, the electroplated silver condiment cap (109-010.1) was concreted to a large iron bolt which likely experienced galvanic corrosion in favor of the silver, a nobler element with a higher E_{corr}.

Corrosion rates can aid in the understanding of corrosion mechanisms and the deterioration of iron, as well as provide a general sense for the thickness of concretion on the artifacts. Despite the differences between wrought and cast iron, both corrode at the same rate. Corrosion rates have an average minimum of 0.004 in/yr (0.1 mm/yr). However, they are greatly dependent on the electropotential (E_{corr}) and the pH of the surrounding seawater and iron (Pearson 1987:77; MacLeod 2002:698-699). Ian MacLeod found that in southern Australian waters, the corrosion rates of shipwrecks depended on the depth of the wreck because dissolved oxygen concentrations increased as the temperature and salinity decreased at lower depths. MacLeod's equation to calculate corrosion rates for open ocean wrecks applies specifically to southern Australian latitudes:

$$I_{corr} = 0.2438 - 0.0107\, m + 0.000\, m^2$$

In this quadratic equation, I_{corr} is the corrosion rate and m represents the depth of the shipwreck in meters. *Westfield* sank in the warm waters of Galveston Bay, far from southern Australia. However, with a lack of environmental data or comparative wrecks, this equation is a best attempt at estimating a corrosion rate more fitting than an average minimum. Although the gunboat ran aground and sank at a much shallower depth of approximately 7-8 ft. (2.13-2.43 m), *Westfield* was discovered at a depth of 47 ft. (14.3 m), believed to be her depth for the majority of the time between sinking and excavation. Using MacLeod's equation, the corrosion rate for *Westfield* can be estimated at 0.005 in/yr (0.13 mm). However, the thick layer of concretion can decrease corrosion rate by blocking access to dissolved oxygen and creating a microenvironment on the surface of the metal, with an increased chloride concentration and a more acidic pH. In addition, in the swift currents of Galveston Bay, concretion could be accidentally removed, allowing the chlorides and lower pH of the microenvironment to accelerate corrosion. Therefore, any estimation of corrosion rates must be considered in the general sense, while artifacts must be considered individually (MacLeod 2002:698-703).

3.2.3 Treatment

Conservation treatments of cast and wrought iron have two goals; to lower the concentration of chloride ions and reduce the iron ions to magnetite in order to preserve the greatest amount of iron, and more importantly, to preserve the original surface in the corrosion layers. Two primary treatments applied to marine iron artifacts, alkaline sodium sulfite and electrolysis, can effectively accomplish those goals. However, problems are encountered with the treatment of cast iron versus that of wrought iron.

3.2.3.1 Chloride Diffusion

Chlorides present in iron are primarily FeOCl and $FeCl_3$. These molecules must first dissolve to produce free Cl^- ions which move from the iron and corrosion to the wash solution. This diffusion is described using Fick's Second Law of Diffusion:

$$\frac{dc}{dt} = D \nabla C$$

D is the diffusion constant, ∇ is Laplace's operator, and C is the concentration of chlorides at a specific time and place. The equation shows that the release of chlorides from the iron is controlled through the diffusion rate or coefficient, which depends on the artifacts' volume, properties, porosity, and initial chloride distribution. This rate can only be determined for artifact samples that are constant in composition and structure. Therefore exact solutions to this equation cannot be found for marine artifacts of varying sizes and shapes. To account for this, the diffusion coefficient can be determined from a graph of the total chloride ions released from an artifact in grams, labeled Q by N.A. North and C. Pearson, against the square root of time, or t. If all other variables remain constant during the extraction of chloride ions, the graph will produce a linear equation, resulting in a diffusion coefficient that will remain constant over time.

This concept has many applications concerning the treatment of iron. Primarily, diffusion coefficients aid in the evaluation of treatments, particularly electrolysis. A constant diffusion coefficient from gradually increasing chloride content, measured using the mercuric nitrate test, shows that there is no advantage to replacing wash solutions until the chlorides in the solution and the artifacts reach equilibrium. Once this equilibrium is reached, the chloride content measurements will stabilize, and the diffusion of chloride from the artifacts will dramatically slow down. This allows the conservator to more efficiently treat iron artifacts, and treatment times can be determined more methodically.

If the diffusion rate is known to be constant, manipulation of treatment conditions can be applied experimentally to increase or decrease this rate. The chloride extraction rate has been proven to increase with an increase in temperature, dependent on time. If this temperature is raised to 80ºC (176ºF), the increased diffusion rate was found to be permanent. Changes in pH have been found not to have a great effect, but the addition of sodium hydroxide, with the higher mobility of hydroxide ions, can penetrate the corrosion more quickly and aid in the release of chlorides. Electrolysis and sodium sulfite treatments can both increase the rate of diffusion, but this rate varies between artifacts, especially by volume, but also dependent on porosity, initial chloride content, and properties of the metal (North and Pearson 1978a:26,28,30; North and Pearson 1978b:174-185).

More recently, amendments to this theory have been proposed by Selwyn et al. (2001:113,117). The constant or uniform diffusion rate through time indicates that the chloride ions are evenly dispersed throughout the iron artifact. However, if the chloride ions were concentrated at the surface of the iron, then a more abrupt model is more descriptive, where the graph of the diffusion rate remains lower for an initial amount of time, then increases steadily before creating a plateau at the top of the graph. This graph explains that the artifact must first be passivated, or the corrosion stopped, before chloride ions can diffuse out. In addition, the uniform diffusion rate does not apply to artifacts that change shape during the treatment, i.e. concretion layers falling off. However, the uniform rate is more applicable to treatments that involve the removal of the corrosion products beforehand, as generally practiced with marine artifacts.

3.2.3.2 Alkaline Sodium Sulfite Treatment

The alkaline sodium sulfite treatment is primarily used for cast iron but is applied to wrought iron as well. The purpose of this method is to increase the porosity of the iron in order to increase the rate of chloride release and harden the graphitized zone of cast iron. At a high pH in the presence of sodium hydroxide, ferric chloride ($FeCl_3$) precipitates to form ferric oxyhydroxide through the polymerization of iron hydroxide. The ferric oxyhydroxide undergoes reduction by the sodium sulfite to magnetite. However, the sodium sulfite treatment is most effective as the reducing agent that prevents corrosion and allows chloride ions to diffuse from the metal (Gilberg and Seeley 1982:180; Pearson 1987:222-223; Cronyn 2001:199). As a result, the focus of this treatment is the diffusion of chlorides to stabilize the artifacts when they appear too weak to undergo electrolysis. The treatment is most applicable to small, cast iron artifacts that still contain an iron core, which would otherwise disintegrate during treatment (Hamilton 1996:79-80). In addition, this method is more effective directly following excavation and when concretion layers are not allowed to dry out (Gilberg and

Seeley 1982:183). Following conservation with sodium sulfite, the residual treatment products after conservation do not increase the corrosion of the artifact unless the relative humidity rises above 75% (Rimmer and Watkinson 2010:16-22).

The small, cast iron artifacts in the *Westfield* collection were treated using sodium sulfite. First, concretion was cleaned mechanically from the artifacts' surfaces. They were placed in an airtight container with 0.5 M sodium hydroxide and 0.5 M sodium sulfite, with deionized water. Three consecutive treatments six weeks in length were used to effectively remove the chlorides. The baths are mixed quickly and sealed to avoid oxidation, then heated continuously at 60ºC (140ºF). Due to alkaline sodium sulfites interference with the mercuric nitrate tests, preventing the test from reaching an end point, the chloride levels were measured from the rinse solutions following treatment to confirm the salts had reached a safe or minimal level. Following the treatment, the artifacts were rinsed in baths of deionized water, coated in tannic acid, and sealed in a layer of microcrystalline wax (Hamilton 1996:77-88; Donny Hamilton 2013, pers. comm.).

3.2.3.3 Electrolysis

Following arrival at the Conservation Research Laboratory, the iron artifacts of *Westfield* were stored in tap water with a low concentration of sodium hydroxide, about 2-5%, which passivates the iron at a high pH from 10-12 and allows the chlorides to begin to diffuse out. Treatment began with mechanical cleaning and the removal of the corrosion products using pneumatic air scribes and dental picks.

The less fragile iron objects were treated in baths of 2% sodium hydroxide, in either mild steel or heavy plastic vats to undergo electrolytic reduction. Electrolysis effectively increases the diffusion of chlorides and causes the reduction of iron corrosion to magnetite. An electrolytic cell is created, using a power source to supply the electric current, with the artifact acting as the negatively charged cathode to which positively charged iron ions travel and a mild steel mesh positively-charged anode to which electrons travel. Reduction takes place at the cathode and oxidation at the anode. The conservator adjusts the applied electromagnetic field which controls current density

(Hamilton 1996:56-60). Lower currents prevent corrosion, called cathodic desalting. When the current density is increased, the reduction of iron oxyhydroxides and iron oxychloride to magnetite occurs and releases chlorides. The magnetite is less dense and more porous, allowing for the diffusion coefficient to increase which decreases the amount of treatment time (North and Pearson 1978a:30-31; Cronyn 2001:199). The diffusion of chlorides is measured using the mercuric nitrate test described by Hamilton (1996:60-62). The chlorides, measured in parts per million, are recorded weekly until they are at a minimal level, commonly below 50 parts per million.

For more efficient treatments, multiple artifacts are placed in the same bath and are treated until the chlorides of the solution are minimal. Following electrolysis, the artifacts are washed in three consecutive baths of boiling deionized water. After the final bath and while still hot, the artifacts are painted with tannic acid and allowed to cool. Tannic acid is applied again in two coats before the artifacts were coated in microcrystalline wax to seal the iron from the surrounding environment. Hamilton (1996, 1998) and Cronyn (2001) are recommended for a more detailed explanation of electrolysis methods.

3.2.4 Cast Iron: Problems and Solutions

After treatment began on the initial cast iron artifacts to be conserved, cracking and spalling was observed on the outer edges of the iron. This occurred consistently, affected neither by size, shape, treatment, or location. Cracking also occasionally occurred after the corrosion products were removed and before treatment began.

Because this was not observed with the wrought iron, the assumption is made that the cracking occurred in the graphitized zone of the cast iron. N.A. North in Pearson (1987:212-213) observed that if cast iron is allowed to dry out in air, iron chloride with decompose to form Fe_2O_3, $FeCl_3$, HCl, and FeO(OH) which creates ideal conditions for increased corrosion. In addition, exposure to the environment will weaken the bond between the graphitized zone and the metallic core, ultimately resulting in the breaking off of the graphite during treatment. Pearson (1987:109-110) concurred, including that graphite is very unstable and rapid corrosion can force the surface layers off. In addition, the evolution of hydrogen gas during electrolytic reduction can also cause this graphitized layer to break off. N.A. North recommended storing artifacts in a solution of sodium hydroxide and keeping the artifact wet, a practiced treatment at CRL. However, he also recommended treating cast iron artifacts individually to avoid a concentration of current on any one particular artifact, a method that is not always feasible economically when treating a collection as large as *Westfield*'s (Pearson 1987:227).

Keeping the artifact wet continuously can also become a problem in practice. The artifact may become partially exposed if not monitored carefully or partially dry out during mechanical cleaning. However, North does not speculate on the amount of time an artifact is left in a dry environment before an increase in corrosion and damage to the graphitized zone occurs.

To confirm North's theory, an experiment was conducted to discover if the trend of spalling and cracking is related to time spent in a dry environment, and if so, what is the length of time spent in a dry environment until the effects are observed. Knowing that the artifacts were quickly stored in water after excavation, brought to CRL still in water, and stored wet until treatment, the assumption was made that the cast iron artifacts could have only been dry for short periods of time before treatment. For this test, a Priority 1 artifact consisting of 24 cast iron coupons cut from a piece of diamond pattern floor plating was treated using alkaline sodium sulfite and electrolytic reduction. The coupons measured 3 in. by 3 in. (7.62 cm x 7.62 cm) and were similar in chloride content, state of preservation, and composition. Two coupons were used for each test and were divided into different treatments, shown in the table below (Table 3.1). The control treatment was a bath of 2% NaOH in deionized water. The alkaline sulfite and electrolytic reduction treatments were consistent with the methods described above. Each test group in electrolytic reduction shared a vat, two coupons per vat, due to supply and space constraints.

Table 3.1. Treatment test groups.

	Minimal time	1 hour	6 hours	24 hours
Control	2 coupons	2 coupons	2 coupons	2 coupons
Alkaline sulfite	2 coupons	2 coupons	2 coupons	2 coupons
ER	1 coupon	1 coupon	1 coupon	1 coupon
ER (drilled)	1 coupon	1 coupon	1 coupon	1 coupon

A large piece of cast iron diamond-pattern plate was chosen for this experiment because it could be evenly cut into small 3 in. (7.62 cm) coupons using a tile saw. Once these samples were cut, they were weighed and measured, recording the length, width, and thickness. The samples were left to dry as shown in Table 3.1, after which, each sample was photographed on all six sides (shown in Figure 3.1 and 3.2). The control samples were placed into individual sealed containers in a solution of 2% sodium hydroxide. One sample from each test group treated with electrolytic reduction was drilled, as recommended by Dr. Donny Hamilton, so that a screw could be inserted and attached to the inner iron core (Donny Hamilton 2012, pers. comm.). This allowed for the electrical current to be conducted directly to the iron core, bypassing the resistant outer layer of graphite. The other samples treated with electrolytic reduction were attached to the current in the typical manner, which a clip on the surface of the artifact. The chlorides were monitored weekly through the treatment and the sodium hydroxide electrolyte was replaced subjectively, based on the individual chloride readings on each bath, measured with the mercuric nitrate test. The samples treated with alkaline sodium sulfite were placed in separate airtight containers containing 20 g of sodium hydroxide and 126 g of sodium sulfite per 1 L of water. The containers were placed in an oven heated to 60°C (140° F). Following treatment, the samples were again measured, weighed, and photographed. They were boiled to remove the sodium hydroxide and sodium sulfite, and the salts were measured from the boiled water.

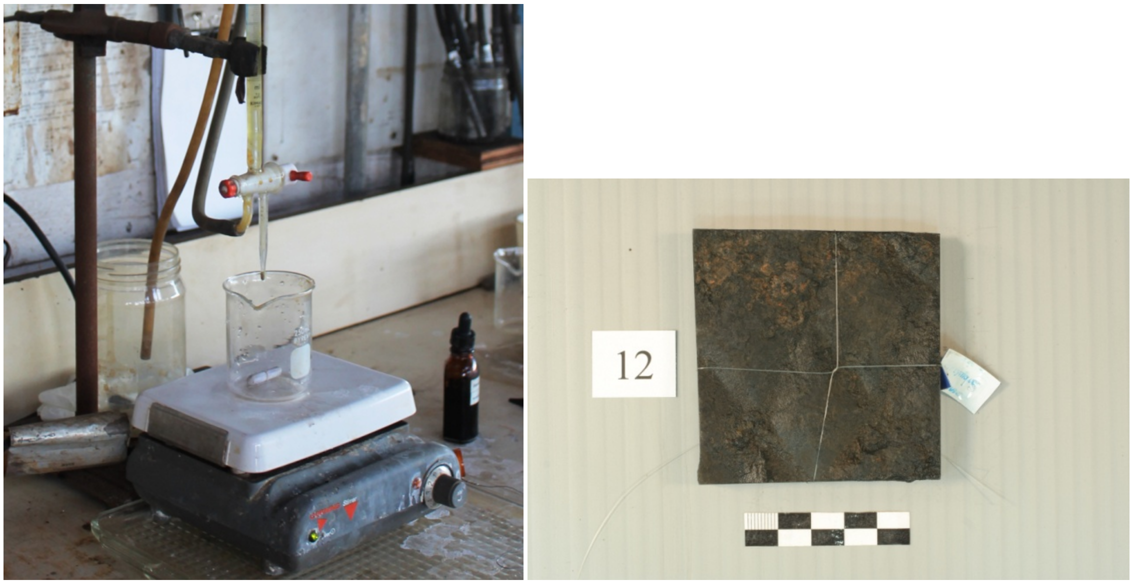


Figure 3.1. Experiment observations. Monitoring chlorides (left) and images of each face after drying (right).

Figure 3.2. Cast iron coupons left to dry after 30 minutes.

The chloride readings were converted from parts per million (ppm) to mg/L then multiplied by the volume of each container to give the amount of chlorides in milligrams diffused from the artifacts each week. This was graphed against the square root of time in days, according to North and Pearson (1978a:26,28,30; 1978b:174-185), mentioned above in Section 3.2.3.1. These graphs are shown in the Appendix (Tables A-3-A-6). The results did not show the strict linear diffusion of salts, nor the abrupt model outlined by Selwyn et al. (2001:113,117). In the first case, the variable nature of the laboratory conditions and the slight differences in each artifact did not produce a straight line. In the latter case, the concretion was removed from the artifacts before they were placed in electrolysis and the extremely porous nature of the graphite would have allowed the salts to migrate through the entire graphite layer. Despite this, a general upward trend was observed when studying the graphs and best fit lines were drawn to connect as many points between vat changes as possible. The points on either end of these best fit lines were connected by a straight line and the slope was calculated. These slopes were averaged to provide a diffusion coefficient for each vat. The diffusion coefficients for the control, 60 minutes, 6 hour, and 24 hour vats were 150 mg/sq. rt. of *t*, 197 mg/sq. rt. of *t*, 221 mg/sq. rt. of *t*, and 204.5 mg/sq. rt. of *t*, respectively. The importance of these numbers is not in their accuracy, they would change had different points been selected for the averages, but in their relationship to each other. The diffusion coefficient for the control was much lower than the coefficient for the artifacts left out for any length of time. In addition, no trend was observed in the diffusion coefficient for the air dried artifacts. Instead, the coefficient consistently hovers around 200 mg/sq. rt. of *t*. This higher diffusion coefficient is caused small fractures in the graphite from exposure to air which results in a faster rate for the diffusion of chlorides. This higher diffusion coefficient was seen for all three drying periods, indicating that even a small amount of time, for the first test one hour, can cause this damage.

This result would also seem to indicate that once done, the damage to the graphite layer does not worsen when air dried for a longer period of time, even up to 24 hours. However, upon visual inspections of the samples left to dry for 24 hours, physical damage to the graphite layer indicated otherwise. The graphite layer for these samples was easily damaged upon handling, a corner breaking off when the sample was removed from the vat, and the surface was visibly softer than the other samples. In addition, both of the 24 hour samples treated in ER had small blisters on the smooth surface of the diamond-pattern face, caused by the diffusion of hydrogen from the core and a much weaker graphite layer.

After treatment, the samples placed into both sodium sulfite and electrolysis were boiled and rinsed in deionized water. This provided the first opportunity to measure the chlorides for the artifacts treated in sulfite. The chloride readings for the sodium sulfite artifacts, the samples treated with electrolysis but not drilled to directly connect the iron core to the current, and the samples which were treated with electrolysis and drilled were 121 ppm, 43 ppm, and 14 ppm, respectively. After a few days of rinses in boiling deionized water, the chloride measurements for all three sample types were minimal, at or below 10 ppm, showing that each treatment was successful at reducing the chlorides in the artifacts.

These results provide recommended treatments for the remaining cast iron artifacts from *Westfield.* First, the conservator should be mindful of how long the artifacts are left in open air during concretion removal and treatment set up, as short as an hour of drying time damages the graphite. Constant and vigilant rinsing with water will alleviate this problem. This is already conducted at the Conservation Research Laboratory and this experiment serves as a reminder of how important that is. Second, drilling the cast iron artifacts to provide a direct current to the iron core is recommended for artifacts sturdy and large enough to be drilled. This treatment is currently being conducted on several large pieces of the cylinder and the results are promising. The concretion layers are cleaving off easily during mechanical cleaning and no spalling has been observed. After treatment, the perforation caused from drilling will be filled and sealed with wax, obscuring the mark.

This experiment was conducted to solve a problem observed on *Westfield* cast iron, using the treatments and monitoring methods available to conservators at CRL. For conservators facing similar dilemmas on contemporary sites, this treatment is also recommended. While this method may seem unorthodox, or even destructive to the artifacts, the benefits of lower levels of salts and a stronger iron core outweighs the negative aspects. However, this treatment should only be used on artifacts with an iron core, where there is very little surface detail that could be damaged, and most importantly, on artifacts that are sturdy enough to be propped up under a drill press and bear the strength of the drill. Leaving the concretion on the underside of the surface being drilled will prevent the drill from breaking off the graphite on that side. In addition, a low current density during the initial phase of electrolysis is highly recommended to prevent damage to the surface.

3.3 Copper

Second only to iron, cupreous artifacts are the most common metal found on 19th- century shipwrecks, used primarily as sheathing to protect the wooden hull from teredo worm damage. Like lead, copper is toxic to marine organisms, which impedes their growth on the artifacts. At seawater temperatures, copper ions oxidize to cuprous (I) and cupric (II). The ions combine with the chlorine and oxygen in the surrounding environment to form primarily copper oxides, cuprous chloride, and copper (II) chloride. Others include cuprous carbonate, azurite, and malachite. Like iron, the copper atoms corrode by losing an electron and bonding with another anion in the surrounding environment.

$$Cu - e^- \rightarrow Cu^+$$

$$Cu^+ + Cl^- \rightarrow CuCl$$

Copper corrodes at a rate of 0.008 in./yr (0.2 mm/yr) at seawater temperatures, about 15°C (59°F), and this rate increases by a factor of 2 for every 10°C (50ºF) rise in temperature. However, the corrosion rate decreases when the copper undergoes galvanic coupling with iron, and many copper artifacts from *Westfield* were found encased in iron concretion. As a result, only a small amount of copper corrosion products were found on the cupreous objects. Additionally, a layer of calcium carbonate precipitated from the seawater can be deposited on the copper, and marine organisms can attach themselves on the layer. This latter phenomenon was not generally observed on *Westfield* copper artifacts. In addition, although to a lesser extent than lead, grit and sand in the seawater can erode and damage copper artifacts (Pearson 1987:81-81,83-84; Hamilton 1996:90-92).

