A TALE OF TWO SHIPPING CRATES FROM *Brother Jonathan* 1865

A Thesis

by

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ABSTRACT

On July 30, 1865, the steamship *Brother Jonathan* sank off the coast near Crescent City, California. Although a well-known tragedy at the time, its exact location was unknown until the 1990s when Deep Sea Research, Inc. located the wreck and began salvage operations. Certain artifacts were given to the state of California, including two shipping crates. These crates were entrusted to the Texas A&M University's Conservation Research Laboratory for analysis and conservation. The first crate was packed with various hardware and trade tools in quantities indicating it was bound for a general store—all of these items were found to have been ordered from the Russell and Erwin Manufacturing Company who packed and sent the crate from San Francisco, California; the second contained more singular hardware and tools from multiple manufacturers, likely ordered by an individual rather than a store. Analysis of the items in the second crate, some of which were also ordered from Russell and Erwin, in relation to historical context and geographical location suggest that the crate was likely intended for a blacksmith. There is no proof of the crate's origin or destination other than the known route of *Brother Jonathan*. Conservation of the artifacts in the second crate preserved the tangible history of the era and of *Brother Jonathan*. Using various methods of conservation provided further case study for the future conservation of similar artifacts of this composition and from this era.

DEDICATION

To my family members—Mom, Daddy, Dallas, and Rainey—and my best friend Angie; you have always given me the support and love I need to accomplish anything. To my own Jonathan, your ambition encouraged me to finish this.

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Contributors

This work was supervised by a thesis committee consisting of Professor Donny L. Hamilton and Luis Filipe Vieira de Castro of the Department of Anthropology and Assistant Professor Lilia Campana of the Department of Visualizations.

The conservation of the hammers was completed in Anthropology 606 class by students: Kirsten Dollarhide, Chelsea Cohen, Joshua Farrar, Rich Hendren, Meredith Stoops, Lauren Baugh, Carrigan Miller, and Dorothy Rowland. The conservation of the wooden handles was completed by Helen Dewolf, and the hammerheads were conserved by John Hamilton at the Conservation Research Laboratory at Texas A&M University. Parker Brooks, Raphael Franca, and Miguel Gutierrez assisted with some of the heavier lifting.

All other work conducted for the thesis was completed by the student independently.

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INTRODUCTION

Objective

The construction of the steamship *Brother Jonathan* was ordered by Edward Mills in 1849 for the purpose of transporting large numbers of passengers and cargo during a time when people were leaving the east coast in search of gold and adventure in the western parts of North America. After fifteen years of hard work, she was making runs from San Francisco, California to Victoria, British Columbia and carrying Civil War soldiers, civilian passengers, plenty of gold, and cargo when stormy conditions caused the ship to run up onto rocks and sink just outside of Crescent City, California on July 30, 1865. Over two hundred lives were lost in under an hour as spectators looked on in horror from the shore; at the time, this was the greatest loss of life in the Pacific Ocean.

The exact location of the wreck was unknown until Deep Sea Research, Inc. discovered it in 1996 and recovered multiple artifacts and portions of the gold coins from the site. The state of California wanted to take possession of the shipwreck and its artifacts, but Deep Sea Research felt they had a valid claim over the wreck. After taking their case to the United States Supreme Court, the decision was made that the already recovered artifacts would be handed over to the state while most of the gold would remain in the hands of the salvage company. DSR was also given possession of the shipwreck site and allowed to continue salvage operations since they employed archaeologists and were cognizant of the need to preserve the cultural and historical context of the site and its artifacts. They continued to work with the Del Norte County Historical Society and Museum, handing over valuable items recovered from *Brother Jonathan* for conservation and display (Bowers 1999:354).

Among the items handed over the state of California were two shipping crates. The Texas A&M University Conservation Research Laboratory was sub-contracted by the Institute of Western Maritime Archaeology in the conservation of the crates. The main objective to this thesis is the conservation of the second crate—DSR artifact field number 97-0042 (Bowers 1999:344)—and its contents. This work will preserve the integrity of the items for future study as well as the history of *Brother Jonathan.* Conservators will also benefit from the conservation work and analysis of various methods used on these artifacts as a guideline for future case study. Shipwrecks have the ability to preserve history and provide archaeologists with information about the transport of goods and people during a specific time period, illuminating societal and cultural themes. The analysis of this crate and comparison to the first crate will give historical insight into the needs and movements of North American settlers in 1865.

Current Status of the Problem

The excavation of the second shipping crate from *Brother Jonathan* had one previous case study with research data to use as a guideline – Sowden's (2006) thesis on the first shipping crate. Sowden's (2006) workspace and method of storage were duplicated because of the success she achieved. Because the contents of the crate were different, the actual excavation approach had to be adjusted to the needs of the second crate, and the conservator had to employ different techniques and solutions to handle each problem as it was presented during the excavation.