Storage in a neutral or alkaline solution passivates the copper artifacts after excavation due to a thin oxide layer that is formed on the surface. Deionized water or sodium carbonate, at a 5% solution in deionized water, will suffice for this purpose. For the *Westfield* artifacts, treatment began with the removal of corrosion products mechanically, with tooth brushes and pneumatic chisels for larger deposits. The copper artifacts were treated with electrolytic reduction in a solution of 2% sodium hydroxide, with mild steel mesh as the anode. The artifacts were then placed in three baths of boiling deionized water and polished with sodium bicarbonate to remove any residual corrosion products (Hamilton 1996:92). Following polishing, the artifacts were immersed in a 2% solution of benzotriazole (BTA), which inhibits corrosion by forming a stable polymeric coating that seals the copper from the atmosphere, effectively stopping any cathodic or anodic reactions from occurring. A coat of microcrystalline wax or Krylon spray is added as an additional sealant to ensure the artifact is completely sealed from the surrounding environment (Pearson 1987:237).

3.4 Lead

Lead artifacts found at the site of *Westfield* include lead belt buckles, a small, square lead sheet, and amorphous, non-diagnostic lead pieces. The explosion and subsequent erosion by sand and sea water left many of these pieces unrecognizable. Lead was commonly used on ships as sheeting, stripping, weights, copper sheathing repair, or shot (Pearson 1987:89,243).

In seawater, lead is less susceptible to corrosion than iron or copper. Lead corrosion products consist of lead (II) sulfate ($PbSO_4$) and lead chloride ($Pb(OH)Cl$).

Lead sulfate creates a coating that passivates the metal and impedes further corrosion. When exposed to seawater, a thin, white layer may form, composed of cerussite, or lead carbonate, and hydrocerussite, or basic lead carbonate, which crystallizes and protects the lead. This layer was occasionally observed on artifacts excavated at the *Westfield* site.

While the corrosion products on the *Westfield* lead were stable, the lead was cleaned mechanically using tooth brushes and dental picks, careful to avoid scratching the soft surfaces of lead artifacts. Hydrochloric acid (1 M HCl) was also used to clean the lead chemically, removing any carbonates or organic debris on the surface (Pearson 1987:243-244; Hamilton 1996:104; Cronyn 2001:202,204). Lead can be dissolved in ‘soft’, or deionized, water, so the HCl was mixed in tap water and the lead rinsed in tap water following treatment (Pearson 1987:244; Hamilton 1996:104). After rinsing, the lead was left to air dry and coated in microcrystalline wax to protect the artifacts from the surrounding environment and to make them safe to handle for analysis (Hamilton 1996:106).

3.5 Ceramics and Glass

3.5.1 Ceramics

The ceramics from the site of *Westfield* consist of fragments of whiteware, ironstone, stoneware, and porcelain. Calcium deposits and iron corrosion covered the surfaces, occasionally surrounding the fragment completely. In addition, surface damage included abrasion from the environment and flaking due to salt crystallization (Pearson 1987:99-101). Prior to conservation, the ceramics were stored in deionized water to remove any salts. Most fragments had corrosion products or marine life that was cleaned mechanically using a toothbrush and dental tools. If staining was present, the ceramics were placed in a solution of 10% hydrochloric acid in tap water in conjunction with mechanical cleaning. If the hydrochloric acid failed to remove the stain, a solution of 10% oxalic acid in deionized water was used to remove the remaining stains.

Following concretion and stain removal, consolidation is the typical conservation method used to conserve ceramics. For consolidation, a 5-20% solution of Paraloid B-72 or polyvinyl acetate (PVA) in acetone is either applied to the surface or is used as a bath to consolidate the body of the ceramic (Hamilton 1996:21). The consolidant should not alter the appearance of the ceramic, so attention must be paid to the concentration of the resin and the solvent's evaporation rate based on the conservator's experience (Pearson 1987:257).

However, silicone oil was used to treat the ceramics from *Westfield* because silicone oil bonds with the surface of the ceramic, creating thin layers of protection. Silicone atoms form chains by bonding with oxygen atoms through polymerization. A catalyst cross-links the bonds to form chains that lock into place around the artifact. The silicone oil is made of various molecular weights that produce different results. Different combinations of silicone oils and cross-linker percentages are used on a variety of materials to produce different results, depending on aesthetic considerations (Helen Dewolf 2011, pers. comm.). In many instances, this treatment is seldom required by ceramics as it is more expensive and labor intensive than consolidation and not generally reversible.

After the ceramics were rinsed in tap water and deionized water to remove the acids, they were placed in dehydration baths outlined below in Table 3.2. The fragments were placed in each bath for a period of two weeks. Dehydration is necessary to remove all traces of water before being placed in silicone oils. When mixed with water, silicone oil forms silicone rubber which is very difficult to remove from the surface of the artifact. Once dehydrated, the fragments were placed into a solution of 85% silicone polymer, made up of 66% SFD-1 and 34% SFD-5, and 15% methtrimethoxysilane (MTMS) cross-linker. This was placed under a vacuum to facilitate the replacement of acetone with the silicone oil. The vacuum was increased then decreased slowly at regular intervals to ensure all the acetone was removed and the ceramic fragments were not damaged. Following removal from the vacuum, the ceramic fragments were allowed to drain before exposure to dibutyltin-diacetate (DBTDA) vapors. The DBTDA vapors act as a catalyst, which links the silicone polymer chains and creates the silicone oil layer around the artifact.

Table 3.2. Standard Conservation Research Laboratory dehydration sequence.

Bath		Bath	
1	75% DI water/25% ethanol	6	75% ethanol, 25% acetone
2	50% DI water/50% ethanol	7	50% ethanol/50% acetone
3	25% DI water/75% ethanol	8	25% ethanol/75% acetone
4	100% ethanol	9	100% acetone
5	100% ethanol	10	100% acetone

3.5.2 Glass

Glass from *Westfield* was fragmentary and often non-diagnostic. Most glass recovered from the site was deposited long after *Westfield* sank, and the modern intrusive glass was not treated. Due to the initial explosion, subsequent erosion, and salvage techniques, the site was not expected to yield complete glass artifacts.

Glass consists of silica, alkali or soda ash and potash, and flux or lime, used as a stabilizer. By the 19th century, glass formulas became more stable than in previous centuries. Impervious to salts, 19th-century glass generally only suffers from devitrification when found in salt water environments (Hamilton 1996:22). As the glass is exposed to salt water, sodium and potassium hydroxides enter the silica structure of the glass and produce hydrated glass. This forms thin layers of glass which are easily spalled or eroded and provide access for the hydroxides to the body of the glass. Gradually, the glass becomes opaque and breaks down (Pearson 1987:101-102). Therefore, the conservation of glass requires consolidation similar to ceramic artifacts. While *Westfield* glass did not exhibit delamination, as generally only seen on 17th-18th century glass, to protect the fragments from further damage, the glass underwent passivation polymerization and catalyzation. The silicone polymer coats the glass to consolidate and bond with the surface, creating a layer that stops devitrification (Smith 2003:96,98). The glass was treated in the same way and at the same time as the ceramics described above. However, this treatment is only recommended for unique or fragile artifacts.

3.6 Organics

Well-preserved organics are typically unique to underwater archaeological sites. The term organics envelops many types of materials, and the properties of each type need to be considered before conservation begins. For organic artifacts, a successful conservation method will depend how close the final results resemble the original appearance (Pearson 1987:122). Conservation methods for organic artifacts from the site of *Westfield* are unique because of the large amount of iron present on the site which caused many of the organic artifacts to exhibit iron corrosion. The conservation methods discussed focus on treatment using silicone polymers, while individual cleaning methods vary. While silicone oil has proven to be successful for the treatment of many organic materials, the expense associated with the treatment may not be feasible for very large artifacts or collections.

3.6.1 Wood

Very little wood was found at the site of *Westfield* relative to the amount of wood that was used during the ship's construction. Most fragments are small and impregnated with corrosion products. A number of wood fragments exhibited evidence of fasteners, primarily bolts. The proximity of the wood to corroding iron preserved the fragments but also made their conservation more difficult.

While there are many methods for conserving waterlogged wood, none fulfill every requirement of the conservator. Many methods claim to be reversible; however, difficulties arise with the removal of bulking agents, and freeze drying can turn the wood a dull gray color, although this method is very useful for larger pieces. Due to the small size of the *Westfield* wood fragments, a silicone polymer treatment was used.

Upon arrival at the Conservation Research Laboratory, the waterlogged wood, along with other organics, was stored in covered containers, the covers preventing biological growth before treatment. Conservation began with mechanical cleaning with pneumatic chisels and tooth brushes. Pneumatic chisels were used frequently due to the large amount of concretion present on most of the wood artifacts.

Iron corrosion imbedded in the wood was removed using baths of dibasic ammonium citrate, a chelating or sequestering agent. Other options for removing the iron include citric acid, oxalic acid, formic acid, acetic acid, and disodium-ethylenediaminotetraacetic acid (EDTA). However, none of these acids can remove iron sulfides and may have some adverse effects. Except EDTA, the compounds have a pH less than five, which has been observed to cause damage to organic artifacts (Pearson 1987:126-127,195). Unlike acids, which use their hydrogen ion to extract hydroxyl ions from the ferric hydroxide in the wood, leaving the iron in a freed ferrous form, chelating agents are electron donors. They bond with a metal ion to form ring structures, thereby extracting only the iron from the wood. Because of this, chelating agents can remove all iron ions, including iron sulfides (Pearson 1987:126-127,195; Rodgers 2004:152).

While a 2% ammonium citrate treatment was chosen to treat the iron impregnated wood, EDTA is the most commonly used chelating agent in conservation and was a viable option. Both compounds have a pH at approximately five and are less of a risk to organic artifacts than other acids. However, an EDTA solution can cause the wood to soften after prolonged exposure greater than 24-36 hours. In contrast to fast treatments in strong solutions, repeated, lengthy baths in weaker solutions, such as 2% ammonium citrate, are more effective and more easily monitored (Pearson 1987:127,195,244; Stambolov 1968:45). In addition, the use of EDTA as a chelating agent generates two reactions, a Lewis-Brönsted equilibrium and a Lewis acid/base equilibrium. These compete and slow down the efficiency of EDTA. Therefore, EDTA requires deprotonization before the solution is used and the addition of a metal ion buffer to increase the selectivity of the solution. The higher selectivity of ammonium citrate is more efficient due to the reduced destructive secondary reactions and effects (Chartier 1991:73-75).

Once the iron corrosion products are removed, the wood fragments are placed in dehydration baths, similar to the ceramics and glass. However, the wood is placed in each bath for a longer period, six weeks instead of two for the ceramics and glass, to ensure complete replacement of the water with acetone. After dehydration, the wood artifacts are transferred into a silicone oil polymer in order for the acetone to be replaced by the polymer. However, wood cannot be placed in a vacuum to facilitate the replacement of acetone with silicone oil because wood has a tendency to change shape when placed under a vacuum, due to the collapse of cellular walls (Helen Dewolf 2011, pers. comm.). Excess oil is removed with a MTMS before a catalyst is used to crosslink the polymer chains. (Smith 2003:23-25). The same percentages of silicone oil and MTMS that are used for the ceramics and glass were used to treat the wood artifacts.

3.6.2 Rubber

The use of rubber in ship construction began in the 19th century, and the use of vulcanized rubber was widespread by the 1860s (Grieve 2009:677). Unprocessed, raw rubber is soluble in non-polar solvents and can become soft and sticky when warm. Charles Goodyear's vulcanization process, introduced in the 1830s, involves heating raw rubber with elementary sulfur that cross-links the isoprene chains in the rubber to provide strength and elasticity in a three dimensional network. Vulcanization also includes additives such as pigments, catalytic agents, reinforcing fillers and protectors, such as antioxidants and softeners. Rubber molecules consist solely of carbon and hydrogen with an empirical formula of C_5H_8. The rubber molecule has one double bond to each C_5H_8 molecule which increases the molecular weight. Rubber in the vulcanized state contains a higher proportion of the double bonds and, while stronger, vulcanized rubber is more susceptible to oxidation from ozone (O_3) in the surrounding air. As the polymer chains are broken down and produce lower molecular weight products, the rubber becomes hard and brittle. Ozone, formed in the air through electrical charges, can start the oxidation process by bonding with the polymer chains. With only one ozone molecule per polymer chain, the molecular weight of the chains can be halved. (Pearson 1987:31; Mills and White 1994:114-115). Therefore, artifacts made of rubber must be kept away from electrical equipment. They need to be stored in a material such as cardboard that is equally susceptible to ozone and therefore can absorb the molecules before they reach the rubber (Mills and White 1994:115).

Rubber artifacts from the USS *Monitor*, like those from *Westfield*, did not show any penetration of iron and cupreous corrosion products; however, staining was frequently encountered. Rubber artifacts found with *Monitor* included vulcanized rubber buttons, rubber gaskets, and vulcanite combs. The combs, issued by the U.S. government during the Civil War, were made from vulcanite, a much harder rubber that contains 30-50% sulfur, versus the less than 30% added to vulcanized rubber. *Monitor* conservators removed any iron concretion remaining on the rubber artifacts mechanically with wooden tools and ultrasonic water baths or chemically with 2% phosphoric acid. Conservators also found that a 2% solution of dibasic ammonium citrate safely removed corrosion products. Staining was removed by placing the artifact in a 5% solution of ethylenediaminotetraacetic acid (EDTA) in deionized water for one week. Electrophoresis was also attempted on rubber gaskets to remove corrosion from tackier rubber surfaces. While the process successfully removed the concretion, electrophoresis also resulted in delamination (Grieve 2009:678-679,681-682).

Rubber gaskets similar to those found on *Monitor* were found on the site of *Westfield.* The gaskets were found in association with the iron hatches. The salt water environment and iron corrosion resulted in damage around the edges; however the gaskets were well preserved relative to other *Westfield* artifacts. The gaskets were mechanically cleaned to remove corrosion products and dehydrated before being treated in the same way as the ceramics, glass, and wood, using a silicone polymer. Because exposure to ultraviolet rays actually helps the polymer catalyze, the silicone can absorb the UV that would otherwise harm the rubber underneath (Helen Dewolf 2011, pers. comm.).

3.6.3 Leather

Leather conservation is very subjective, based on appearance, flexibility, shrinkage, and hygroscopicity, or the leather’s ready ability to absorb water. Like other organic artifacts, stained leather must first be cleaned using both chemical and mechanical techniques. In many cases, the leather staining is not treated, as attempting to remove the stains is more detrimental to the leather artifact as a whole. However, in cases where the stain can be removed, gently running or agitated water can be used to clean fragile pieces. Chemicals such as oxalic acid, disodium and tetrasodium EDTA, ammonium citrate, citric acid, and potassium permanganate have all been used to clean leather, removing various stains and imbedded corrosion products. However, little research has been conducted as to what effect these compounds have on the tanning agents in leather.

Archaeological leather from underwater sites is conserved using bulking agents and various methods of drying, and the application of fats, oils, or waxes. Without a bulking agent like polyethylene glycol (PEG) or glycerol, the proteins in the leather begin pulling themselves together, causing shrinkage and hardening. Treating leather with PEG has fallen out of use recently due to hygroscopicity, shrinkage at high temperatures, and PEG's dark and greasy appearance. Glycerol also has similar disadvantages. However, these bulking agents in combination with freeze drying provide a successful treatment for wet archaeological leathers. Fat, oils, and waxes such as Bavon, Guildhall Museum leather dressing, nealsfoot oil, and lanolin can be used to soften the dried leather, although none offer completely successful treatments (Pearson 1987:128-131). The small leather fragments found with *Westfield* were treated in silicone oil in the manner described for the various artifacts above. They were placed in the ten dehydration baths for six weeks each and will be treated with silicone oil and MTMS in a vacuum, catalyzed using DBTDA, and cleaned of excess polymer. The leather artifacts are still undergoing treatment, however, previous treatments of leather with silicone were positive, producing leather that was flexible and near the original color.

3.6.4 Bone

Bone is both hygroscopic and anisotropic, so all salts must be removed before drying to prevent splitting and cracking. Salts can be easily removed through subsequent baths of tap water and deionized water until the salt content is minimal. After the soluble salts are removed, the bone is dehydrated using the aforementioned method of ten baths for six weeks each. The removal of insoluble salts is subjective and conducted with both mechanical and chemical means. Hydrochloric acid or formic acid at 5-10% can be used to remove calcium carbonate deposits. Oxalic acid and ammonium citrate at 5% is used to remove iron stains while hydrogen peroxide at 5-10% is used to remove sulfide stains. However, the removal of stains should be done judiciously, as more damage can be done to the artifact than is warranted.

Following salt and stain removal, consolidation is necessary. Polyvinyl acetate or Paraloid B-72 is typically used for consolidation, similar to ceramics. The artifact can either be fully immersed in a 5-10% solution of the consolidant, or the consolidant can be applied to the surface using a brush. The bone can be placed in a vacuum to speed up the process of absorption. The bone can be removed from the consolidant once air bubbles cease rising to the surface of the solution (Hamilton 1996:16-18).

Bone artifacts from *Westfield* are similar to other categories of artifacts; small, fragmentary, and non-diagnostic. After dehydration, the bones were conserved using silicone polymers. While the treatment is not reversible, bone lends itself well to silicone oil treatment, as the silicone oil easily replaces traditional consolidants. The bone is treated in the same manner as other organic artifacts; transferred from 100% acetone into silicone oil and MTMS, placed in a vacuum, and removed from the silicone oil and catalyzed with DBTDA. Excess polymerized silicone oil is removed with MTMS (Smith 2003:112-118).

3.6.5 Textile

Very few fragments of textiles were preserved on *Westfield*. Iron corrosion played a large role in their preservation, either preserving individual fibers or impressions of the textile fragments. The standard treatment for conserving textiles includes careful cleaning in water or chemical cleaning, while striving to maintain a pH between 6.5 and 10, deemed safe for most textiles. Following cleaning, the textile is dried through slow exposure to air, through solvents, or freeze drying. If consolidation is necessary, glues like polyvinyl acetate, methyl acrylate, or Paraloid B-72 mixed in a non-polar solvent is applied locally, as immersion could damage the fibers (Pearson 1987:141-146).

For artifacts like those from *Westfield*, cleaning and removal of the corrosion products would cause the fibers to pull apart and lose their shape. The use of the silicone oil treatment allows for the cleaning step to be saved until after the fibers have been conserved. The textile is placed directly into the dehydration baths without the removal of the concretion that holds the fabric together. After dehydration, the fragment is placed in silicone polymer, removed and catalyzed, and cleaned with MTMS. The silicone oil will coat the concretion particles, allowing them to be easily cleaned off after the treatment. In their conserved state, the textile fibers are strong enough to be thoroughly cleaned and preserved (Helen Dewolf 2011, pers. comm.). For artifacts that contain only an impression of a textile, casts of the impressions were made to preserve the shape of the fibers using RTV adhesive.

3.7 Conclusion

After the conservation process is completed, artifacts are stored at the Conservation Research Laboratory until they are shipped to a Naval History and Heritage Command storage facility or to various Texas museums for display. Conservation is crucial to the artifacts' future preservation and availability for study. In addition, knowledge is gained from the conservation methodologies applied specifically to artifacts 19th-century artifacts, through experience and experimentation.

4. ARTIFACT CATALOG

4.1 Introduction

Exploded, salvaged, dredged, and eroded, the artifacts from the site of the sunken USS *Westfield* exhibited a wide range of preservation. Many were mere fragments, while occasionally an object was found complete. The small finds tended towards the fragmented side, some completely unrecognizable. As mentioned in Section 1, only Priority 1 artifacts were conserved, and from this, a total of 79 artifacts were selected for this catalog. They were selected based on specific criteria. First, only objects not related to ship construction or steam machinery were chosen. This includes ceramics, glass, tableware, tools, and clothing related artifacts. Second, small artifacts which were possibly diagnostic or a ship-related artifact used regularly by the crew, including unidentified objects, bricks, cupboard buttons, chain, sash weights, and sheaves. Artifacts relating to ordnance and the Dahlgren cannon will be published in a master's thesis by Andrew Thomson, and objects relating to the boiler, steam machinery, and ship construction will be analyzed in a dissertation by Justin Parkoff.

This section begins with a short description of the manufacture of each metal type found on *Westfield*; iron, copper, and lead. At the beginning of the sections on ceramics, glass, condiment shaker top, brick, plates and buckles, and files is a short discussion of each. Following the discussion, individual artifacts are cataloged by classes and groups, modeled from Stanley South's (1977:95-96) classification. A condensed list can be found in the Appendix (Table A-7). Each artifact description begins with the artifact number, useful measurements, and a short description. For the more diagnostic artifacts, this description may include a short synopsis on the manufacture and use of the item. The ceramics and bricks include colors from the Geological Society of America's Rock-Color Chart using Munsell color chips (Geological Society of America 1991). This is followed by a photograph of the artifact, Figures 4.1-4.19, 4.24-4.39, 4.41-4.78, 4.80-4.87, taken following conservation by staff at the Conservation Research Laboratory.

The identification of artifacts presented the greatest challenge in this analysis. While some are easily recognized, others, in their fragmented condition, simply could not be identified and are presented as such. In other cases, extensive visual examination of published archaeological finds, illustrated catalogs, and picture catalogs published by Civil War relic collectors provided the source for identification.

4.2 Metals

Metal artifacts of iron, copper, and lead comprise the majority of *Westfield* artifacts. This section details the production and economic importance of these metals in the 19th century, condensed here and applicable to the metal artifacts throughout Section 4.

4.2.1 Iron

Iron exists within the earth's crust as an ore, most commonly as hematite. The rusty, metallic ore is generally between 40-60% pure iron and is mined from iron beds on the surface or from deep veins within the earth. Iron production began with removal of the ore from the iron beds. Once removed, the ore was washed, roasted to remove sulfur, which weakens the iron, and smelted using a blast furnace, to drive off water and oxygen. Blast furnaces were heated using anthracite coal, coke, and charcoal, which resulted in the production of carbon dioxide into the atmosphere and sulfur run-off, harming biological life in the surrounding areas (Freedley 1856:246-249; Gordon 1906:4). A blast furnace could produce between 120-160 tons of iron per week, on average.

The iron ore was poured into shallow troughs, called pigs. Next, the pig iron was melted into cast or wrought iron, depending on a classification and based on a numerical grade. Gray pig iron flowed well and contained the most carbon and oxygen, while white pig iron was more pure but extremely hard and weak. Pig iron smelted again in blast furnaces, formed cast iron (Freedley 1856:249-250,252). Cast iron was then poured into intricate molds or items with hollows. Various, complicated recipes were developed to control how the iron cooled, as the chemical components of cast iron were not fully understood until the end of the 19th century. Deviations from these recipes generally caused failures, especially in cannon (Gordon 1906:10-11,14). Wrought iron was converted from pig iron in puddling furnaces using charcoal as fuel (Freedley 1856:251). Charcoal contains less sulfur, which produces better wrought iron which was used for products requiring strong, thin iron, such as steam boilers. Low temperature bloom smelting and the skill of the iron worker kept the wrought iron free from weakening impurities such as carbon, sulfur, and phosphorous (Gordon 1906:7-8,14).

The iron industry sat at the forefront of commerce in 19th-century America. The abundant iron deposits in the United States were believed to be inexhaustible; iron was mined without concern for the number of mines that had been opened or what iron was left for future generations (Freedley 1856:245,247-248). During the Civil War, the iron industry prospered, producing guns and rifles, railroads, wagon wheels, machines, tools, hardware, ironclad ships, and steam engines. In 1864, iron manufacturers produced 1,135,996 net tons of pig iron, compared to the 731,544 net tons produced in 1861 (Table 4.1) (Battis 1989:154,172). Iron also remained the cheapest of metals, before the mass production of mild steel after 1866 (Freedley 1856:253; Gordon 1906:12). The high demand for iron resulted in an increase in imported metal starting in 1861 through 1872, despite high importation tariffs (Battis 1989:158).

Table 4.1. Pig iron production from 1857-1866, in net tons (Battis 1989:172).

Year	Anthracite Iron	Bituminous and Coke Iron	Total
1857	390,385	77,451	798,157
1858	361,430	58,351	705,094
1859	471,745	84,841	840,627
1860	519.211	122,228	919,770
1861	409,229	127,037	731,544
1862	470,315	130,687	787,622
1863	577,638	157,961	947,604
1864	684,018	210,125	1,135,996
1865	479,558	189,682	931,582
1866	749,367	268,396	1,350,343

The demand was so great that anthracite pig iron was increasingly accepted as a substitute for charcoal iron. Melted using anthracite coal or coke instead of charcoal for heat, anthracite pig iron could not be made as thin or as strong as charcoal iron. This shift to anthracite furnaces, characterized by hotter blasts and higher pressures, was the largest development in the iron industry during the Civil War. By the 1870s, the majority of iron produced came from anthracite furnaces (Battis 1989:163,169; Freedley 1856:251).

Despite this change, there was little innovation in the years surrounding the Civil War. The 1860s marked the beginning of an understanding of the chemical components of iron and the start of a transition period between viewing iron production as an art to regarding it as a science (Battis 1989:189,191). Previously, iron manufacturers controlled iron quality by controlling the composition, basing their formulas on amounts of iron from different sources, with the belief that the qualities of each source varied. Manufacturers believed that the difference was mechanical, that in cast iron the atoms were arranged homogenously while in wrought, the atoms were stretched into distinct fibers held together by a, “cementing principle contained in the cinder of the iron”. Despite the trust put into the various sources of iron in the 19th century, there is little practical difference between different mining sites, and the differences between cast and wrought iron are chemical rather than mechanical, as discussed in Section 3 (Freedley 1856:250; Gordon 1906:5).

Iron artifacts comprise 37% of the total Priority 1 artifacts from the USS *Westfield* collection. The majority of these artifacts are related to ordnance, ship construction, and machinery. A lower percentage, about 17%, of the artifacts discussed in this thesis, are composed of iron.

4.2.2 Copper

The Industrial Revolution brought changes in the production of copper and copper alloys. New inventions in steam machinery and electricity increased demand for copper. The demand was met with increased supply through the use of steam-driven technology, including pumps to remove water during mining. Copper and brass are ideal for ship building, sheathing, and measuring instruments at sea because they are non-magnetic and corrosion resistant (Joseph 2001:5-6). The use of steam in water transportation greatly increased the use of copper in shipbuilding. Copper was needed for stripping, rivets, boiler plate, and steam engines. At the start of the Civil War, the copper industry became second in importance only to iron and was supplied primarily by copper from the Lake Superior region, transported by water to New England through the Great Lakes and the Erie Canal.

As the copper industry expanded, war production consumed the newly improved copper refineries and rolling mills. The production of copper for ships and locomotives, ordnance, and copper ingots reached a peak in the history of nonferrous metals, and wartime consumption exceeded any previous demand for copper. However, the Civil War was also a transition period for the copper industry. Towards the second half of the war, copper became scarcer, and the supply could not meet the continuous high demand. At the same time, the competition for government contracts increased, with suppliers selling copper at wholesale prices to beat the competition. This practice was quickly stopped by a newly created association of American copper merchants and manufacturers (Whiteman 1971:119-120,192-193,197,199).

These changes were reflected in the prices of copper throughout the war. The wholesale price per pound remained steady in the first few years then quickly doubled in the second half of the war, as shown in Table 4.2. In the decades that followed, the price of copper dropped again, half of the price at the beginning of the 1860s (Weed 1916:1252). The American Civil War also marks the beginning of significant changes in the American copper industry. Between 1861 and 1870, the United States produced less than 10% of the world's supply of copper. In 1869, a copper tariff barrier was introduced which allowed the U.S. to meet the world's demand of copper at minimum cost and allowed for almost immediate control of the market. By the end of the 19th century, the U.S. produced more than half the world's supply (The Arizona Copper Tariff Commission 1932:88-91).

Cupreous artifacts comprise 29% of the USS *Westfield* priority 1 artifacts, mostly in the form of cupreous fasteners. Cupreous objects represent 27% of the artifacts included in this thesis, as personal objects, clothing items, tools, and unidentified objects.

Table 4.2. Price of copper in the United States, by year (Weed 1916:1252).

Year	Price per pound (Dollars)
1858	.23
1859	.22
1860	.23
1861	.22
1862	.22
1863	.34
1864	.47

4.2.3 Lead

Third only to iron and copper, lead was widely distributed across the United States, due to improvements in transportation and metallurgical practice. There were many sources of lead available in New York in the 19th century. The ore was mined and extracted in three varieties; galena, or lead sulfide, cerussite, or lead carbonate, and anglesite, or lead sulfate. Extracting lead was an art, based on the reduction of lead oxide by carbon or carbon monoxide, the reaction between lead sulfide and lead sulfate or oxide, and the decomposition of lead sulfide by metallic iron, all of which are endothermic reactions. By 1885, lead extraction was transformed from an art to a science, in order to maximize the amount of lead and minimize the cost.

There were three types of lead on the market, and variations on the quality of these types were common. The first two, desilverized, or soft lead, and antimonial, or hard lead, have little differences. The last type contains a small percentage of copper and antimony and is more resistant to acids. The grades of lead also depended on the supply and demand in the market, and the quality of lead available at any given time.

During the 19th century, the primary use of lead was as a white color additive to paint and pigment. Also, sheet lead was used for linings that could withstand acids and acid vapors. During *Westfield*'s construction, lead came primarily from New York, Virginia, and Joplin, Missouri. Very little lead was imported before 1883, although the price of lead was higher in New York than in London between 1861 and 1870. The chart below, Table 4.3, shows the lead production in the United States and cost of lead in New York leading up and during the first couple of the Civil War (Ingalls 1908:3,37-38,83-84,86-87,215,217).

Lead objects are a relatively small portion of the priority 1 artifacts, at 6.3%, as belt buckles, small lead sheets, and amorphous lead fragments. The brass clad lead core buckles are cataloged in this section and represent 10% of the total artifacts cataloged in this thesis. The brass clad front surfaces did not survive on all of the buckles.

Table 4.3. Production of lead in the United States in tons, 1 ton equivalent to 2,000 lbs., and price of pig lead in New York (Ingalls 1908:200, 203).

Year	U.S. Lead Production (tons)	Price (cents per pound in New York)
1858	19,500	5.94
1859	21,000	5.50
1860	20,200	5.65
1861	14,100	5.25
1862	14,200	6.10
1863	14,800	6.25

4.3 Kitchen Artifact Group

4.3.1 Ceramics

The few surviving ceramic fragments from *Westfield* were most likely standard issue items from the US Navy and imported from Europe. During the 19th century, American pottery, which rivaled Europe in texture, durability, hardness, and finish, could not compete with the supply of European pottery, despite the vast resources available in the US. The clay is mined by workmen, assisted by steam machinery and prepared by moistening, grinding, kneading, and dividing the clay into various size lumps required by a particular vessel. The lumps are shaped into vessels on a throwing wheel before they are dried and packed into a kiln for baking, causing the clay to become hard and tough (Freedley 1856:472-473).

Stoneware, one of the most common types of pottery in the 19th century, is fired at very high temperatures, vitrifying the clay and making it leak proof. This makes stoneware ideal for holding liquids. By this time, most of the flatware was made by casting the clay in molds before firing. For decoration, various glazes were used. While stoneware made strong, utilitarian vessels, they were not easily transportable and broke easily (Crouch 1992:20). The clay used for stoneware vessels was grey or buff-colored when fired and turned brown from iron oxide. Salt-glazed stoneware, developed in Germany and brought to Britain in the 1670s, was made by throwing salt into the kiln during firing. The salt vaporized at the high temperatures and settled on the surface of the pots forming a distinctive mottled glaze (Potteries Museum and Art Gallery 1999:8).

Other common types of ceramics represented on *Westfield* include porcelain, whiteware, and ironstone. Porcelain became more common in the 19th century, produced in a thicker variety, and therefore cheaper. Whiteware was also widespread. Fired at a low temperature, whiteware suffered from crazing or surface cracks that caused the clay to leak. Whiteware developed from pearlware which evolved from the prolific creamware of the 18th century. Whiteware, with creamware, pearlware, and stone china, dominate 19th-century ceramic assemblages and are frequently confused because the differences depend on a subjective observation of how much bluing is in the glaze. Ironstone was a very utilitarian and thick ware, more common in the later 19th century, from the 1870s to the 1900s. Between the 1850s and 1870s, plain ironstone seemed to replace transfer-printed wares and vessels were comparable in form and size. Except for porcelain, all fine wares from the 19th century were made in England (Miller 1980:2-4; Helen Dewolf 2012, pers. comm.). In this thesis, no attempt was made to place the ceramics in established typologies. The ceramic catalog follows this section and subsequent sections will follow this format, with the catalog proceeded by a short description, as outlined in the introduction, Section 4.1.

118-017 Porcelain Sherd

Fig. 4.1.

L:2.00 in. (5.08 cm), W:1.06 in. (2.70 cm), Th.:0.25 in. (0.64 cm)

Small porcelain body sherd. No diagnostic features.

Figure 4.1. Artifact 118-017.

134-046 Porcelain Sherd

Fig. 4.2.

L:2.25 in. (5.72 cm), W:2.00 in. (5.08 cm), Th.:0.25 in. (0.64cm)

Small porcelain rim sherd. Small portion of rim preserved. Bend on opposite end where the original object may have sloped downwards to create the concave lower portion of a plate or bowl.

Figure 4.2. Artifact 134-046.

120-280 Ironware Sherd

Fig. 4.3.

L:5.00 in. (12.70 cm), W:2.50 in. (6.35 cm), Max. th.:0.38 in. (0.95 cm)

Ironware rim sherd from plate or platter. Original diameter approximately 12.59 in. (32.00 cm). Scratches along surface. Side opposite rim bends to slope down into concave lower portion of plate.

Figure 4.3. Artifact 120-280.

135-009 Whiteware Sherds

Fig. 4.4

(A) L:1.00 in. (2.54 cm), W:0.50 in. (1.27 cm), Th.:0.19 in. (0.48 cm)

(B) L:1.75 in. (4.44 cm), W:0.75 in. (1.91 cm), Th.:0.13 in. (0.32 cm)

Small whiteware body sherds. No diagnostic features. Significant crazing.

Figure 4.4. Artifact 135-009.

140-039.1 Whiteware Sherd

Fig. 4.5.

L:1.63 in. (4.13 cm), W:1.06 in. (2.70 cm), Th.:0.19 in. (0.48 cm)

Small whiteware rim sherd. Portion of rim preserved. Significant crazing.

Figure 4.5. Artifact 140-039.1.

103-039.1 Whiteware Sherd

Fig. 4.6.

L:3.13 in. (7.94 cm), W:1.88 in. (4.76 cm), Th.:0.31 in. (0.79 cm)

Small whiteware rim sherd. Portion of rim preserved. Opposite of rim, the sherd bends to create the concave lower portion of the original plate. Significant crazing observed.

Figure 4.6. Artifact 103-039.1.

132-001.7 Whiteware Sherd

Fig. 4.7.

L:2.38 in. (6.03 cm), W:1.13 in. (2.86 cm), Th.:0.25 in. (0.64 cm)

Small whiteware rim sherd. Portion of rim preserved. Glazing eroded away.

Figure 4.7. Artifact 132-001.7.

139-011 Whiteware Sherd

Fig. 4.8.

L:3.63 in. (9.21 cm), W:2.31 in. (5.87 cm), Th.:0.25 in. (0.64 cm)

Whiteware rim sherd. Original diameter of plate approximately 9.84 in. (25 cm). Three blue annular lines; two around the edge, one thick and one thin, and one thin line where the sherd bends down into the lower portion of the bowl. Significant crazing observed.

Figure 4.8. Artifact 139-011.

140-039.2 Stoneware Sherd

Fig. 4.9.

L:1.50 in. (3.81 cm), W:0.44 in. (1.11 cm), Th.:0.25 in. (0.64 cm)

Small stoneware body sherd. Maroon glaze on both sides. No diagnostic features. Munsell color grayish brown 5YR 3/2 (Geological Society of America 1991:2).

Figure 4.9. Artifact 140-039.2.

124-033 Stoneware Sherd

Fig. 4.10.

L:5.38 in. (13.65 cm), W:4.00 in. (10.16 cm), Th.:0.31 in. (0.79 cm)

Stoneware body sherd. Maroon (Munsell color very dusky red 10R 2/2) glaze on inner side with horizontal striations or grooves, tan (Munsell color grayish orange 10YR 7/4) mottled glaze on outer side (Geological Society of America 1991:1-2). No diagnostic features preserved.

Figure 4.10. Artifact 124-033.

109-123 Salt-glazed Stoneware Sherd

Fig. 4.11.

L:2.87 in. (7.29 cm), W:3.00 in. (7.62 cm), Th.:0.5 in. (1.27 cm)

Salt-glazed stoneware body and base sherd. Outer surface flecked with orange and dark brown. Inner surface has streaks of orange and dark brown. Towards base, streaks change from angled to parallel with base. Munsell colors: inside- very dusky red 10R 2/2, outside- Light olive gray 5Y 5/2 (Geological Society of America 1991:2-3).

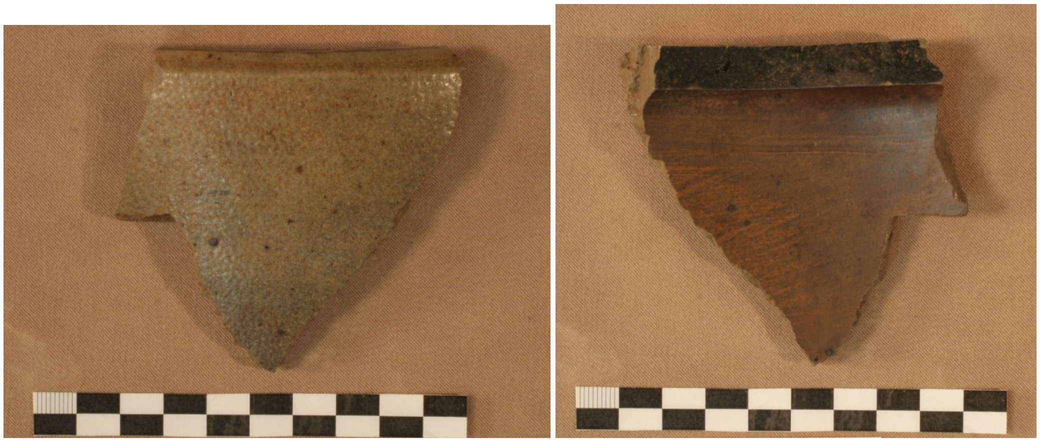


Figure 4.11. Artifact 109-123.

132-001.7 Salt-glazed Stoneware Sherd

Fig. 4.12.

L:1.88 in. (4.76 cm), W:2.00 in. (5.08 cm), Th.:0.25-0.50 in. (0.64-1.27 cm)

Small salt-glazed stoneware rim sherd from lid. Glaze present on lower, inner portion of sherd. Rim preserved which would sit on both the outer and inner portion of the pot rim. The heavy lid may have possibly belonged to a large crock pot used for vinegar or pickling (Helen Dewolf 2012, pers. comm.). Munsell color pale yellowish brown 10YR 6/2 (Geological Society of America 1991:2).

Figure 4.12. Artifact 132-001.7.

4.3.2 Glass

From 1833-1903, glass manufacture was one of the largest and most important industries in America (McKearin and Wilson 1978:68). During this time, the glass industry was highly competitive and highly secretive. Accordingly, records are scarce for glass production. The Civil War increased demand for glass products. The war was also a transition period in glass manufacture, and there were a variety of techniques used, resulting in a variety of qualities. As such, no characteristics exist for recognizing Civil War bottles. In addition, most glass does not have any identifying markings, including the glass from *Westfield* (Russell 1988:11,13,15).

There are two essential ingredients for glass production, silica and alkali, in the form of soda, lime, potash, or pearl ash. Ordinary containers were made from green glass or bottle glass, referring to the composition, as opposed to the color. This green glass was naturally colored from the impurities and chemical nature of the ingredients; however, during the 1840s and 1850s, artificial glass colors became common. By the 1870s this trend had shifted toward more colorless or clear glass containers. A glass recipe for lighter green glass from 1867 calls for 12 parts of sand, 5 parts soda, 2 parts lime, and 10 parts sandstone. Darker green glass was produced by substituting the ash in the sandstone with lime. The dark green glass, exhibited by several examples found on *Westfield*, was tougher and used for alcoholic liquids; wine, port, ales, beers, and cider, for example.

The ingredients for the glass were mixed and vitrified, or melted, when placed in a coal burning furnace. An iron tube with a small bore that was wider and thicker towards one end, called a blowpipe, gathered up the mixture, or the metal. The metal was rolled into a cylindrical shape as it cooled. A bubble was formed by blowing into the blowpipe. Any final adjustments in size were added and the neck and base was formed, or the glass was placed into a mold of clay, wood, or metal. The bottle was next cracked off of the blowpipe and the kick-up was added. Between 1857 and 1867, six patents were issued for devices to hold the bottle while it was cracked off the blowpipe. Finally, the neck was finished and polished, and a ring was added for the collar (McKearin and

Wilson 1978:7-9,12-15). This method left a small pontil scar on the base of the bottle where the blowpipe was removed, even when molds were used to form the bottles. During the 1850s, there was a shift away from leaving the pontil scar; however, bottles from the early period of the Civil War still exhibited this mark (Russell 1988:11,14).

121-025 Bottle Base
Fig. 4.13.
L:8.06 in. (20.48 cm), Base diam.:2.81 in. (7.14 cm), Kick-up height:2.19 in. (5.56 cm), Th. (at base):0.25 in. (0.64 cm)
Large dark green glass bottle fragment. Glass is thick and heavy. Missing neck, rim, and most of body. Significant portion of base and kick-up still intact. Outside surface shows horizontal bands or stretch marks that correspond to a smooth, wavy surface on the inside. Outer surface around base exhibits numerous scratch marks. Kick-up is 1.25 in. (3.18 cm) in diameter and has a smooth, concave surface. Walls of the kick-up are almost parallel to bottle walls. Small air bubbles on base, especially on the kick-up.

Figure 4.13. Artifact 121-025.

132-396 Bottle Base

Fig. 4.14.

L:3.75 in. (9.53 cm); Base diam.:3.13 in. (7.94 cm), Kick-up height:1.50 in. (3.81 cm), Th. (at base):0.31 in. (0.79 cm)

Very dark green (almost black) bottle base fragment. Glass is thick and heavy. Only base, kick-up, and small portion of walls preserved. Surface shows scratch marks. A few large air bubbles present, in particular, one along the inside junction between the wall and the kick-up. Kick-up has low sloping walls that are almost at 45 degrees from the walls of the bottle. A small, shallow pontil scar is on the outside, convex side of the kick-up. No mold seams present.

Figure 4.14. Artifact 132-396.

111-066.1 Bottle Base Fragment

Fig. 4.15.

L:1.31 in. (3.33 cm), W:0.88 in. (2.22 cm), Th.:0.25 in. (0.64 cm)

Dark green bottle base fragment. Identical color and texture to 132-396, possibly from a similar bottle. Surface is worn and scratched. Original bottle would have had a similar kick-up to 132-396.

Figure 4.15. Artifact 111-066.1.

140-013 Bottle
Fig. 4.16.
L:9.13 in. (23.18 cm), Diam.:2.25 in. (5.72 cm), Rim diam.:1.19 in. (3.02 cm), Rim th.:0.13 in. (0.32 cm)
Possibly intrusive. Light bluish-green soda or mineral water bottle. Neck and rim broken in multiple places and missing a few fragments, otherwise complete. A seam runs down both sides of the bottle, except for the rim, indicating the bottle was made using a two piece mold. There are air bubbles throughout the glass, smaller ones concentrating in the body and a few larger ones in the base. The base is unique, rounded so that the bottle cannot sit upright.

Soda and mineral water bottles were introduced around 1850. They were made heavier and thicker to prevent explosion and breakage, and fitted with wire fasteners around a heavily collared mouth, to withstand the pressure of the carbonation. The majority of mineral water bottles range from 6-8.5 in. (15.24-21.59 cm) and could hold anywhere from 8-14 oz. (0.24-0.41 L). They were primarily aquamarine, green, or blue. However, their most diagnostic feature was the smooth or round base, preventing the bottle from being stood upright, an innovation developed in England (Van Rensselaer 1926:39-40; McKearin and Wilson 1978:238-239). This prevented the cork from drying out and shrinking, causing the liquid inside to lose carbonation or evaporate. They were usually produced using a two piece mold; the neck, shoulder, body and entire base was molded, before the thick collar was added by hand. The majority of these soda, or mineral water bottles, were imported from Great Britain, more so than those made in the United States or those made overseas for American companies. Sometimes referred to as ballast bottles, they are thought to have been imported from England as ballast due to their heavy weight. The majority of the round bottom base bottles date from the 1870s to the 1910s, indicating that this example recovered from *Westfield* may be intrusive or deposited on the site during the dredging in the early 20th century. The preservation of the bottle, the only one which is almost complete, would indicate that this may be the case, having been spared from the initial explosion (Lindsey 2012).