The gold rush era of the late 1840s in California is well-known and documented. By 1865, the previously unsettled west coast had a heavy population and was becoming quite established. It was still growing, however, and the manufacturers of the east coast were profiting from the settlement of the west whose needs were focused on building townships in states newly admitted to the Union (Bancroft 1890:446-80). Due to an historical focus on the Civil War and annihilation of Native Americans during this time, the record does not reveal much about the nature of the transportation of peoples and their establishment of the west coast after the initial gold rush. This is why the *Brother Jonathan* crates are so valuable. They offer tangible evidence of the needs of those who were migrating to and settling the western United States and Canada during this time.

Another problem faced by the researcher is the determination of the origin and destination of the crates, which would provide some more definitive historical context. While the first crate seemed to have been packed and shipped from the Russell and Erwin Manufacturing Company in San Francisco, the second does not show any indication of a specific manufacturer. The cargo manifest printed in the

Daily Alta California (1865c:4) newspaper on July 29, 1865 does refer to four crates of hardware (Bower 1999:255).

As the problems on how to best excavate the contents of the crates were encountered and solved, a working thesis regarding the conservation, research, and documentation of the artifacts was developed. The aim is to outline the results of various conservation methods, analyze the contents and compare the first and second shipping crates for some historical insight into the commercial needs of the western settlers in 1865, and attempt to identify the origin and destination of the second crate.

Outline

Every story starts at the beginning, so a chapter is included to present the reader with *Brother Jonathan's* construction, employment, demise, and the much later discovery and recovery of artifacts from the salvage operations. This chapter is also meant to expose what steamship transportation and shipping was like between 1850 and 1865; the United States had not yet extended a railroad system from the east to the west, so ships were heavily relied upon.

Because the work done on the first crate served as a precursor to the work done on the second crate, a brief synopsis of its contents and analysis are given. A comprehensive analysis of the second crate's disassembly, contents, and conservation precedes a comparison of the two crates, which illuminates the material, commercial, and social cultures of 1860s North American Pacific coast.

As was the case with the first crate, the main objective with the second crate was to excavate, identify, document, and conserve each of the artifacts in the crate. Due to the number of the items in the crate and the amount of time needed to conserve them all, it was not feasible for the researcher to complete conservation on each; however, conservation of the remaining artifacts continues at the Texas A&M Conservation Research Laboratory. The artifacts' composition and levels of deterioration were assessed before proceeding with a conservation plan. Almost all of the items were composed of wood, metal, or a combination of both, and the appropriate research for conserving these materials was conducted and is discussed in a later chapter. Complete conservation was performed on the wooden handles using silicone oil, and the hammerheads all went through electrolytic reduction.

A thorough description of four conservation methods used on five complete hammers is outlined in a separate chapter. Silicone oil was used on two hammers, acetone-rosin on two hammers, and a combination of freeze-drying and electrolytic reduction was used on a hammer that was able to be disassembled. The outcome of each is covered.

Research is pulled from sources and records specific to the history of *Brother Jonathan*, work on the first crate, each of the artifacts, and the conservation methods employed. The information compiled from catalogs, articles, conservation manuals, and academic journals will advance the understanding of the artifacts' utility in North America during the Civil War and the best methods for conserving waterlogged artifacts of this type.

CHAPTER II

HISTORY OF *Brother Jonathan*

1849 – 1851

Before the American Gold Rush, most of the country's population was living on the Eastern Seaboard. When news of James Marshall's gold find at Sutter's Mill started rolling in from California in January 1848, everyone wanted to head west and stake their claim (Bowers 1999:17-19). People living on the east coast had two travel options: by land or by sea. Those who had settled in the Midwest, such as St. Louis, and adventurers would gather in groups of hundreds in their wagons and on their horses to make the trek across the mostly unknown western territories. These pioneers experienced attacks by Native Americans, cholera, water and food deprivation, and shocking climates; many of them never made it to their destination. The other option was to make the trip by ship. Ship routes would take passengers to Panama, where they had cross land at the isthmus, or all the way around Cape Horn at the tip of South America (Bowers 1999:29-31). At the time, there were no ships on the east coast with the capabilities to take hordes of people to the west coast; this is where steamships found a new niche. These ships could carry more passengers and cargo, so more steamers were commissioned (Sowden 2006:8).

Perrine, Patterson & Stack built *Brother Jonathan* for Edward Mills in Williamsburg, New York. She was launched November 2, 1850—at the cost of

$190,000. Constructed with live oak, locust, cedar, and iron braces, her dimensions were roughly 221 feet in length, a thirty-six foot width, and fourteen foot depth, with a tonnage of 1,181 and passenger capacity of 350. The ship originally had two decks with white oak flooring, two masts—a square-rigged foremast and schooner-rigged mainmast. Steering and navigation were located between the funnel and foremast, with the boilers forward of amidships. The paddlewheels on either side were thirty-three feet in diameter and were powered by a walking beam engine; the engine room itself was fitted by Morgan Iron Works (Lomax 1959:331-2). The engine was salvaged from the *Atlantic*, which hit a storm in Long Island Sound and sank in 1846 (Sowden 2006:10). The ship began its route from New York to Panama (Chagres) in early 1851.