Figure 4.16. 140-013.

134-047.1 Bottle Neck Fragment

Fig. 4.17.

L:2.00 in. (5.08 cm), W:1.88 in. (4.76 cm), Th.:0.38 in. (0.95 cm)

Light bluish green bottle neck fragment. Identical color and texture to 140-013, possibly from similar bottle with wider base. The angle from the neck to the body is slightly wider than 140-013. Small air bubbles present in glass. No seams visible. Wavy bands on outside surface of neck not present on 140-013.

Figure 4.17. Artifact 134-047.1.

4.3.3 Tableware

Only one example of metal tableware, an electroplated silver condiment shaker cap, possibly for dispensing salt or pepper, was preserved with USS *Westfield*. Electroplating began in the 1840s and was introduced commercially by the mid-19th century. The date of the first electroplating experiment is unknown; however, the beginnings of electroplating are associated with the development of electricity in the early 19th century (Raub 1993:284-285; Turner 1993:211). The technique first involved the silver or gold plating of decorative items or better quality utilitarian objects (Child

1993:293). Plating with precious metals, for decorative purposes or fraud, allowed for the maximum display value at minimum cost, producing cheaper copies of silver originals (La Niece 1993:201). Silver was one of the first metals to be electroplated commercially, primarily for tableware. Electroplated silver objects are highly decorative and resistant to attack from fruit acids and other foodstuffs (Canning 1960:383). The Elkington cousins monopolized the emerging industry for decades, with patents on silver and gold plating with an electric current (Child 1993:293). By the 1860s, electroplating with silver was becoming commonplace.

The commercial methods of producing plated metal objects have remained relatively the same since the initial invention. Metals are plated in two methods. The first is very similar to the electrolytic reduction used to conserve the iron and cupreous artifacts from *Westfield*. Metal salts are dissolved into an aqueous solution, which is reduced by a current of electricity passed between two electrodes. Here, the cathode is negative, attracting the ions which plate the base metal attached to the cathode. The anode is positive and dissolves into the electrolyte, producing more metal ions of the plating metal. The weight of the deposited metal is proportional to the electricity passed through the solution. This method allowed for control of the thickness of the plated surface and the amount of silver used. A typical solution for silver plating would include 20 grams of silver nitrate, 36 grams of potassium cyanide, and 22 grams of potassium carbonate, for every liter of water. When plating pewter, an excess of potassium cyanide is used to produce a matte silver finish which is polished to a highly reflective surface. The second method relies on a chemical reaction. The plated metal is deposited on the base metal from a chemical solution such as copper sulfate (Child 1993:291-293,295,298-299).

Few small artifacts belonging to USS *Westfield* are as diagnostic or important as the condiment shaker cap. The discovery of the possible pepper shaker cap was momentous. Weeks of x-raying *Westfield* concretions had yielded little more than a series of bolts, bleeds, and boiler bits. A large bolt, which appeared to have a small button towards the end, was visible on the x-ray. Further x-rays revealed the condiment shaker cap, which confirmed suspicions that this was something significant.

109-010.1 Condiment Shaker Cap

Figs. 4.18, 4.19, 4.20.

Height: 0.92 in. (2.34 cm), Max. diam.: 1.15 in. (2.91 cm), Inner diam.: 0.87 in. (2.21 cm), Diam. of finial: 0.30 in. (0.76 cm), Th. of side: 0.05 in. (0.13 cm), Diam. of holes: 0.07 in. (0.19 cm)

Electroplated silver condiment shaker cap. Small finial at the top surrounded by 14 holes to dispense a condiment, most likely either salt or pepper. The top is rounded around the edges from which the sides descend almost perpendicularly, with a small band designed to fit around the top of the glass bottle below. The inside surfaces are smooth with a spiral pattern on the top. Initial testing with the Bruker XRF revealed that the condiment shaker cap is made from electroplated silver on pewter. High levels of tin, silver, and copper were found, with smaller amounts of antimony and lead. A drawing is shown in Figure 4.20.

Figure 4.18. Artifact 109-010.1. Possible pepper shaker top in progress photos. Side view, bottom view, and top view.

Figure 4.18. Continued

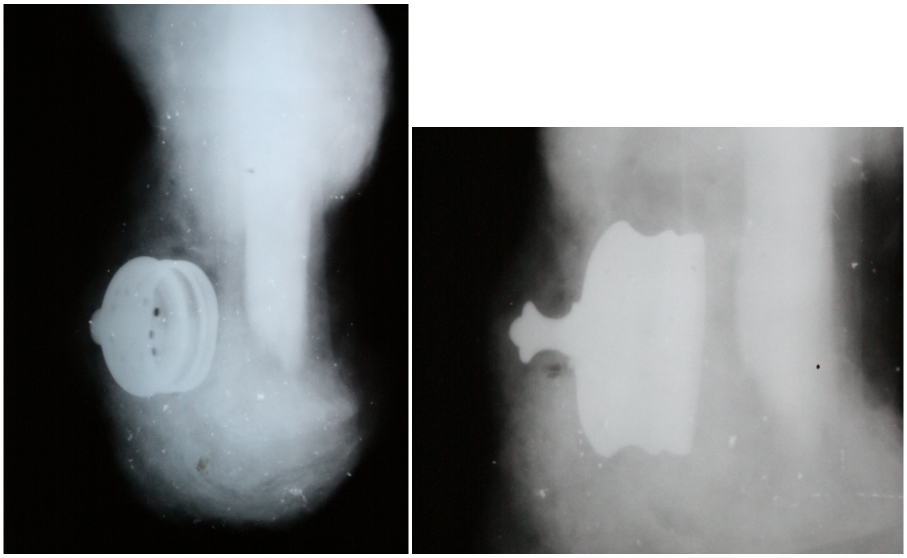


Figure 4.19. Artifact 109-010.1 X-ray.

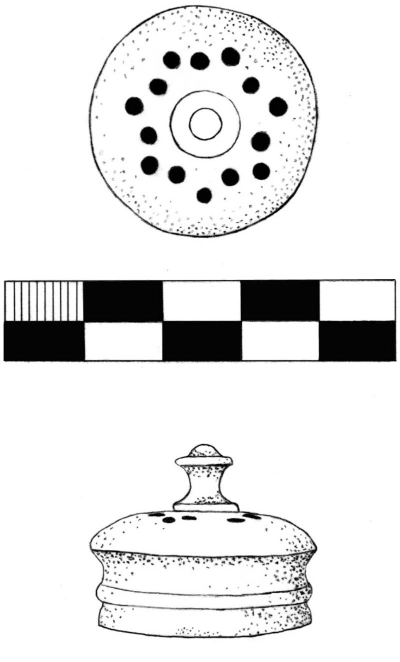


Figure 4.20. Drawing of Artifact 109-010.1. By Jessica Stika.

The pepper shaker cap was separated from the bolt, and a significant amount of the concretion was removed using a pneumatic chisel. As the surface of the cap was revealed, the pneumatic chisel was abandoned for small wooden dowels, so the surface would not be scratched (shown in Figure 4.21). After the concretion was completely removed, the pepper shaker cap was placed in baths of 2% sodium sesquicarbonate until the salt content reached a minimum, about 3.5-7 parts per million. After three baths of boiling deionized water, the cap was polished using sodium bicarbonate and a small fiberglass brush. Since the cap base was a cupreous metal, the cap was soaked in a 2% benzotriazole (BTA) and ethanol solution before being coated with Krylon clear finish with 2% BTA added. Following the final coating, the cap was wrapped in a lint free paper towel that had been soaked in 2% BTA and then was sealed in a plastic bag.

Figure 4.21. Cleaning the condiment shaker cap.

The pepper shaker cap, Artifact 109-010.1, was found in grid square 109, as indicated by the artifact number. Other Priority 1 small artifacts in square 109 include a salt-glazed stoneware fragment, 109-123, and a US cartridge box plate, 109-089. The relative locations of the other small Priority 1 artifacts are shown in Figure 4.22. Due to the nature of the salvage excavation, provenience information for *Westfield* concretions is somewhat general. The clamshell grabs were aimed at each of the 15 by 15 ft. (4.6 by 4.6 m) squares; however, in many instances the grabs overlapped adjacent grid squares.

A map of the *Westfield* site is shown below in Figure 4.22, overlaid with the 15 ft. (4.6 m) grid squares in red. An outline of a sketch of USS *Clifton*, sister ship of *Westfield* and very similar in design, is superimposed above the grid squares. The outline has been greatly simplified, stretched, and shifted to fit the length, shape, and possible original position of *Westfield*. Outlined in yellow are the officer's cabins, located on the port side of the ship, directly over square 109. If the room designations of *Clifton* are identical to *Westfield*, *Westfield* sank approximately where the outline is placed over the grid, and erosion and dredging of the site did not move the condiment shaker cap after the sinking, then there is a possibility that this cap came from the officer's table. However, the pepper shaker cap was found concreted to a bolt, which might not be near the cap's original location.

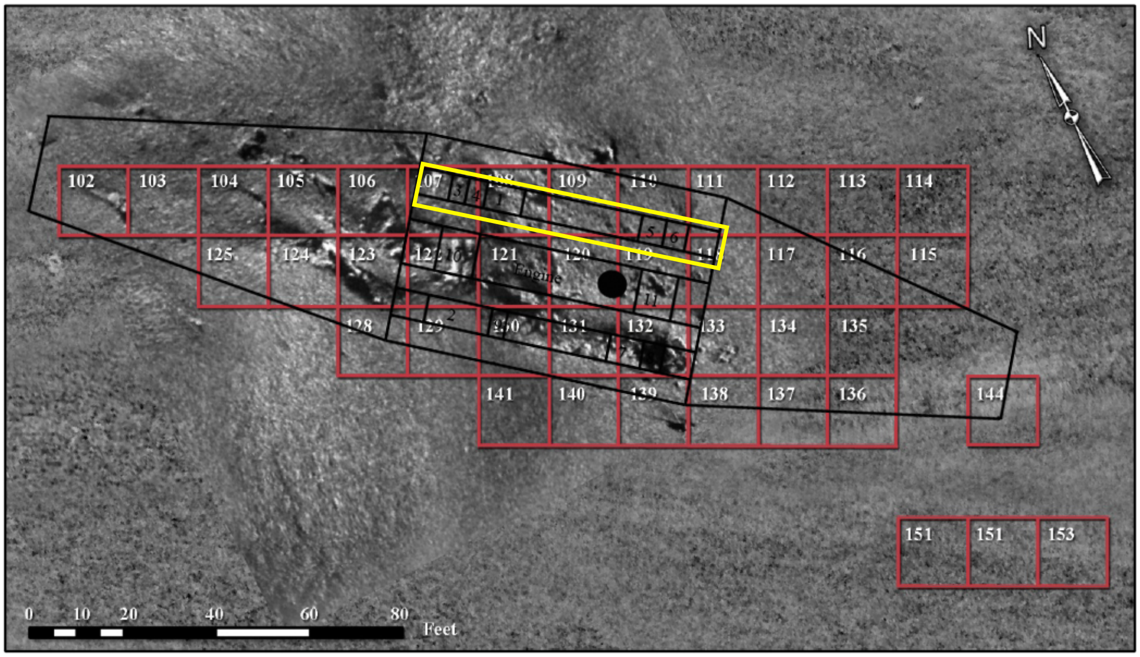


Figure 4.22. Site map of USS *Westfield*. Imposed over the map are a numbered grid and an outline of a sketch of USS *Clifton*. Labels from sketch indicate that row of cabins along the port side, highlighted in yellow, are the officer's rooms and water closet After Borgens et al. (2010:128,D-6).

Documentary research may shed more light on the origins of the pepper shaker cap. In Donald Fennimore's *American Silver and Pewter* (2000:68), the author lists a Victorian electroplated cruet made in 1861 by the Meriden Britannia Company from Meriden, Connecticut. The example shown in Figure 4.23 has three free-swinging baskets which rotate a center axel, allowing the items in each basket to be easily reached. While the set from which the *Westfield* pepper shaker cap may not have been as fanciful as this, the cap does match this set almost identically. The cap most likely came from a glass bottle similar to those shown on the bottom left of Figure 4.23; however, designating the cap as belonging to a pepper shaker is an educated guess. The silver-plated cap could have easily belonged to a salt shaker or another condiment.

Figure 4.23. Victorian electroplated cruet (Fennimore 2000:68).

4.4 Small Ship Construction Elements

4.4.1 Brick

Brick from USS *Westfield* is fragmented and highly eroded. Bricks were used to line and insulate the boiler, so there were no standard brick allotments for navy ships as the amount necessary varied according to each boiler (United States Navy Department 1865:24). Bricks are made from clay, composed of crystalline particles or minerals, of which the most common are kaolinte, montorillonite, illite, and chlorite (McKee 1973:41; Gurcke 1987:3-6). Other minerals in the clay can produce different colors. For example, ferric oxide produces shades from pink to reddish black while ferrous oxide can produce colors from green to black. The presence of lime turns the bricks to yellow or greenish-yellow. Magnesia and alumina results in buff colored bricks and manganese produces brown.

The first step in the manufacture of brick is obtaining the clay from which to make them, called mining, or "winning". The clay is then prepared for molding.

Additives can be mixed into the clay to produce a better brick. For example, between 30-70% sand can be added to reduce warping and cracking (McKee 1983:41-42). Rocks are removed from the clay during the process of tempering and drying to produce consistency. Various clays can also be blended for the same result (Gurcke 1987:6-13).

Molding, or “forming”, is the process where the clay is shaped into bricks. The three methods, soft-mud, stiff-mud, and dry-pressed, are based on the percentage of water in the clay. Soft-mud bricks are either made by hand or machine and formed by pushing the clay into a mold. Stiff-mud bricks are made by a machine that extrudes then cuts the clay to form the brick shape. This is the most common brick manufacture techniques used in the present day. Dry-pressed clay can contain up to 10% water and are formed like soft-mud bricks, except a machine compresses the dry clay into a steel mold, exerting enough pressure to form the brick. The 19th century was a transitional period between molding by hand and the introduction of brick making machines (Gurcke 1987:13-23). The first steam molding machines were introduced to New York in 1849. With a few improvements, these machines soon completely replaced the hand molding method (Tomkins 1888:282).

Following molding, the bricks are left to dry, or they will break apart in the kiln. Handmade bricks could take up to two to three weeks of drying time. Firing, or “burning”, followed in three stages. The bricks were placed into the kiln and raised to between 250° and 350°F. This first stage, called “water-smoking”, caused white steam to evaporate from the bricks. Raising the temperature to between 1,400° and 1,800°F, called dehydration, drives off the remaining water. During vitrification, the temperature of the kiln is raised to 1,600° and 2,200°F, the clay softens, and the harder particles melt and adhere to each other. The entire process can take up to a week in a primitive kiln, but can be as short as 40 hours in a modern kiln (Gurcke 1987:28-34).

Mortar is soft and pliable, made to fill the cracks between bricks for strength and durability. Obtained from limestone and marble, lime-sand mortar was used until about 1880. This was considered a soft mortar, in comparison to the concrete mortar used after 1880, and was flexible enough to be used in a ship. However, more waterproof mortar, in the form of hydraulic cement, waterproof cement, and water-lime mortar, was available in the United States before 1870. New York was the largest producer of natural cement during this time. The waterproof or cement mortar was used where strength and resistance to moisture was necessary (McKee 1973:61-62,68). Mortar remnants can still be seen on some of the brick fragments, indicating that they had been used (Lenik 1966:11).

122-003 Brick
Fig. 4.24.
L:3.20 in. (8.12 cm), W:4.30 in. (10.92 cm), Th:2.03 in. (5.15 cm)
Large brick fragment. Large grained with large inclusions. No mortar, but impressed lettering on obverse side. Letters read “OLE”, followed by what could have been an “N” or “H”. These letters measure 0.75 in. (1.91 cm) tall. Underneath this, the letters are “LON” and measure 0.56 in. (1.43 cm) tall, possibly indicated the word, “LONDON”. Bricks made in London commonly had chalk added to the clay before firing. This chalk prevented shrinkage and cracking and often turned the brick a more yellowish color (Gurcke 1987:12-13). Dark, maroon staining on top of brick. Munsell color pale yellowish orange 10YR 8/6 (Geological Society of America 1991:2).

Figure 4.24. Artifact 122-003.

135-011 Brick

Fig. 4.25.

L:3.00 in. (7.63 cm), W:1.25 in. (3.18 cm), Th:0.93 in. (2.37 cm)

Small brick fragment. Possible original surface near small bit of mortar, 0.15 in. (0.38 cm thick). Fine grained with small sand grit; small air bubbles that have been compressed in some areas. Munsell colors: brick is moderate red 5R 5/4, mortar is pale yellowish brown 10R 6/2 (Geological Society of America 1991:1).

Figure 4.25. Artifact 135-011.

136-004 Brick

Fig. 4.26.

L:4.29 in. (10.90 cm), W:2.44 in. (6.19 cm), Th:1.65 in. (4.20 cm)

Almost complete brick in 2 pieces, fine grained with very small grit. No mortar preserved. Small air bubbles on inside of brick. Parallel indentions on one edge of the brick. Munsell color light brown 5YR 6/4 (Geological Society of America 1991:2).

Figure 4.26. Artifact 136-004.

152-003 Brick

Fig. 4.27.

L:1.32 in. (3.36 cm), W:1.14 in. (2.90 cm), Th:1.13 in. (2.86 cm)

Fine grained small brick fragment with medium sized inclusions. The fragment has two colors, split halfway down the middle, perhaps due to burial environment. Small air pockets. Munsell colors pale reddish brown 10R 5/4 and moderate reddish orange 10R 6/6 (Geological Society of America 1991:1).

Figure 4.27. Artifact 152-003.

130-033 Brick and Mortar

Fig. 4.28.

L:2.26 in. (5.75 cm), W:1.94 in. (4.93 cm)

Small mortar fragment with the surfaces of three bricks present. The bricks were fine-grained with large inclusions. The mortar is fine-grained with few inclusions. The mortar was between two bricks and two layers of bricks. The thickness of the mortar between layers is 0.65 in. (1.64 cm) and between the bricks is 0.31 in. (0.8 cm). The brick is Munsell colors moderate reddish orange 10R 6/6 and the mortar is pale yellowish brown 10YR 6/2 (Geological Society of America 1991:1-2).

Figure 4.28. Artifact 130-033.

4.4.2 Sash Weights

The sash weights may remain a mystery. Indicating the presence of large windows which would have been expected on a New York ferryboat, the sash weights seem unnecessary when viewing the small portholes present on the Memphis drawing of *Westfield* as a navy gunboat, shown in the Appendix (Figure A-1). Current theories support that these may have been cut from their windows during *Westfield*'s conversion from ferryboat to gunboat. However, no evidence of portholes has been found among the *Westfield* artifacts. Similar sash weights are commonly used by fisherman as buoy weights. Thus, they may be modern. The variety of sash weights found on *Westfield* may support the conclusion that these are intrusive artifacts.

119-171 Sash Weight

Fig. 4.29.

L:7.17 in. (18.20 cm), Diam.:1.83 in. (4.66 cm)

Lower portion of sash weight. Cylindrical in shape and starts to narrow 2.99 in. (7.60 cm) from the end. Made from a two-piece mold. Two ridges run along the sides opposite of each other, indicating that the mold pieces were not correctly attached when the sash weight was made. No weight markings were found, as that portion of the weight was not preserved.

Figure 4.29. Artifact 119-171.

120-074 Sash Weight
Fig. 4.30
L:8.82 in. (22.40 cm), Diam.:1.49 in. (3.79 cm), Hole diam.:0.50 in. (1.28 cm), Weight number indention H./W.:1.61/0.95 in. (4.09/2.42 cm), Weight number H./W.:1.10/0.85 in. (2.79/2.15 cm)

Upper portion of sash weight with hole or opening to allow a rope to be tied around the top. A number “8” is molded into the side, indicating the weight. This sash weight was made from a two-piece mold and shows a small portion of a ridge along one side, indicating the two mold halves were slightly out of alignment.

Figure 4.30. Artifact 120-074.

118-177 Sash Weight

Fig. 4.31

L:10.63 in. (27.00 cm); Diam.:1.75 (4.44 cm), Hole diam.:0.74 in. (1.89 cm), Weight number indention H./W.:1.71/0.96 in. (4.34/2.45 cm)

Upper portion of sash weight with hole or opening to allow a rope to be tied around the top. A number "10" is molded into the side, indicating the weight; however the "1" has eroded away. This sash weight was made from a two-piece mold and shows a ridge along one side. Poorly preserved with many pockets in the cast iron.

Figure 4.31. Artifact 118-177.

122-004 Sash Weight

Fig. 4.32.

L:7.68 in. (19.50 cm), Diam.:1.73 in. (4.39 cm), Weight number indention H./W.:1.52/0.84 in. (3.87/2.13 cm), Weight number H./W.:1.06/0.80 in. (2.68/2.04 cm)

Upper portion of sash weight with hole or opening to allow a rope to be tied around the top. A number "10" is molded into the side, indicating the weight. This sash weight was made from a two-piece mold and shows a small portion of a ridge along one side, indicating the two mold halves were slightly off.

Figure 4.32. Artifact 122-004.

4.4.3 Sheaves

120-308 Sheave

Fig. 4.33.

Iron sheave: Outer diam.:5.43 in. (13.78 cm), Inner diam.:1.73 in. (4.41 cm), Th.:1.56 in. (3.95 cm)

Inner cupreous ring: Outer diam.:1.65 in. (4.19 cm), Inner diam.:0.95 in. (2.43 cm)

Cupreous bearings: H.:1.38 in. (3.50 cm), Diam.:0.59 in. (1.50 cm)

Cast iron (epoxy) shaft: L.:3.74 in. (9.49 cm), Diam.:0.57 in. (1.45 cm)

Cast iron sheave with cupreous bearings. Six spokes connect the inner circle to the outer circle. The inner circle shows ridges on the top and bottom to encase the cupreous bearings. The outer surface of the outer circle has a wide indention to hold the rope or chain. Poor cast iron preservation obscures any sign of wear. Six small cupreous bearings are sandwiched between two circular plates. The plates are held together by two cupreous rectangular rods. The cylinders rotate around small circular protrusions on the two plates. The bearings rotated around a cast iron shaft. The shaft, cast in epoxy, is poorly preserved and signs of wear are not visible.

Figure 4.33. Artifact 120-308.

128-016 Sheave

Fig. 4.34.

Iron sheave: Outer diam.:5.49 in. (13.94 cm), Inner diam.:1.79 in. (4.54 cm), Th.:1.54 in. (3.91 cm)

Inner cupreous ring: Outer diam.:1.66 in. (4.21 cm), Inner diam.:0.90 in. (2.29 cm)

Cupreous bearings: H.:1.21 in. (3.07 cm), Diam.:0.61 in. (1.56 cm)

Cast iron (epoxy) shaft: L.:2.74 in. (6.97 cm), Diam.:0.71 in. (1.79 cm)

See description for 120-208.

Figure 4.34. Artifact 128-016.

4.4.4 Chain

102-009 Chain (large)

Fig. 4.35.

L.:2.44 in. (6.19 cm), W.:1.52 in. (3.85 cm), Diam.:0.57 in. (1.45 cm)

Nine complete wrought iron chain links and one half link. Poorly preserved.

Figure 4.35. Artifact 102-009.

103-067 Chain (large)

Fig. 4.36.

Chain link: L.:2.60 in. (6.60 cm), W.:1.71 in. (4.34 cm), Diam.:0.53 in. (1.35 cm)

Eight complete wrought iron chain links. Poorly preserved.

Figure 4.36. Artifact 103-067.

114-004 Chain (medium)

Fig. 4.37.

Chain link: L.:2.28 in. (5.80 cm), W.:1.25 in. (3.17 cm), Diam.:0.37 in. (0.95 cm)

Poorly preserved iron chain (cast epoxy). One link and four partial chain links preserved.

Figure 4.37. Artifact 114-004.

134-086 Chain (medium)

Fig. 4.38.

Chain link: Diam.:0.40 in. (1.02 cm)

Two partial iron (cast epoxy) chain links. Poorly preserved.

Figure 4.38. Artifact 134-086.

110-056 Chain (small)

Fig. 4.39.

Small chain links: L.:0.65 in. (1.65 cm), W.:0.52 in. (1.32 cm), Th.:0.11 in. (0.28 cm)

Possible small/medium chain link: L.:1.09 in. (2.77 cm), W.:0.72 in. (1.83 cm), Diam.:0.10 in. (0.25 cm)

Medium chain link: L.:1.76 in. (4.47 cm), W.:1.30 in. (3.30 cm), Diam.:0.21 in. (0.54 cm)

Teardrop chain link: L.:2.11 in. (5.37 cm), W.:1.34 in. (3.40 cm), Diam.:0.084 in. (0.21 cm)

Small complete iron chain links attached to a possible small/medium and medium chain link. This is attached to another link shaped like a teardrop. All measurements are taken from the x-radiograph. The chain links are yet to be conserved.

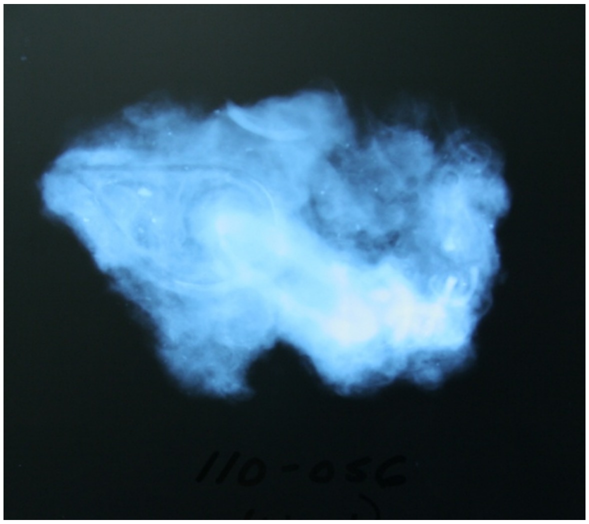
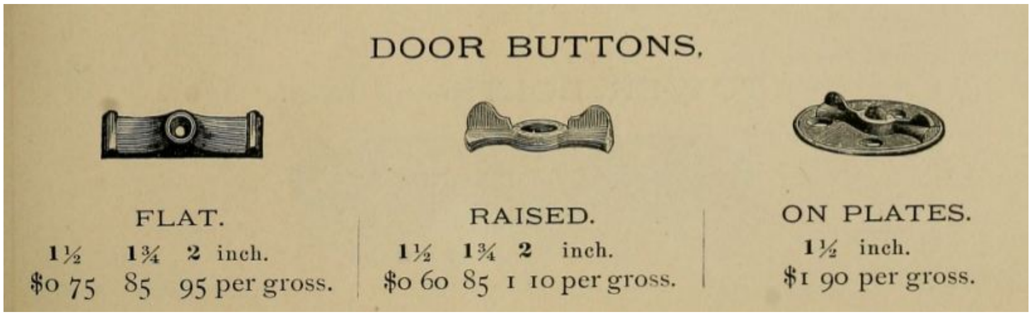


Figure 4.39. Artifact 110-056 X-ray.

4.4.5 Cupboard Button Latches

The cupboard button latches may have remained a mystery if not for a couple of hardware catalogs from 1865 and 1870. They were a very logical choice for keeping cabinet doors closed on a ship using a cheap and efficient method. The button was attached to a small plate split between the cupboard door and the frame and rotated to open or lock the cupboard door shut. The first catalog example, from Lynn Blumenstein's *Wishbook 1865* (1968), listed two types of cupboard buttons. The first looked identical to Artifact 120-284, but was iron and japanned, or coated in black lacquer, while the *Westfield* artifact is cupreous. The *Wishbook* also listed an example in cast brass which appears more like Artifact 132-128, but was advertised in dimensions at least 1 in. (2.54 cm) smaller than the *Westfield* example (Blumenstein 1968). The second catalog James L. Haven & Co.'s *Illustrated Catalogue and Price List of Hardware and Implements* (1870:21) showed similar examples and included an image of the entire latch, shown in Figure 4.40 below.



DOOR BUTTONS.

FLAT.
1½ 1¾ 2 inch.
$0 75 85 95 per gross.

RAISED.
1½ 1¾ 2 inch.
$0 60 85 1 10 per gross.

ON PLATES.
1½ inch.
$1 90 per gross.

Figure 4.40. Cupboard buttons from James L. Haven's Illustrated Catalog (Haven 1870:21).

120-284 Cupboard button latch

Fig. 4.41.

L:1.76 in. (4.46 cm), W:0.49 in. (1.24 cm), Inner diam.:0.24 in. (0.61 cm)

Cupreous cupboard button. Rotated on cupreous plate to hold a cupboard door shut. Two small wings on either side aided in grasping and turning the button. Each end slightly concave to fit on top of the plate. The length is an estimate, perhaps slightly less than the diameter of the plate.

Figure 4.41. Artifact 120-284.

132-128 Cupboard button latch

Fig. 4.42.

L:2.94 in. (7.48 cm), W:0.72 in. (1.83 cm), Center hole diameter:0.27 in. (0.68 cm.)

Cupreous cupboard button. Larger than 120-284, this button would have been for a more substantial cabinet latch. The two wings aided in grasping and turning the button on the plate below. The opposite side shows elliptical shallow recess, 1.44 in. (3.66 cm) in length.

Figure 4.42. Artifact 132-128.

121-078.1 Cupboard button latch with screw

Fig. 4.43.

L:2.82 in. (7.16 cm), W:0.67 in. (1.70 cm), Th.:0.37 in. (0.93 cm)

Screw: L:0.67 in. (1.69 cm), Shaft diam.:0.26 (0.66 cm), Head diam.:0.32 in. (0.81 cm), Head th.:0.05 in. (0.13 cm)

The two wings aided in grasping and turning the button on the plate below. The original screw that the plate rotated on was preserved. The opposite side shows elliptical shallow recess. Flat head screw through central hole in cupboard button. Not yet conserved at the time of this submission.

Figure 4.43. Artifact 121-078.1.

4.4.6 Rope

128-043 Rope

Fig. 4.44.

(1) L:2.76 in. (7.00 cm), W: 0.78 in. (2.00 cm)

(2) L:2.52 in. (6.40 cm), W: 0.75 in. (1.90 cm)

(3) L:1.73 in. (4.40 cm), W: 0.55 in. (1.40 cm)

Remnants of rope preserved in concretions. Did not survive conservation.

Figure 4.44. Artifact 128-043.

4.5 Clothing

4.5.1 Plates

The Civil War was a transition period away from decorative to more functional uniforms for soldiers. This is typified by a decrease in the use of belt and cartridge box plates. Plates encompass both belt buckles and decorative plates used for uniforms, and the term is generally used in place of the name "buckle". They were made by stamping the design into a copper plate to create a shell, attaching the hooks or loops onto the back, and then filling the shell with lead. At the beginning of the war, the Union issued plates with a vast array of decorations. Individual states created their own plates but most were unable to resupply their soldiers with replacements. In addition, the federal government issued the common plate, with the large letters "US" stamped into the front, identical to the ones found on *Westfield*. For the waist belt plates, a leather belt from which equipment, such as a bayonet scabbard, was attached. These had three hooks on the back of each plate, two on one side to attach the plate to the leather belt and one larger hook to secure the belt once placed around the waist. Cartridge box belt plates were placed on the shoulder strap holding the cartridge box, and cartridge box plates were on the box, both as a decoration and as a weight to hold the covering flap shut. These plates had two small loops on the back, one on either side, to attach them to the cartridge box. Other types of plates include sword belt plates and shoulder and cross strap plates, used for carrying a sword, bayonet, or powder flasks.

The Confederacy could not provide soldiers with this variety and in some cases any type of plate at all. Confederate soldiers often used U.S. plates worn upside down as a substitute. The British blockade runners also supplied the Confederate troops with snake or “S” shaped buckles, which were attached to two oval links on either side of the “S”. One such example was found on the *Westfield* site and may have been taken off a British blockade runner, as the Union personnel were not above using British plates also. As the Civil War progressed, both sides were unable to furnish troops with the necessary plates, and there was a decrease in their use. In addition, with the introduction of rifled guns, accuracy was greatly increased, and the plates functioned less as a decorative item and more as a shiny moving target (Kerksis 1974:3-5,441).

The plates listed below include pieces from a possible British snake belt plate and a frame of what may have once been a belt plate. The list also includes the examples of “US” marked belt and cartridge box plates, differentiated by the different types of clasps either on the back or sides of the plate. Those marked with the “U.S.” symbol appear to be lead but once had a shell of copper alloy overlaid above the lead. Traces of this cupreous material can still be seen on closer examination.

135-003 Snake belt plate loop
Fig. 4.45.
L:2.31 in. (5.87 cm), W:0.74 in. (1.89 cm), Th:0.12 in. (0.31 cm)
Cupreous snake belt buckle loop. Associated with snake belt plate (111-064). The midpoint of one long side shows a weld point, and the metal is thicker at that point. In addition, a break point is seen next to the weld point. This is most likely the original

attachment to a small circular loop where the snake buckle would have attached. Another identical loop on the other side of the snake belt plate would have completed the attachment to the belt.

Figure 4.45. Artifact 135-003.

111-064 Snake Belt Plate

Fig. 4.46.

L:1.56 in. (3.97 cm), W:0.65 in. (1.64 cm), Th.:0.22 in. (0.55 cm)

Cupreous snake belt plate. Associated with snake belt plate loop, 135-003. Most likely originally decorated to look like a snake. The head shape is clearly seen in the photograph. A small circular loop would have been linked to both ends and attached to an elliptical loop. The loop would be attached to the belt.

Figure 4.46. Artifact 111-064.

108-103 Belt Plate

Fig. 4.47.

L:3.20 in. (8.13 cm); W:2.07 in. (5.27 cm); Th. (center):0.28 in. (0.70 cm); Th. (edge):0.11 in. (0.27 cm), Letter height:1.21 in. (3.08 cm)

Lead belt plate. Stamped "US" on the front, cupreous mount on reverse, a few tiny spots where stamped brass plate remains.

Figure 4.47. Artifact 108-103.

106-032 Belt Plate

Fig. 4.48.

L:2.97 in. (7.54 cm); W:1.97 in. (5.00 cm); Th. (center):0.19 in. (0.48 cm); Th. (edge):0.11 in. (0.29 cm); Letter height:1.17 in. (2.97 cm)

Lead belt plate. Stamped "US" on the front, cupreous mount on reverse.

Figure 4.48. Artifact 106-032.

123-042 Belt Plates (A&B)

Fig. 4.49.

(A) L:2.85 in. (7.23 cm); W:2.00 in. (5.09 cm); Th. (center):0.19 in. (0.49 cm); Th. (edge):0.08 in. (0.20 cm); Letter height 1.20 in. (3.04 cm)

(B) L:2.88 in. (7.32 cm); W:2.04 in. (5.18 cm); Th. (center):0.22 in. (0.57 cm); Th. (edge):0.10 in. (0.25 cm); Letter height:1.57 in. (3.98 cm)

2 Lead belt plates. Stamped "US" on the front, cupreous mount on reverse.

Figure 4.49. Artifact 123-042.

124-041 Belt Plate

Fig. 4.50.

L:3.27 in. (8.31 cm), W:2.07 in. (5.25 cm), Th. (center):0.19 in. (0.49 cm), Th. (edge):0.10 in. (0.27 cm), Letter height:1.18 in. (3.00 cm)

Lead cartridge box plate. Stamped "US" on the front.

Figure 4.50. Artifact 124-041.

107-024 Cartridge Box Plate

Fig. 4.51.

L:3.27 in. (8.30 cm); W:2.08 in. (5.29 cm); Th. (center):0.18 in. (0.46 cm); Th. (edge):0.11 in. (0.28 cm); Letter height:1.18 in. (2.99 cm)

Lead cartridge box plate. Stamped "US" on the front.

Figure 4.51. Artifact 107-024.

121-142 Cartridge Box Plate

Fig. 4.52.

L:3.25 in. (8.26 cm); W:2.08 in. (5.29 cm); Th. (center):0.23 in. (0.59 cm); Th. (edge):0.11 in. (0.27 cm); Letter height:1.20 in. (3.05 cm)

Lead cartridge box plate. Stamped “US” on the front, a bit of the stamped brass plate remains.

Figure 4.52. Artifact 121-142.

122-061 Cartridge Box Plates (A & B)

Fig. 4.53.

(A) L:3.31 in. (8.40 cm); W:2.07 in. (5.27 cm); Th. (center):0.21 in. (0.53 cm); Th. (edge):0.08 in. (0.21 cm); Letter height:1.20 in. (3.04 cm)

(B) L:3.23 in. (8.21 cm); W:2.00 in. (5.08 cm); Th. (center):0.18 in. (0.45 cm); Th. (edge):0.10 in. (0.26 cm); Letter height:1.18 in. (3.01 cm)

Lead cartridge box plate. Stamped “US” on the front, a little bit of the stamped brass plate remains (mostly on 122-061A).

Figure 4.53. Artifact 122-061.

109-089 Cartridge Box Plate

Fig. 4.54.

L:3.29 in. (8.35 cm); W:2.05 in. (5.21 cm); Th. (center):0.19 in. (0.49 cm); Th. (edge):0.09 in. (0.22 cm); Letter height:1.21 in. (3.07 cm)

Lead cartridge box plate. Stamped “US” on the front.

Figure 4.54. Artifact 109-089.

123-041 Belt Plate

Fig. 4.55.

L:3.48 in. (8.83 cm), W:3.03 in. (7.70 cm), Th.: 0.10 in. (0.24 cm)

Cupreous belt plate. Most likely originally had decorative insert belt plate. Small tabs still preserved along edges to hold decoration. Bent and poorly preserved.

Figure 4.55. Artifact 123-041.

4.5.2 Textiles

133-181 Fabric impression shown on amorphous cupreous fragment

Fig. 4.56.

Measurements unavailable. See photo.

Fabric impression preserved in corrosion products on surface of amorphous cupreous object.

Figure 4.56. Artifact 133-181.

133-123 Fabric impression

Fig. 4.57.

Th. of fiber:0.076 in. (0.19 cm)

Fabric impression preserved in concretion. The fibers appear to be the same size or larger than 133-181.

Figure 4.57. Artifact 133-123.

103-039 Fabric impression

Fig. 4.58.

Th. of fiber:0.021 in. (0.55 cm)

Fabric impression preserved in concretion. Smallest fiber of the three examples selected. Impression indicates that original fabric pieces folded over, possibly wrapped around the ceramic piece that is associated with this artifact.

Figure 4.58. Artifact 103-039.

4.5.3 Other Clothing Related Items

133-111 Clasp

Fig. 4.59.

L:1.29 in. (3.28 cm), W:1.25 in. (3.17 cm), Cylinder inner diam:0.15 in. (0.38 cm), outer diameter:0.35 in. (0.89 cm)

Cupreous clasp. Wear marks on inside of clasp. The marks are regular, straight, and parallel with the cylinder. Irregular scratch makes on both sides. Two small holes on either side of clasp filled with cupreous material. The cylinder is hollow with wear marks on outside at either end.

Figure 4.59. Artifact 133-111.

120-296 Pack hook

Fig. 4.60.

L:1.30 in. (3.31 cm), W:1.25 in. (3.17 cm), Th:0.19 in. (0.48 cm)

Cupreous pack hook.

Figure 4.60. Artifact 120-296.

111-065 Leather pack button

Fig. 4.61.

L:0.90 in. (2.29 cm), Diameter of base:0.64 in. (1.63 cm), Th. of base:0.06 in. (0.15 cm), Shaft diam.:0.16 in. (0.40 cm); Top sphere L:0.43 in. (1.09 cm), W:0.39 in. (0.98 cm)

Cupreous stud or button for leather pack.

Figure 4.61. Artifact 111-065.

131-096 Leather pack button

Fig. 4.62.

L:0.86 in. (2.19 cm), Diameter of base:0.47 in. (1.20 cm), Th. of base:0.06 in. (0.14 cm), Shaft diam.:0.15 in. (0.37 cm); Top sphere L:0.41 in. (1.04 cm), W:0.38 in. (0.97 cm)

Cupreous stud or button for leather pack.

Figure 4.62. Artifact 131-096.

110-122 Strap Clasp

Fig. 4.63.

L:1.77 in. (4.49 cm), W.:1.06 in. (2.70 cm), Th.:0.14 in. (3.51 cm), Inner diam. of eye:0.44 in. (1.13 cm)

Cupreous strap clasp. Rectangular opening for strap opposite an eye. A small hook would have been inserted through the eye to connect the strap to another item. Highly eroded.

Figure 4.63. Artifact 110-122.

4.6 Personal Items

120-295 Key

Fig. 4.64.

L:3.08 in. (7.83 cm), Max. shaft W:0.35 in. (0.88cm)

Cupreous key. Missing portion of ring. Three bands around the shaft, 0.10 in. (0.26 cm) hole at handle towards bottom of shaft.

Figure 4.64. Artifact 120-295

108-067 Bayonet scabbard hook

Fig. 4.65.

Plate: L.:2.35 in. (5.96 cm), W.:1.64 in. (4.17 cm), Th.:0.02 in. (0.06 cm)

Clip: L.:1.25 in. (3.19 cm), W.:0.49 in. (0.05 cm), Th.:0.30 in. (0.77 cm)

Cupreous bayonet scabbard hook used to clip the bayonet scabbard to the frog that suspended the scabbard from the belt. Attached to cupreous plate which wrapped around the top of the leather bayonet scabbard. Two holes in plate for fasteners.

Figure 4.65. Artifact 108-067.

110-054.1 Oil Lamp Piece

Fig. 4.66.

Max. diam. (top):1.71 in. (4.35 cm), max. diam. (bottom):1.04 in. (2.63 cm), thickness:0.87 in. (2.22 cm)

Cupreous oil lamp piece. Circles unevenly spaced around circumference, 0.02-0.13 in. (0.05-0.33 cm) apart holes are uniform in size, 0.12 in. (0.30 cm) in diameter. These are most likely made from a punch by hand. The lip around the top circumference would have held the glass in place. The lower portion is formed to fit onto the base of the lamp. The oil lamp piece shows damage and wear on both the top and bottom.

Figure 4.66. Artifact 110-54.1

4.7 Activities Group

4.7.1 Tools

Tools provided for the vessels of the U.S. Navy varied by the size and type of ship, according to the Navy Department's specific allotment. When compared to the large varieties and quantities allotted, the tools recovered from *Westfield* represent a very small and poorly preserved portion of what was originally available.

132-385 Hammer Head

Fig. 4.67.

L:5.05 in. (12.83 cm), Max. W:1.38 in. (3.50 cm), Diam. of round end:2.33 in. (5.93 cm), Elliptical handle hole L:1.04 in. (2.64 cm), W:0.75 in. (1.90 cm)

Iron hammer head. Square in section with round, flat hammer end. Elliptical handle hole in center with original wood fragments recovered. Original surface poorly preserved. The U.S. Navy issued a variety of hammers issued to navy ships, including chipping hammers, hand hammers, riveting hammers, and assorted copper hammers (United

States Navy Department 1865:26). The type of this particular example is difficult to identify due to the hammer's poor preservation.

Figure 4.67. Artifact 132-385.

132-385A Wood Handle fragments from hammer

Fig. 4.68.

Left fragment: L:1.51 in. (3.83 cm), W:0.85 in. (2.17 cm), Th.:0.20 in. (0.51 cm)

Right fragment: L:1.53 in. (3.89 cm), W:0.83 in. (2.11 cm), Th.:0.31 in. (0.79 cm)

Two wood fragments from hammer head. Fragmented on inside, side towards the middle of the original handle, and smooth on the outside, where the wood sat against the iron.

Figure 4.68. Artifact 132-385A.

139-005 and 119-021 Bullet Mold

Fig. 4.69.

L: 7.87 in. (20 cm)

Cupreous bullet mold with complete handle on one half of mold (139-005) that splays outward and downward from the mold at a length of 6.19 in. (15.73 cm). The handle is missing for the other half (119-021). The two halves join together just behind the mold where the handle is much wider. The piece with a missing handle (119-021) may have sat on top of 139-005. 119-021 has a circle hole with a diameter of 0.33 inches (.84 cm) at the attachment point. The other half, 139-005, may have been placed under the first piece and has a square attachment hole with a length of 0.28 in. (0.70 cm). The mold cavity matches up well on both sides with a maximum length of 1.22 in. and a maximum width of 0.61 in. (3.1 cm and 1.54 cm, respectively). There is a small spout where the metal was originally poured. At the top of the spout, the diameter is 0.47 in. (1.2 cm) which narrows to 0.30 in. (0.77 cm). A small hole, diameter 0.24 in. (0.61 cm), on the upper portion of the mold on the complete handled half (139-005) either marks a fill line for the mold or indicates another piece was attached, at 1.00 in. (2.54 cm) from bottom of the mold. Another hole is below the spout and in front of the “U” shaped mold cavity. Another piece would have likely gone here, so that both halves could lock together on the other side of the mold. The lower half (139-005) shows evidence of a washer with a diameter of 0.65 in. (1.66 cm) fitted to the bottom face at the attachment between the two halves, while the other half (119-021) shows evidence for a similar washer with a diameter of 0.57 in. (1.46 cm) on the top of the attachment point. Due to their similar size, the two mold halves likely belonged to the same bullet mold or to an identical mold.

Figure 4.69. Artifacts 139-005 and 119-021.

118-023 Unidentified Tool

Fig. 4.70.

L:3.23 in. (8.20 cm), Max. W.:0.90 in. (2.28 cm)

Cupreous unidentified cross-shaped tool. Base has extension to fit into a handle, possibly of wood. Opposite this, a 0.03 in. (0.06 cm) slit originally held another thin object. The object would have been held in place by a small screw at the top of this unidentified tool and supported by the two arms or extensions. The slit extends 0.89 in. (2.25 cm) from the top of the tool. The two arms or extensions are hollowed out in the shape of a cylinder with a diameter of 0.21 in. (0.53 cm).

Figure 4.70. Artifact 118-023.

133-130 Unidentified object or tool

Fig. 4.71.

L:3.78 in. (9.60 cm), Shaft diam.: 0.66 in. (1.68 cm), Head width:0.74 in. (1.88 cm), Head length:0.60 in. (1.53 cm)

Unidentified cupreous object or tool. Square head with cylindrical shaft. Small indentations visible on bottom, possibly from use or from erosion.

Figure 4.71. Artifact 133-130.

4.7.1.1 Files

Files are made in a wide variety of sizes, shapes, and weights for multiple or specific tasks, and they are of great importance to all workers of metal. Files have to be strong and durable, and harder than the metal they are filing. Prior to the late 19th century when files were made with special alloy steel, files were made using carburized wrought iron, blister steel, shear steel, and cast steel. A special class of blacksmiths, called filesmiths, made files by hand. By the 19th century, there were further specializations in filesmithing, such as forgers, grinders, cutters, and hardeners. File blanks were forged and ground to the appropriate shape and smoothness. Teeth were individually cut in rapid succession, using a chisel and hammer by a skilled workman relying only on sight and feeling. Easily replaced handles, primarily wooden, were optional, depending on the file's use and user. Files were then tested, cleaned, oiled, and shipped out (Freedley 1856:349; Ross and Light 2000:20-22). By the late 19th century, time and labor saving machines were introduced which eliminated the need for the old, highly skilled methods of file making. Production of files in the United States was relatively new in the 1860s, having just started in the previous decade. Prior to the 1850s, they were imported from Sheffield, England, the center of the file industry in England. The first American file company was established in Pittsburgh in the 1820s. Not until 1845 were files first manufactured in New York, by John Rothery (Arbor 1994:36).

The U.S. Navy Department issued files under three categories. For the engineer's department, between 18 and 36 files and 12 to 18 file handles may have been issued to *Westfield* for a two year period. For the carpenter, between 3 and 6 cross cut saw files, fine saw files, and 2-3 rat tail saw files, in addition to 6 to 15 handsaw files were issued. In a separate section, the carpentry department was issued between 4 and 10 flat bastard files, flat, fine files, half-round files, and half-round bastard files. Between two and four rat-tail, three-sided, and four-sided files were also issued (United States Navy Department 1865:25,78,87). Determining which department these files, 119-151 and 119-054, were allocated to, is impossible. However, this information clearly demonstrates that the files recovered from *Westfield* are only a small portion of the many files issued to a naval ship. Both files listed above came from the same grid square on the site, 119. This grid square is located almost in the center of the wreck site and may indicate a central location for tool storage on the ship. However, due to the wrecking event, assumptions of this nature remain questionable.

119-151 Flat File
Figs. 4.72, 4.73.
L:4.80 in. (12.20 cm), W:1.28 in. (3.25 cm), Th.:0.33 in. (0.84 cm)

Fragment of iron single-pointed flat file. Point opposite the tang or spike preserved. Teeth 0.04 in. (0.10 cm) apart on faces and edges. Angled, double-cut teeth across both faces. On the original cast, the double-cut teeth are preserved. These are shown in photographs of the cast below (Figure 4.73). These are not as evident on the painted epoxy cast (Figure 4.72). Teeth along the edges and point are perpendicular to the surface. Poorly preserved. Original iron not preserved, only the epoxy cast of the concretion mold.

Figure 4.72. Artifact 119-151.

Figure 4.73. Surface detail of Artifact 119-151.

Figure 4.73. Continued.

119-054 Half-Round File

Fig. 4.74.

L:12.20 in. (31.00 cm), W:1.20 in. (3.04 cm), Th.:0.44 in. (1.12 cm)

Almost complete half-round file. Preserved from point to the upper portion of tang or spike. Missing the majority of the handle. Teeth 0.05 in. (0.13 cm) apart on faces and edges. Angled, double-cut teeth across flat face and angled, single-cut teeth on rounded face. These are shown in photographs of the original artifact below (Figure 4.72). Original iron artifact did not survive conservation, this is the epoxy cast.

Figure 4.74. Artifact 119-054.

4.7.2 Other

108-093 Latch

Fig. 4.75.

L:2.18 in. (5.55 cm), W:0.95 in. (2.41 cm), Th.:0.26 in. (0.66 cm)

Cupreous latch. Eye opposite of hook not preserved. One large band around the shaft. Ring end missing.

Figure 4.75. Artifact 108-093.

128-063 Latch

Fig. 4.76.

L:1.39 in. (3.53 cm), Th:0.04 in. (0.09 cm), Eye outer diam.:0.30 in. (0.77 cm)

Cupreous hook or latch. Surface flat on one side and concave on the opposite side. Edges not well preserved around the eye. Ring end is badly eroded.

Figure 4.76. Artifact 128-063.

121-137 Unidentified threaded loop

Fig. 4.77.

L:1.04 in. (2.63 cm), Loop inner diam:0.37 in. (0.94 cm), outer diam:0.72 in. (1.83 cm), lower base cylinder inner diam:0.33 in. (0.83 cm), outer diam:0.54 in. (1.38 cm)

Cupreous loop. Threaded, hollow cylinder with loop attached to top.

Figure 4.77. Artifact 121-137.

121-084 Counterpoise Weight

Fig. 4.78, 4.79.

L:2.36 in. (6.00 cm), Min. diam.:1.61 (4.1 cm), Max. diam.:1.92 in. (4.9 cm), Upper circle:0.79 in. (2.0 cm), Lower circle:0.47 in. (1.2 cm), Weight:11.23 oz. (318.45 g)

Cylindrical counterpoise weight. Cast iron with lead adjustment in central shaft originating from bottom central depression. Small circle on the top which allowed the weight to be hung. A ring would have been attached to the top for hanging. Bottom has another indented circle which allows the lead inside to be seen. The weight would have hung from a scale, counterbalancing the object was placed on the scale to be weighed. A cross-sectional drawing is shown in Figure 4.79.

Figure 4.78. Artifact 121-084. Top view, bottom view, and side view

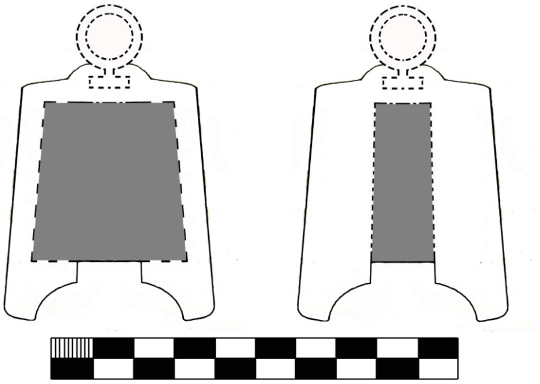


Figure 4.79. Cross-section drawing of counterpoise weight. The two drawings show two possible theories on the extent of the lead core inside the weight. The lead is shown in gray surrounded by a dashed line. The ring, shown by the dashed circle at the top of the weight, is a possible reconstruction for how the weight may have hung from the scale.

134-035 Hasp

Fig. 4.80.

L:5.31 in. (13.49 cm), Max W:1.81 in. (4.60 cm), Max Th.:0.22 in. (0.55 cm), Inner diameter of loops at end:0.29 in. (0.73 cm), Outer diam.:0.72 in. (1.82 cm), Long ellipse L:1.79 in. (4.56 cm), W:0.42 in. (1.09 cm)

Cupreous hasp for padlock clasp. Two holes on one end. One of these holes is filled with copper, suggesting that the other portion of the hasp was also made of copper. The other end has decorative beveling, flat on one side and concave on the other, and a long ellipse opening to allow for loop to enter and a lock to be attached.

Figure 4.80. Artifact 134-035.

125-037 Plate with rope decoration

Fig. 4.81.

L:8.31 in. (21.10 cm), Max. W.:0.57 in. (1.44 cm), Max. Th.:0.22 in. (0.58 cm), Center hole diam.:0.32 in. (0.82 cm)

Cupreous plate with rope decoration. Possibly a handle or decorative plate for a handle. “S” shape rope design on outer face. Both ends show break. Small circular hole with oval border in center for handle. Twisted and bent.

Figure 4.81. Artifact 125-037.

4.8 Unidentified

132-001.02 Unidentified Finial

Fig. 4.82.

L:0.89 in. (2.25 cm), Max W.:0.91 in. (2.31 cm)

Cupreous finial. Composed of two pieces. Lower portion appears to be cylindrical with a circular base, 0.91 in. (2.31 cm) in diameter. Inside of lower portion is hollow, with a diameter of 0.32 in. (0.80 cm). The outer diameter of the cylinder, barely visible below the upper portion, is 0.46 in. (1.18 cm). The upper portion fits over the lower portion and has a maximum diameter at its base of 0.58 in. (1.46 cm). This diameter slowly decreases as the upper portion extends until it forms a convex cross-section with a diameter of 0.37 in. (0.95 cm). The diameter increases to form the top button, diameter 0.56 in. (1.42 cm), which marks the top of the finial. Small, poorly preserved grooves or teeth are evident around the top circumference of the button.

Figure 4.82. Artifact 132-001.02.

125-062 Unidentified

Fig. 4.83.

L:3.08 in. (7.82 cm), W:0.40 in. (1.02 cm)

Unidentified cupreous object.

Figure 4.83. Artifact 125-062.

120-271 Unidentified

Fig. 4.84.

L:1.20 in. (3.04 cm), W:0.44 in. (1.11 cm)

Unidentified cupreous object.

Figure 4.84. 120-271.

128-064 Unidentified

Fig. 4.85.

L: 0.68 in. (1.73 cm), W: 0.15 in. (0.37 cm), Th.: 0.11 in. (0.28 cm)

Unidentified cupreous object.

Figure 4.85. Artifact 128-064.

131-078 Unidentified strap

Fig. 4.86.

L:3.69 in. (9.38 cm), L of fork ends:1.51 in. (3.83 cm), Max W:1.03 in. (2.62 cm), Max Th. of strap before fork:0.23 in. (0.59 cm)

Cupreous unidentified forked strap. One hole at the end of the strap. Originally, the two sides would have formed a “U” shape. Small copper shaft through opposite end. Fork sides separated 0.37 in. (0.93 cm), holes at end of forked ends diameter of 0.39 in. (1.0 cm).

Figure 4.86. Artifact 131-078.

40 Unidentified Object

Fig. 4.87.

L:5.75 in. (14.6 cm), Max. W.:1.61 in. (4.1 cm), Th.:0.59 in. (1.49 cm)

Unidentified cast iron object. Concave and half-circle in shape with a small, possibly purposeful notch on the top left.

Figure 4.87. Artifact 40.

4.9 Conclusion

This catalog provides descriptions of the Priority 1 small artifacts related to the crew and the daily running of the ship for comparison to other archaeological collections, possible future identification for objects not yet identified, and as a record of artifacts found on the site of USS *Westfield*. The artifacts listed in the catalog were chosen based on their diagnostic properties and importance in representing the artifacts from the *Westfield* site. In some cases, like the belt and cartridge box plates, the entire collection was cataloged above, while in others like the brick, glass, and ceramics, only the most important are cataloged. In a large part, the choice to include an artifact was purely subjective, based on how the item fit within the larger group.

Artifact identification and measurements consumed the most time and effort for the creation of this catalog. Due to this and the fragmentary nature of the artifacts, research of individual artifacts was neglected in favor of general research on the materials and types of objects. This research, included throughout this section, reflects the transitional period of the Industrial Revolution in the 19th century, when iron and copper dominated the metal industry and new technologies expanded the supply and use of these materials. The manufacturing methods for the items listed in the section changed also, taking advantage of new technologies.

Iron and copper artifacts comprise the majority of finds from USS *Westfield.* Iron artifacts include most of the *Westfield* collection and were in the form of boiler and machinery parts, while cupreous artifacts dominate the small finds of the collection because they survive better than small iron objects. Noticeably absent from the catalog are iron and copper fasteners, which comprise the majority of the small finds. These artifacts were not included because they are categorized as part of the hull construction, and the large quantity and types of fasteners would have overshadowed the unique artifacts in the catalog.

Few diagnostic, organic artifacts survived on the wreck site and those few were left out of the catalog. The wood fragments found on the *Westfield* site were not included because most of the small pieces were intrusive and the larger fragments were most likely part of the hull. Only a few glass and ceramic remains from the site were included because they were very fragmentary, and no writing or maker's marks were found on the small pieces. Anthracite coal pieces found on *Westfield*, distributed across the site, were also not discussed in the catalog because the sizes and shapes of the individual pieces have little archaeological value.

The *Westfield* artifacts show very poor preservation in general due to the initial explosion during the Battle of Galveston, dredging activity in the early 20th century, and the harsh conditions of the wreck location. Due to this, the small finds are more than likely not in or near their original location when *Westfield* sank, eliminating any reliable provenience information. To increase the difficulty of determining provenience, the rescue archaeology conducted at the site only provides a general location of artifacts, within a 15 ft. (4.57 m) square (Borgens et al. 2010:D-6).

As such, much of the information learned from the small finds comes from studying the artifact groups, in combination with historical records, and not their relation to one another or the site. This is detailed further in Section 5.

5. CONCLUSION

5.1 Introduction

After nearly 150 years on the sandy bottom of Galveston Bay, USS *Westfield* now exists as an artifact collection of twisted metal and small fragments available for study by archaeologists and for public education. This thesis examines the small artifacts found with *Westfield*, including a discussion of their conservation and a catalog for future reference. This concluding section briefly summarizes the previous four sections. In addition, this section uses historical documents, in combination with archaeology, to connect the material culture to the people who built, equipped, and worked on USS *Westfield*.

5.2 Excavation and Prioritization

USS *Westfield* was excavated by PBS&J (now Atkins Global) in late 2009, and the artifacts were cataloged in early 2010, as part of the Texas City Channel Improvement Project in Galveston, Texas. The site was divided into 15 x 15 ft. (4.57 x 4.57 m) grid squares distributed virtually over the wreck site. A large electromagnet and a clamshell dredge were used to bring up most of the remains, as the swift moving water and harsh conditions of the channel made regular diving on the site impossible. After the artifacts were excavated, they were sent to Freeport, Texas where they were cataloged, recorded, and photographed (Borgens and Gearhart 2010:4-5).

In the spring of 2010, the artifacts were brought to the Conservation Research Laboratory at Texas A&M University's Riverside campus for prioritization and conservation. The *Westfield* artifacts were prioritized into five categories. Priority 1 artifacts were kept for conservation, for their display and informational value. Priority 2 and 3 artifacts were deaccessioned and moved into permanent wet storage, or reburial. Some Priority 2 artifacts were relabeled Priority CRL and kept for training purposes. Priority 4 and 5 artifacts were made up of concretion bleeds or fragments of non-diagnostic artifacts, and were discarded. Prioritization required extensive knowledge of the collection by conservators. To aid in this process, a database was created to organize the information about the artifact number, location, material type, description, and priority of each of the over 8,000 artifacts. In addition, x-radiographs were taken to identify the small iron artifacts preserved under layers of iron corrosion or concretion.

While prioritization and x-rays were necessary for determining whether or not an artifact was kept for conservation, the process was extremely time-consuming. After the artifacts were prioritized, the priorities had to be approved by all interested parties, including the U.S. Army Corps of Engineers, the Naval History and Heritage Command, the Texas Historical Commission, and the Conservation Research Laboratory. Finalizing the database was a tedious, but important process. Once the priorities were approved, artifacts stored in an array of vats were re-sorted by priority which took a span of three months, delaying conservation further. However, these steps were necessary to complete the deaccession process ethically.

5.3 Historical Background

The *Westfield* was built by Jeremiah Simonson of Brooklyn, New York and commissioned for the Staten Island Ferry Service by Cornelius Vanderbilt in the spring of 1861. The ferryboat had a length of 214 ft. (65.2 m), a breadth of 34 ft. (10.4 m), and a depth of 12 ft. 11 in. (3.9 m), and its hull registered at slightly less than 900 tons. The ship's vertical walking beam engine was built by Morgan Iron Works of New York (Heyl 1965:335). *Westfield* served as a ferryboat for five months before the ship was purchased by the U.S. Navy, which lacked the ships needed to conduct the blockade of Southern ports. USS *Westfield* was commissioned on 13 February 1862, with Lieutenant Commander William B. Renshaw as captain (*New York Times* 1862a, 1862d).

Westfield was employed with the West Gulf Blockading Squadron and sent to the Gulf of Mexico and the Mississippi River for an attack on New Orleans. Prior to the battle, the ferry gunboat served to pull heavy mortar schooners over the bar at the entrance to the Mississippi and to observe the Confederate forts (Cotham 2006:43,45,47). During the battle, in late April 1862, *Westfield* assisted in pummeling Confederate Forts Jackson and St. Philip and extinguishing or deflecting fire rafts, sent down the river by the Confederate Navy (Mahan 1885:62-63,65; Dufour 1960:231).

Between May and October 1862, *Westfield* completed many different tasks in the Gulf of Mexico, participating in an attack on Mobile, Alabama, patroling Lake Ponchartrain and surrounding waters, and fighting in the Battle of Vicksburg (Cotham 2006:37-74). In October, *Westfield*, *Harriet Lane, Owasco,* and *Clifton* were sent to capture Galveston, Corpus Christi, Sabine Pass, and Port Lavaca, Texas (Cotham 1998:57-59). Galveston was captured in early October and occupied by Union ships until January of 1863. During this time, *Westfield* and *Clifton* made their way to Matagorda Bay to demand the surrender of Port Lavaca and Indianola. The Confederates fought back, resulting in the capture and looting of Indianola and the bombardment of Port Lavaca by *Westfield*'s guns (Malsch 1988:137-138,162,167; Cotham 2006:110-111,114,115).

Westfield and *Clifton* returned to Galveston Bay in November of 1862. Rumors of Confederate ships in the bay kept the sailors and marines on alert (Cotham 2006:116-119). In the early hours of New Year's Day, 1863, four Confederate ships attacked from the north of Galveston Bay, while General Magruder and his troops crossed the bridge onto Galveston Island and attacked the Union troops stationed on Kuhn's Wharf (Davis 1863:458; Palmer et al. 1863:447-448; Cotham 1998:113-114). *Westfield* spotted the Confederate ships at 4:00 A.M. and immediately weighed anchor, sailed forward, and grounded in the sand on the northeast side of Pelican Spit (Burt 1863:455; Jones 1961:323; Tucker 2006:325,354). As the Battle of Galveston progressed, *Harriet Lane* was captured by the Confederate cottonclads, the troops on shore were taken prisoner, and *Westfield* remained stuck in the sand. Acknowledging the need for a retreat, Renshaw decided to scuttle the gunboat instead of leaving the ship for the Confederates. The ship exploded prematurely, killing Captain Renshaw, the officers, and a few crew members (Burt 1863:456; Palmer et al. 1863:449).

The Battle of Galveston was a significant defeat for the Union Navy during the Civil War. Galveston thereafter remained under Confederate control until the end of the war. The loss of *Westfield* was labeled as unjustified by David Farragut, and Captain

Renshaw was blamed for the loss of the gunboat, the abandonment of *Harriet Lane*, and defeat by the Confederates (Farragut 1863c:447).

5.4 Conservation

Iron artifacts comprise the majority of objects found on the site of USS *Westfield*. Their conservation is detailed in Section 3. The preservation of the iron from this site is challenging for conservation, ranging between the stage of a completely whole iron artifacts, a partially preserved iron core and a mushy graphite surface, and an empty concretion cavity. The largest challenge to conservation came from the cast iron objects, which in some cases were entirely graphitized. This graphite layer consistently flaked or spalled off the surface of the artifacts.

An experiment was conducted to solve this problem and determine better conservation methods for *Westfield* artifacts. The results supported the hypothesis that damage to the graphite layer of the cast iron artifacts was caused in a relatively brief period that artifacts were allowed to air dry, shorter than what would have been expected. In addition, electrolysis with artifacts drilled to directly attach the electrical current to the iron core was found to be the best treatment for *Westfield* cast iron. These findings have a significant implication for the successful treatment of any similar collection and are considered to be a major contribution of this thesis. These results, as well as developing techniques for casting the degraded iron artifacts were critical to the success of the *Westfield* conservation effort.

Copper artifacts were also commonly found with *Westfield* and were conserved using electrolytic reduction, similar to the iron objects. Lead objects were cleaned mechanically and chemically with hydrochloric acid before being rinsed and sealed in microcrystalline wax. Ceramics and glass were treated with catalyzed silicone oil polymer. While this method is sufficient to treat these artifacts, for general conservation, this process is expensive and unnecessary for glass and ceramics. On the other hand, the treatment is very beneficial to the organic artifacts, especially wood, leather, and rubber.

5.5 Artifact Catalog

The artifact catalog documents the small, unique Priority 1 artifacts related to the crew or the daily running of the ship found on the site of USS *Westfield*. The catalog also serves as a comparative collection for those studying American Civil War sites. The list includes basic measurements, a description, and photographs. In order to connect the material culture, or the artifacts, back to the people who made the objects, research was conducted on the manufacturing processes and industries producing the various material types, including iron, copper, and lead, as well as individual artifacts such as the belt plates, a soda bottle with a rounded bottom, and the condiment shaker cap. This research highlighted the transitional period during the Industrial Revolution of the 19th century, showing changes in the development of technology and an increased demand for supplies during the Civil War.

The provenience for the Priority 1 artifacts chosen for this thesis is very general. The salvage excavation, conducted with a clamshell dredge and an electromagnet due to the harsh environment of the site, only allowed the location of artifacts to be recorded within a 15 ft. (4.57 m) square. However, because of the explosion during the Second Battle of Galveston and 20th-century dredging operations, most small finds were most likely not in their original position. Despite this, a site map was created below (Figure 5.1) showing the relative locations of Priority 1 artifacts listed in Section 4. This map shows that the artifacts were spread across the entire site and not found in one specific area. This is expected; in addition to the explosion resulting in the spread of objects, the artifacts chosen in Section 4 had a variety functions, material type, and preservation.

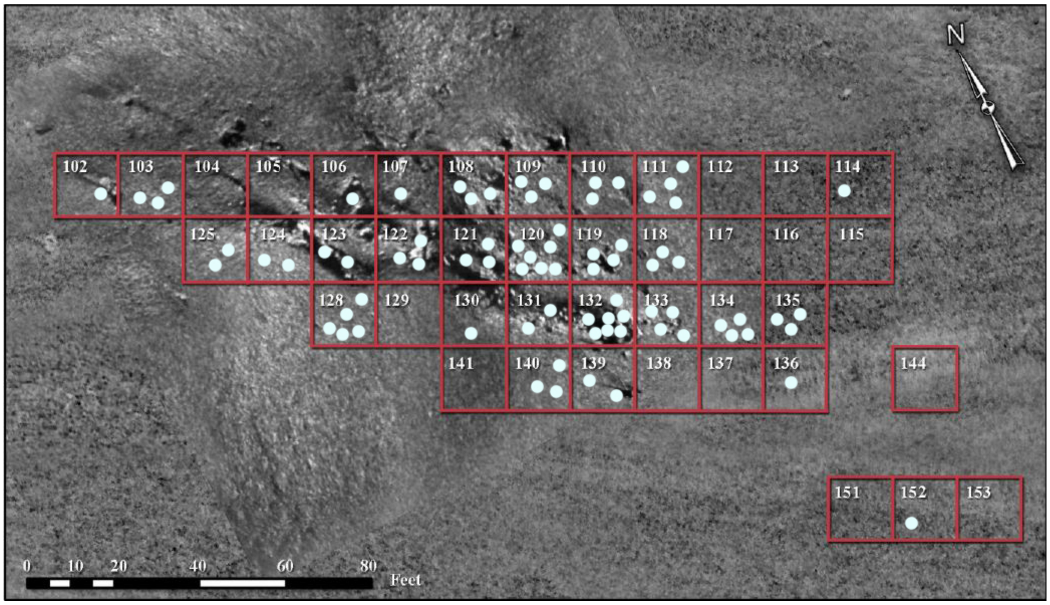


Figure 5.1. Site map of USS *Westfield* showing locations of small Priority 1 artifacts. After Borgens et al. (2010:D-6).

5.6 U.S. Navy Regulations and Allotment of Equipment

The changes and transitions represented in the study of the *Westfield* artifact collection and characteristic of the Industrial Revolution in the 19th century were also experienced by the U.S. Navy, as the allotment of equipment became more regulated. By studying these regulations, in comparison to objects found on the site during the Confederate salvaging and the later excavation, this is made apparent. The *Regulations for the Government of the United States Navy, 1865* (1865b:1-2), lists the types of U.S. Navy ships by rate (shown below in Table 5.1). According to this chart, *Westfield* would have been considered a Fourth Rate ship, as a purchased paddle-wheel steamer of just less than 900 tons. A second document, *Allotment Established for Vessels of the United States, 1864* (1865a:33-34), lists regulations for the sizes of anchors and kedges required by ships of a specific rate. The bower anchor weight is determined by multiplying the square of the extreme breadth of the ship by a multiplier based on the rate of the ship, listed in the document and shown below in Table 5.2. *Westfield*, with a breadth of 34 ft.

(10.36 m) and a fourth rate ship, may have been issued a 2,500 ton bower anchor, if these regulations were followed.

Table 5.1. Navy regulations for third and fourth rate ships (United States Navy 1865b:1-2).

Third Rate	**Fourth Rate**
Sailing ships from 700 to 1,300 tons	Sailing ships under 700 tons
Screw steamers from 600 to 1,200 tons	Screw steamers under 600 tons
Paddle-wheel steamers from 700 to 1,000 tons	Paddle-wheel steamers under 800 tons
Iron-clad steamers from 1,200 to 2,000 tons	Iron-clad steamers under 1,200 tons
Purchased screw steamers from 700 to 1,400 tons	Purchased screw steamers under 700 tons
Purchased paddle-wheel steamers from 900 to 1,500 tons	Purchased paddle-wheel steamers under 900 tons
Receiving ships	Store and supply vessels

Table 5.2. Allotment of anchors and kedges for paddle-wheel steamers in the U.S. Navy, based on rate (United States Navy 1865a:34).

Rate	Type	Multiplier	Bower	Sheet	Stream	Kedge
1st	If rigged as ship or bark	3.0	2	2	1	4
2nd	If rigged as ship or bark	3.0	2	2	1	3
3rd	If rigged in a lighter way	2.2	2	1	1	3
4th	**If between 700 and 500 tons**	**2.0**	**2**	**1**	**1**	**2**
4th	If between 500 and 300 tons	2.0	2	0	1	2
4th	If between 350 and 200 tons	2.0	2	0	1	2
4th	If less than 200 tons	2.0	2	0	1	1

Based on Table 5.2, and *Westfield*'s 891 tons, *Westfield* may have had two bower anchors, one sheet, one stream, and two kedge anchors. This document also lists regulations for the size of the stream and kedge anchors, and their associated chain size, calculated based on the rules and listed in Table 5.3 below. The stream anchors were regulated to be one-fourth the size of the bower and sheet anchors, and the kedge anchors, in the case of the ship having two, were at one-sixth and one-tenth of the bower anchor weight. Charts in the document dictate what size chain, both diameter and length, for each size anchor (United States Navy 1865a:33-39).

Table 5.3. Possible allotment of anchors, kedges, and anchor chain for USS *Westfield* (United States Navy 1865a:33-39).

Anchor	Quantity	Size (tons)	Chain diameter (in./cm)	Chain length (fathoms)	Chain length (ft./m)	Chain weight (tons)
Bower	2	2,500	1.25/3.18	135	810/247	6.35
Sheet	1	2,500	1.25/3.18	120	720/219	5.64
Stream	1	625	0.63/1.60	60	360/110	0.72
Kedge #1	1	416	0.50/1.27	n/a	n/a	n/a
Kedge #2	1	250	0.44/1.11	n/a	n/a	n/a

This information is useful as an estimate of the anchors and chain that were aboard USS *Westfield* and can be calculated for any U.S. Navy ships from the Civil War, as long as the breadth and rate of the ship are known. However, this estimate may not reflect reality and is contradicted by two sources. According to the Confederate Prize Commission Records (see Section 2.6.5, Table 2.6), a four inch diameter hawser was recovered from the ship. In *Allotment Established for Vessels of the United States, 1864* (1865a:38), a four inch diameter hawser, or a circumference of 12.5 inches, would be associated with a bower anchor weight of between 3,000 and 3,500 tons, larger than *Westfield* would have needed based on the U.S. Navy regulations. The chain preserved on *Westfield*, cataloged in Section 4.4.4, presents another issue. The task of identifying where this chain came from on the ship is impossible; however, there is a possibility that the chain may have come from the kedge or stream anchors. The chain is poorly preserved, so any diameter measurements taken from the chain links is a minimum. The diameters from the largest size of chain are 0.57 in. (1.45 cm) and 0.54 in. (1.35 cm), which is too large for either estimated chain size for the two kedges. Most likely, the original diameters would have been larger, due to the poor preservation of the iron;

however, these diameters may still have been too large for the regulation size stream anchor chain as well.

While the evidence from the chain diameters is only approximate at best, the large hawser recovered from the ship could indicate that *Westfield* may have had larger anchors than what would have been necessary for a ship of that size. Many factors could have contributed to this. Primarily, at the time of *Westfield*'s purchase, the U.S. Navy was not equipped to provide standardized equipment as outlined in the 1865 regulations, as discussed in Section 2.2 (*New York Times* 1862a; Roberts 2002:9-10), exemplified by the Navy's purchase of a ferryboat. *Westfield* may have been converted and equipped using whatever supplies were available locally and inexpensively. On the other hand, *Westfield*'s equipment may come from more extensive forethought. Larger, heavier anchors could have assisted the ship when anchoring close to land, such as in rivers or just outside of harbors, in the heavy storms of the Gulf of Mexico or the East Coast, or in towing heavy mortar schooners (Kevin Crisman 2013, pers. comm.).

In either case, there seems to be a change towards the end of the war from a "use what we got" mentality to more standardization and regulation in equipping Navy ships, whether or not those rules were followed. The experience gained by the Navy during the years between *Westfield*'s commissioning and the publication of the *Allotment Established for Vessels of the United States*, and a steadier supply of ships and equipment, allowed for this transition to take place. Further, these changes parallel the changes that were occurring in the manufacturing processes of supplies, shown in Section 4.

5.7 Conclusion

In 2009 and 2010, USS *Westfield* was excavated from Galveston Bay almost 150 years after the converted ferryboat sank during the Battle of Galveston on 1 January 1863. In the spring of 2010, the collection of artifacts was brought to the Conservation Research Laboratory at Texas A&M University's Riverside Campus where they were prepared for conservation. Standard laboratory procedures for conservation were conducted on the majority of the Priority 1 artifacts, or those conserved for display and informational value, and included variations on electrolytic reduction and silicone polymer treatment. Historical research of USS *Westfield* highlighted the vessel's use as a New York ferryboat, its conversion to a gunboat, and its use in the West Gulf Blockading squadron in 1862. Details of the Second Battle of Galveston and *Westfield*'s sinking included in that section recognized the importance of the loss for the Union in the Gulf of Mexico. A timeline in the Appendix (Table A-1) was created as a condensed version of the historical background for easy reference. Unique Priority 1 artifacts, related to the crew or the daily running of the ship, were chosen for a catalog in Section 4. This catalog was intended to be a reference for others studying Civil War collections, as well as a way to further research *Westfield*. While the artifacts themselves are not extremely diagnostic, research into their manufacture emphasized the transitions and changes that were experience in the 19th century.

The result of this thesis is a better understanding of *Westfield*'s history and role in the American Civil War, a working knowledge of how to manage, prioritize, and conserve an extensive artifact collection, and a reference catalog of the unique small artifacts from the site. The conservation techniques, cataloging process, and analysis can be successfully applied to any future Civil War conservation project and will alleviate any of the problems encountered and eventually solved during the *Westfield* project. In addition, this thesis was completed in honor and in memory of those who perished during the Second Battle of Galveston on New Year's Day 1863, whose memory is preserved by the seemingly small bits and pieces of *Westfield* that are discussed in the preceding sections.

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APPENDIX

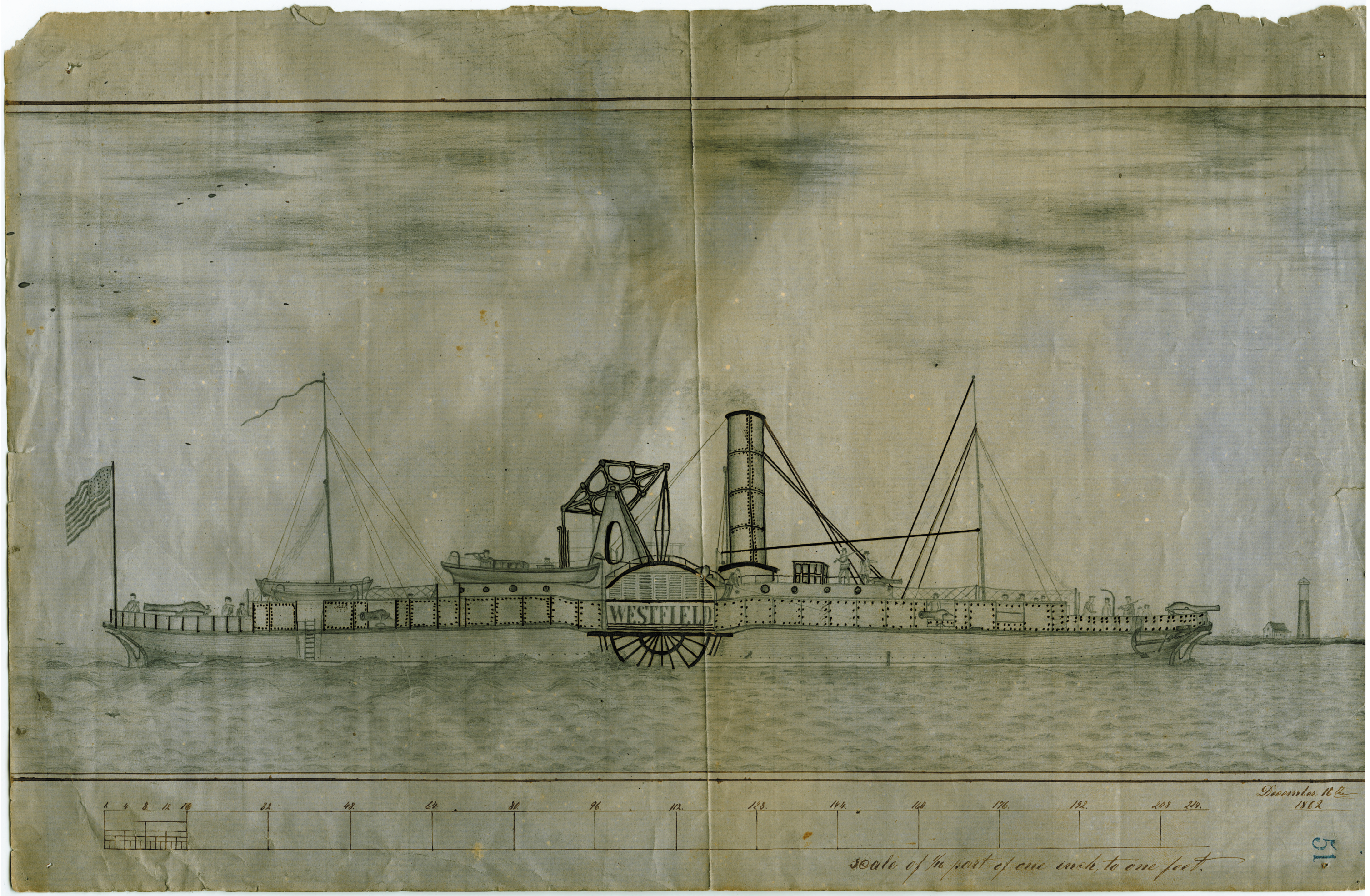

Figure A-1. Drawing of USS *Westfield* from the Memphis Public Library. Courtesy Memphis and Shelby Public Room, Memphis Public Library and Information Center.

Table A-1. Historical Timeline for USS *Westfield.*

DATE	EVENT
1 June 1860	Cornelius Vanderbilt begins construction on *Westfield* at the Simonson shipyard (Stiles 2009;337).
9 July 1861	A small sailboat containing three soldiers from Governor's Island capsizes off of Quarantine in New York. Two of them are saved by Captain Braisted of the Staten Island ferry boat *Westfield* (*New York Times* 1861).
22 November 1861	U.S. Navy purchases *Westfield* (Silverstone 1989;102).
31 January 1862	*Westfield* arrives in New York to be armed and put into commission (*New York Times* 1862b).
10 February 1862	*Westfield* receives armament of four 32-pounders, broadside, and two pivot guns, one fore and one aft (*New York Times* 1862c).
13 February 1862	USS *Westfield* commissioned (*New York Times* 1862d).
22 February 1862	*Westfield* leaves Staten Island and heads south (Cotham 2006:40).
25 February 1862	*Westfield* sails with USS *John P. Jackson*, *Clifton*, and *Forbes* to join Captain David D. Porter's mortar fleet (*New York Times* 1862e).
26 February 1862	Off Cape Hatteras, North Carolina, *Westfield* encounters a large gale where the force of the waves removed a few planks. Pumps were used to remove the incoming water until the ship reached the harbor in Port Royal, South Carolina (Cotham 2006:43).
28 February 1862	*Westfield* arrives in Port Royal, South Carolina for repairs from a heavy storm. Her forward guard was bent inward (*New York Times* 1862f).

Table A-1. Continued.

DATE	**EVENT**
8-10 March 1862	*Westfield* reunites with *Clifton* in Key West, Florida. A few days later, *Westfield* leaves for Passe a l'Outre in the Mississippi River and spends two weeks towing vessels over the bar and rescuing larger ships that run aground (Cotham 2006:43,45).
18 March-13 April 1862	*Westfield* tows and assists USS *Mississippi* and USS *Pensacola* over the bar at Southwest Pass, south of New Orleans in the Mississippi River (Renshaw 1862a). The time is also spent disguising the fleets' outer hulls with Mississippi mud and attaching tree limbs to the tops of the masts of the mortar schooners (Cotham 2006:47).
31 March 1862	*New York Times* (1862i) Key West correspondent reports that *Westfield* has departed from Key West, Florida. *Westfield* arrives in Pilot Town, LA to rendezvous with the fleets to be used in the capture of New Orleans. There are 47 vessels total with 440 large caliber guns (Cotham 2006:46-47).
13 April 1862	*Westfield* is part of a coastal survey party along with USS *Harriet Lane*. Two rebel gunboats approach *Westfield* and the crew fires upon the rebels with rifle shot. The two Union ships are quickly joined by six to eight more, before the Confederate boats escape to safety under Fort Jackson. The crew of *Westfield* fires the 100 pounder rifle, breaking the shaft of the gunboat CSS *Defiance*, damaging the rebel ship sufficiently to warrant the crew to scuttle the ship (Renshaw 1862a).

Table A-1. Continued.

DATE	**EVENT**
17 April 1862	*Westfield* assists in extinguishing the flames of two Confederate fire rafts (Renshaw 1862a).
18 April 1862	*Westfield* tows mortar schooners and drives off a rebel steamer which retreats to Fort St. Philip. The crew fires ten shots with the rifle, while receiving similar rifle shot from the steamers and 10 inch shot and shell from the fort (Renshaw 1862a).
18-24 April 1862	Battle of New Orleans. *Westfield* assists in supplying ammunition for mortar schooners as the bombardment of the forts at New Orleans continues day and night (Renshaw 1862a; Cotham 2006:49).
21 April 1862	*Westfield* extinguishes another Confederate fire raft (Renshaw 1862a).
24 April 1862	3:45 am. *Westfield*, with the rest of the mortar flotilla steamers led by USS *Harriet Lane*, attacks Fort Jackson and Fort St. Philip. *Westfield*'s crew concentrates fire on Fort Jackson from a distance of 600 yards (549 m). Renshaw later informs David Porter that with their conservative use of ammunition, for the entire operations since March, *Westfield* has only used 35 rifle shot and shell, 11 9-inch shells, and 17 8-inch shells (Renshaw 1862a). Henry O. Gusley states that event was a, "terrific battle of nearly an hour" after fleets reached a position both above and below the forts (Cotham 2006:49).

Table A-1. Continued.

DATE	**EVENT**
27-28 April 1862	General Benjamin Butler lands a large force behind Fort St. Philip, effectively cutting off the forts on three sides and concluding the Battle of New Orleans. Both Forts Jackson and St. Philip surrender to Commodore Porter on the 28th of April and marines from *Westfield* are ordered to take possession of Fort Jackson (Cotham 2006:51).
29 April-5 May 1862	*Westfield* returns to Pilot Town just below Southwest Pass at the mouth of the Mississippi River to aid ships into the river. Henry O. Gusley complains of mosquitoes (Cotham 2006:38-39).
8 May 1862	Master's Mate William L. Babcock promoted to Acting Master. *Westfield*, along with *Harriet Lane, Clifton, John P. Jackson,* and *Miami*, are anchored four miles from Fort Morgan, near Fort Gaines, for reconnaissance in preparation for an attack on Mobile (*New York Times* 1862k).
10 May 1862	*Westfield* arrives back at Ship Island after a not entirely successful blockade on Mobile. *Clifton* ran aground within range of the Forts Morgan and Gaines but succeeded in extricating herself before any damage was done. *Westfield* participated in a friendly race back to Ship Island in which the crew was able to prove *Westfield* was the faster of *Clifton* and *John P. Jackson* (Cotham 2006:56,58).

Table A-1. Continued.

DATE	EVENT
14 May-1 June 1862	*Westfield* explores Lake Ponchartrain, Pearl River and the Rigolettes in search of rebel steamers. On the night of 15 May, *Westfield's* armorer Jacob Snukel threw himself overboard, without an apparent cause, and drowned. *Westfield* returns to Ship Island on 16 May and travels to Pensacola, Florida on the 31st of May to find that the town of Warrington, Florida, and the correspondingly naval yard, to have been burned (Cotham 2006:58-67).
4-19 June 1862	*Westfield* travels between Pilot Town, New Orleans, and Rodney, Mississippi before meeting with Commodore Farragut's fleet in Vicksburg, Mississippi in preparation for an attack there (Cotham 2006:68-77).
26 June-15 July 1862	The battle that ensued at Vicksburg was much slower and ineffective compared to the quick results at New Orleans. CSS *Arkansas* caused damage to her connecting rod with a rifle shot. The shell passed through her wheel house, cutting an arm of the wheel, and then was picked up on deck. The WGBS sets out to destroy *Arkansas*. Renshaw reports on the scuttling of *Sidney C. Jones* (Renshaw 1862b; *New York Times* 1862m). The siege of Vicksburg continues until the 15th of July when the Union commences a two hour attack by night that silences the Confederate batteries and results in the firing of the town (Cotham 2006:81-84).

Table A-1. Continued.

DATE	**EVENT**
23 July 1862	*Westfield* is back in New Orleans. (Renshaw 1862b).
7 August 1862	*Westfield* travels to Baton Rouge, LA as reinforcements for Commander Farragut. Confederate forces numbering to 6,000 had attacked the Union's 2,500 on 5 August. CSS *Arkansas* was engaged with two Union gunboats, resulting in the destruction of *Arkansas* by the crew to avoid capture by the Union (Cotham 2006:87-89).
8 August-20 September 1862	*Westfield* ordered to leave her current location in Baton Rouge and head to New Orleans, Louisiana to prepare to leave the Mississippi River (Farragut 1862a). By 8 August, she is anchored once again at Pensacola, FL where she remains until 19 September before returning to Ship Island (Cotham 2006:90-98).
25 September-2 October 1862	*Westfield* is between Ship Island and Pilot Town preparing for an attack on Galveston, Texas. The ship arrives at Sabine Pass on 2 October (Cotham 2006:99-104).
4-6 October 1862	Galveston is captured by Captain Renshaw and *Westfield,* with the aid of *Harriet Lane, Owasco, Clifton,* and *Henry Janes* (Renshaw 1862d). Renshaw requests the surrender of Galveston, which was denied. Union forces exchange fire with the rebels and soon discover that the large guns at Galveston are actually Quaker guns. Galveston soon surrenders (Cotham 2006:104,106).

Table A-1. Continued.

DATE	EVENT
12-21 October 1862	Marines aboard *Westfield* are stationed on Pelican Island and used to disperse any rebel forces and defend the island (Cotham 2006:107-109).
23 October 1862	*Westfield* is joined by the *Clifton* in their journey to Matagorda Bay. Both vessels run aground in the entrance into the bay. *Westfield* captures *Lecompte*, a blockade runner (Cotham 2006:110-113).
26 October 1862	Indianola surrenders to *Westfield* (Cotham 2006:113-114).
31 October-2 November 1862	Attack on Lavaca and the bursting of *Westfield*'s 100 pounder Parrot rifle. The bombardment lasted two days. *Westfield* ran low on ammunition, so the battle subsided and the gunboats set sail for Galveston (Cotham 2006:115-116).
5-14 November 1862	*Westfield* remains at Galveston, hearing rumors of rebel steamers in the bay. HBM *Greyhound* arrives in Galveston and *Westfield* acts as transport for *Greyhound*'s captain. A boat crew from *Owasco* goes ashore and is fired upon in an ambush. Almost all of the crew is wounded (Cotham 2006:116-120).
20-29 November 1862	*Westfield* captures another blockade runner, runs aground off Pelican Spit, and, on the 29th, spies a rebel ram coming down the bay and *Westfield* gives chase (Cotham 2006:120-122).

Table A-1. Continued.

DATE	**EVENT**
1-21 December 1862	*Westfield* continues monitoring rebel activity at Galveston. She receives a nine-inch Dahlgren cannon from *Clifton* (Cotham 2006:123-126).
24 December 1862	The 42nd Massachusetts Regiment of 400 soldiers arrives aboard USS *Saxon* (Cotham 2006:120-127).
1 January 1863	Battle of Galveston: Union naval forces are attacked by two cottonclads and two other vessels. *Westfield* is scuttled to prevent capture and *Harriet Lane* is captured. What remains of the Union vessels and sailors, 70 from *Westfield*, head back to New Orleans (Farragut 1863a).
4 January 1863	The marines and sailors from *Westfield* arrive in New Orleans aboard *Clifton* (Cotham 2006:130).
19 March 1863	The guns from *Westfield* and *Harriet Lane* are used to create rebel battery at Galveston (*New York Times* 1863b).
4 May 1863	Rebel steamers are used in an attempt to raise a part of *Westfield* (*New York Times* 1863c).
1 June 1863	*Houston Telegraph* reports that a total of five guns, including an eight-inch Columbiad and a nine-inch Dahlgren have been salvaged from the wreck of *Westfield*. The *Telegraph* predicts that there will be more found (*Houston Telegraph* 1863c).

Table A-2. Chloride Readings from Cast Iron Experiment. Vat Δ indicates the electrolyte was changed. UR indicates the reading was unreadable.

		Vat #22- Control		**Vat #27- 60 minutes**		**Vat #23- 6 hours**		**Vat #28- 24 hours**	
		Amp/V	**Sol./Cl.**	**Amp/V**	**Sol./Cl.**	**Amp/V**	**Sol./Cl.**	**Amp/V**	**Sol./Cl.**
1	10/16/2012	2/3	UR	2/2	UR	2/2	UR	2/3	UR
2	10/23/2012	2/3	UR	2/2	UR	2/2	UR	2/3	UR
3	10/30/2012	2/3	UR	2/2	UR	2/2	UR	2/3	UR
4	11/6/2012	Vat Δ	UR	Vat Δ	UR	Vat Δ	UR	Vat Δ	UR
5	11/13/2012	2/3	85	3/2	10.6	2/2	57	2/3	70
6	11/20/2012	2/3	18	3/3	21	2/2	18	2/3	28
7	11/27/2012	2/3	10.6	2/3	28	2/2	25	2/3	43
8	12/7/2012	Vat Δ	n/a	2/3	39	2/2	46	2/3	46
9	12/11/2012	1/2	14	2/3	32	1/2	25	2/3	57
10	12/18/2012	1/2	18	2/3	25	1/2	32	2/3	50
11	1/2/2013	1/2	10.6	2/3	28	1/2	32	2/3	39
12	1/7/2013	1/2	14	2/3	32	1/2	35	2/3	46
13	1/14/2013	1/2	85	2/3	35	1/2	39	2/3	57
14	1/22/2013	1/2	21	2/3	27	1/2	32	2/3	46
15	1/29/2013	1/3	10.6	2/3	21	2/3	18	1/3	50
16	2/5/2013	1/3	25	1/3	32	1/3	35	1/3	53
17	2/12/2013	1/3	21	1/3	43	Vat Δ	50	Vat Δ	n/a
18	2/19/2013	1/3	21	Vat Δ	53	2/2	UR	1/3	10.6
19	2/26/2013	1/3	14	1/3	14	2/2	7	2/3	10.6

Table A-3. Graph of chloride readings versus the square root of time for Vat #22 Control. The red line indicates best fit line for most points and the green line indicates straight line connecting dots, from which the diffusion coefficient, or slope, was calculated. The black line indicates a general trend line.

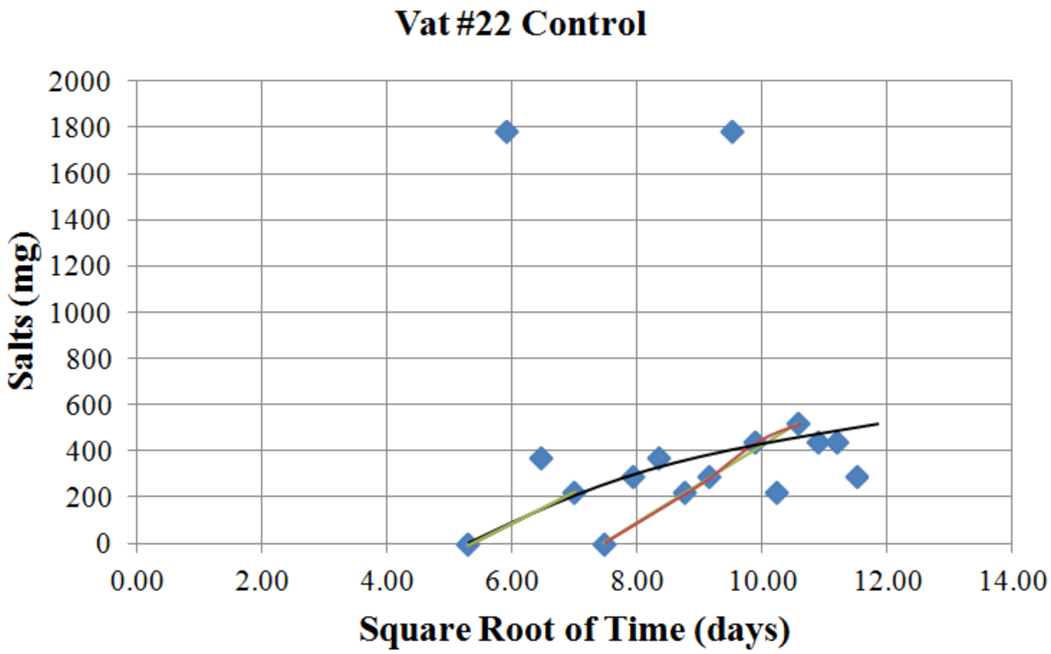

Table A-4. Graph of chloride readings versus the square root of time for Vat #27 60 minutes. The red line indicates best fit line for most points and the green line indicates straight line connecting dots, from which the diffusion coefficient, or slope, was calculated. The black line indicates a general trend line.

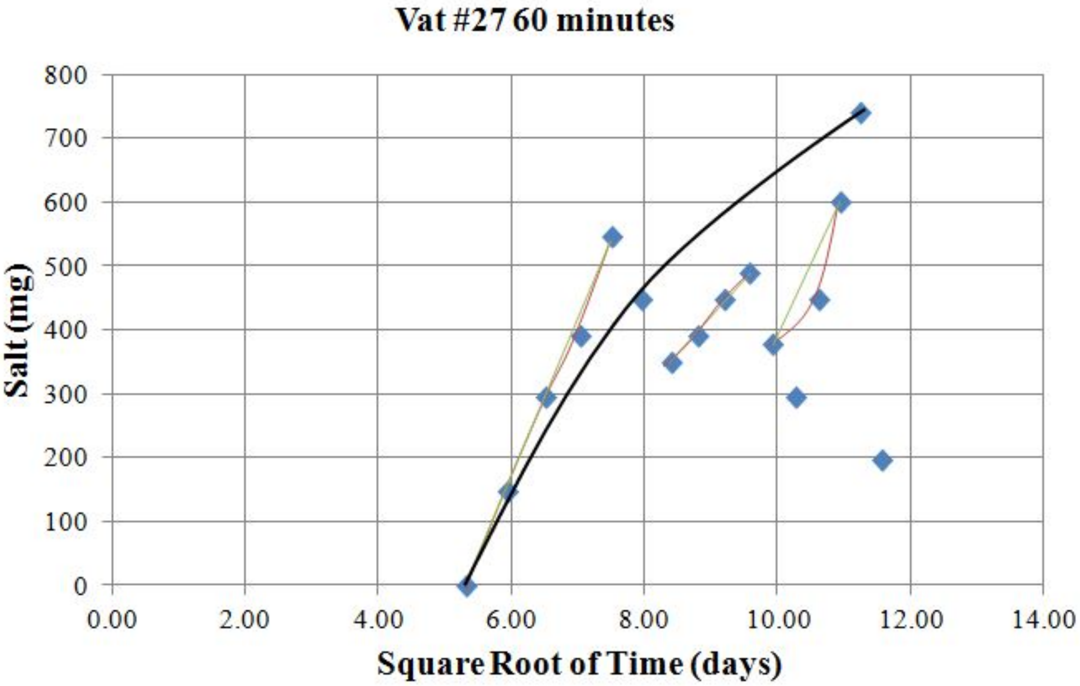

Table A-5. Graph of chloride readings versus the square root of time for Vat #23 6 hours. The red line indicates best fit line for most points and the green line indicates straight line connecting dots, from which the diffusion coefficient, or slope, was calculated. The black line indicates a general trend line.

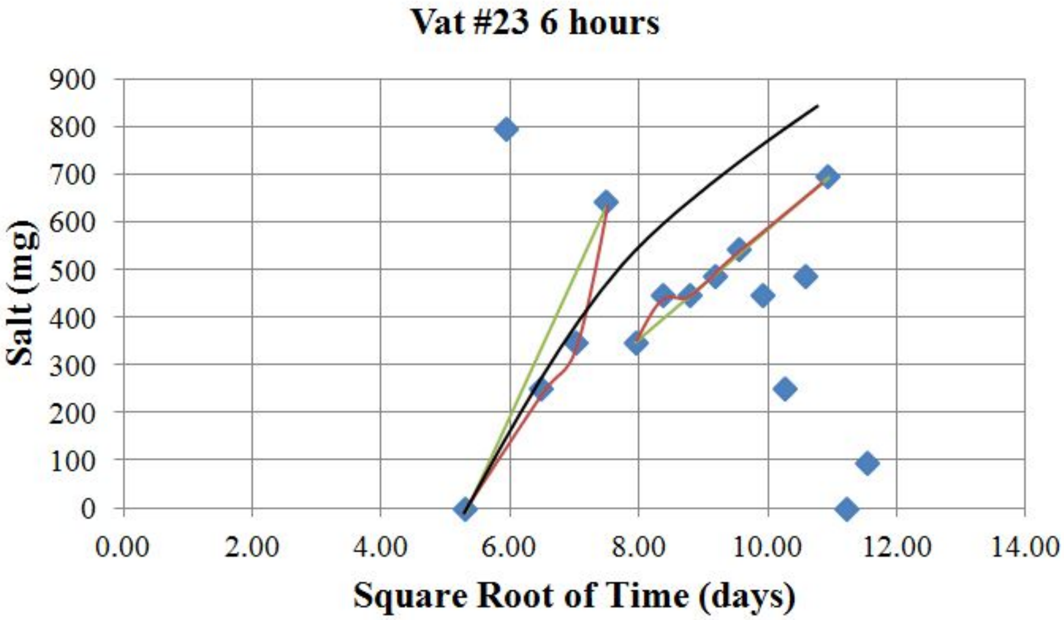

Table A-6. Graph of chloride readings versus the square root of time for Vat #28 24 hours. The red line indicates best fit line for most points and the green line indicates straight line connecting dots, from which the diffusion coefficient, or slope, was calculated. The black line indicates a general trend line.

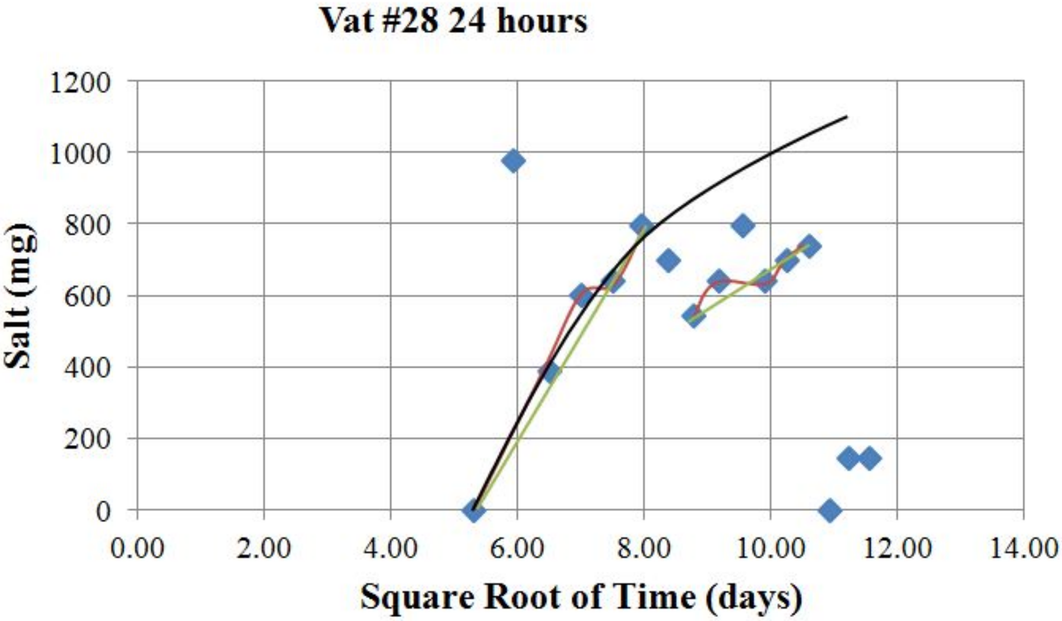

Table A-7. List of Artifacts Cataloged in Section 4.

Artifact Group (by section number)	**Artifact (Short description and number)**	**Material Type**	**Page**
4.3 Kitchen artifact group			
4.3.1 Ceramics			
	Porcelain body sherd (118-017)	C	89
	Porcelain rim sherd (134-046)	C	89
	Ironware rim sherd (120-280)	C	90
	Whiteware body sherds (135-009)	C	91
	Whiteware rim sherd (140-039.1)	C	91
	Whiteware rim sherd (103-039.1)	C	92
	Whiteware rim sherd (132-001.7)	C	93
	Whiteware rim sherd with blue annular lines (139-011)	C	93
	Small stoneware body sherd (140-039.2)	C	94
	Stoneware body sherd (124-033)	C	95
	Salt-glazed stoneware body and base sherd (109-123)	C	95
	Small salt-glazed stoneware rim sherd from lid (132-001.7)	C	96
4.3.2 Glass			
	Dark green glass bottle fragment (121-025)	G	98
	Very dark green bottle base fragment (132-396)	G	99
	Dark green bottle base fragment (111-066.1)	G	99
	Bluish green soda or mineral water bottle (140-013)	G	100
	Bluish green bottle neck fragment (134-047.1)	G	102
4.3.3 Tableware			
	Condiment shaker top (109-010.1)	Ag	104
4.4 Architecture (Small ship construction) group			
4.4.1 Brick			
	Large yellow brick fragment (122-003)	A	112
	Small brick fragment (135-011)	A	113
	Fine grained light color brick (136-004)	A	114

Table A-7. Continued.

Artifact Group (by section number)	**Artifact (Short description and number)**	**Material Type**	**Page**
	Fine grained small brick fragment (152-003)	A	115
	Small mortar fragment (130-003)	A	115
4.4.2 Sash weights			
	Lower portion of sash weight (119-171)	Fe	116
	Number "8" sash weight (120-074)	Fe	117
	Number "10" sash weight (118-177)	Fe	118
	Number "10" sash weight (122-004)	Fe	119
4.4.3 Sheaves			
	Sheave (120-308)	Cu/Fe	119
	Sheave (128-016)	Cu/Fe	120
4.4.4 Chain			
	9 large complete chain links (102-009)	Fe	121
	8 large complete chain links (103-067)	Fe	122
	Medium chain links (114-004)	Fe	122
	Medium chain links (134-086)	Fe	123
	Small chain links (110-056)	Fe	124
4.4.5 Cupboard buttons			
	Small cupboard button (120-284)	Cu	125
	Large cupboard button (132-128)	Cu	126
	Cupboard button with screw (121-078.1)	Cu	127
4.4.6 Rope			
	Rope fragment (128-043)	O	129
4.5 Clothing group			
4.5.1 Buckles			
	Snake belt buckle loop (135-003)	Cu	130
	Snake belt buckle (111-064)	Cu	131
	"US" stamped belt plate (108-103)	Pb	132
	"US" stamped belt plate (106-032)	Pb	133
	"US" stamped belt plate (123-042)	Pb	133
	"US" stamped belt plate (124-041)	Pb	134
	"US" stamped cartridge box plate (107-024)	Pb	135
	"US" stamped cartridge box plate (121-142)	Pb	136

Table A-7. Continued.

Artifact Group (by section number)	**Artifact (Short description and number)**	**Material Type**	**Page**
	“US” stamped cartridge box plates (122-061)	Pb	136
	“US” stamped cartridge box plate (109-089)	Pb	137
	Cupreous belt plate frame (123-041)	Cu	138
4.5.2 Textile			
	Fabric impression on cupreous amorphous fragment (133-181)	O	138
	Fabric impression in concretion (133-123)	O	139
	Small fabric impression in concretion (103-039)	O	140
4.5.3 Other Clothing Related Items			
	Clasp (133-111)	Cu	140
	Pack hook (120-296)	Cu	141
	Leather pack button (111-065)	Cu	142
	Leather pack button (131-096)	Cu	143
	Strap clasp (110-122)	Cu	143
4.6 Personal items group			
	Key (120-295)	Cu	144
	Bayonet scabbard clip (108-067)	Cu	145
	Oil lamp piece (110-054.1)	Cu	145
4.7 Activities group			
4.7.1 Tools			
	Iron hammer head (132-385)	Fe	146
	Wood fragments from hammer handle (132-385A)	O	147
	Bullet mold (139-005; 119-221)	Cu	148
	Tool or handle-cross shaped (118-023)	Cu	150
	Unidentified tool (133-130)	Cu	152
4.7.1.1 Files			
	Flat file (119-151)	Fe	152
	Half-round file (119-054)	Fe	154
4.7.2 Other			
	Cupreous latch (108-093)	Cu	155
	Cupreous latch (128-063)	Cu	156
	Unidentified threaded loop (121-137)	Cu	157

Table A-7. Continued.

Artifact Group (by section number)	**Artifact (Short description and number)**	**Material Type**	**Page**
	Counterpoise weight (121-084)	Fe/Pb	157
	Hasp (134-035)	Cu	159
	Decorative rope handle plate (125-037)	Cu	159
4.8 Unidentified group			
	Unidentified finial (132-001.02)	Cu	160
	Unidentified cupreous object (125-062; 120-271; 128-064)	Cu	161
	Unidentified strap (131-078)	Cu	163
	Unidentified cast iron object (40)	Fe	163

Key:

A: Architectural

Ag: Silver

C: Ceramic

Cu: Cupreous

Fe : Iron

G: Glass

O: Organic

Pb: Lead