1852 – 1857

Travel from the New York to San Francisco took approximately thirty-five days, with ports in Charleston, Savannah, Havana, Kingston, Acapulco, San Blas, Mazatlán, San Diego, and Monterey. The dangers were numerous; shipwrecks, seasickness, storms at sea, and cholera and malaria contracted during the land crossing at Panama (Sowden 2006:11-2). Mills' tickets were often half the price of his competitors', so people jumped at the opportunity. He partnered with Empire City Lines to transport passengers from Panama to San Francisco, but the line was not always reliable; some ended up stranded in Panama when other lines refused to honor Mills' cheap tickets. Mills' bad business practices and refusal to refund passengers eventually led to the sale of *Brother Jonathan* to Cornelius Vanderbilt in March of 1852. Vanderbilt added the ship to his Accessory Transit Line and transferred her to the Pacific for the west leg of the route from Panama (Delgado 1995:8-2 – 3). First, the ship was overhauled to accommodate 750 passengers. A mast and deck were added, the well and forecastle were enlarged, and the semi-clipper bow and sprit were replaced by an almost vertical bow. There were six lifeboats, which was hardly enough for 750 passengers. Clearly, the new design was focused on monetary gain and not safety. On top of this, the ship was consistently loaded with closer to a thousand passengers. She left New York for her new home port in San Francisco on May 14, 1852. By July, the ship was making regular trips from San Francisco to San Juan del Sur, Nicaragua. Vanderbilt chose this alternate route because the crossing at the isthmus was easier, and he had a railroad built that hastened the journey. Now, the entire trip from east to west coast could take as little as twenty-four days (Sowden 2006:15-8).

1858 – 1860

In November of 1857, *Brother Jonathan* was sold to John T. Wright, who rechristened her *Commodore* and added her to his Merchants Accommodation Line. *Commodore* was Cornelius Vanderbilt’s nickname, and the new owners believed that customers would flock to her due to Vanderbilt’s reputation for low prices. Wright also set her on a new path northward from San Francisco to British Columbia (Lomax 1959:335). It was on April 10, 1858 that the ship brought news of a gold strike on the Fraser River in British Columbia; so Wright placed the first ad in the Bay area papers for transport to Fraser River to take advantage of this newly discovered vein:

> "For the new gold mines on Frazer's River, Puget Sound. In consequence of the favorable news received from Frazer's River, the undersigned has been induced to put on the well-known steamship Commodore, which will sail from Pacific Wharf on Tuesday, April 20, 1858, at ten o'clock a.m. touching at Mendocino, Trinidad, Crescent City, Port Orford, and Victoria, Vancouver's Island, connecting with steamship Sea Bird at Port Townsend for all ports on Puget's Sound. For freight and passage apply on board, at Pacific Wharf, or to
>
> J. T. Wright
>
> 89 Front St., upstairs" (Lomax 1959:336)

Three hundred people purchased tickets ranging from twenty-five to fifty dollars. By April 30, she was headed back to San Francisco. This route ran for only three months, but an estimated 20,000 people migrated northward during this time on up to fifty-six different steamers (Lomax 1959:337). Victoria was a town of seventy-nine homes and twelve businesses in 1855; within the first two months of the 1858 gold strike, the town had ballooned to over two hundred buildings. However, this strike was not nearly as abundant as the California gold rush and it was much easier to get back home this time, so many people moved back south within the first year after the strike (Sowden 2006:21).

In July 1858, *Commodore* experienced its first tragedy when it took on water and the boiler fires were doused. The captain jettisoned the cargo and told the passengers to abandon ship; they were able to get the pump working again and sail her back to San Francisco where she was sold to the California Steam Navigation Company. Her new owners gave her a complete overhaul: six thousand iron bolts, copper sheathing below water line, general repairs, and her old name, *Brother Jonathan*. News of Oregon's statehood was brought to them by the steamer in March 1859. She was set back on her course to British Columbia until she was sold to Samuel J. Hensley of the Oregon & San Diego Steamship Company August 7, 1860 (Delgado 1995:8-4 – 5).

1861 – 1865

The steamer started a new south run from San Francisco to San Diego with stops in San Luis Obispo, Santa Barbara, and Los Angeles until 1861 when she was given her third overhaul. These efforts were described as shipbuilding rather than mere repairs as the ship was stripped to her keel and completely redone. She was given all new planking, decking, interior, boilers, copper sheathing, false keel and two bilge keelsons, and stronger masts. They removed a deck and refitted the ship for only for less passengers (250) and more cargo (900 tons). The ship was relaunched on December 14, 1861 with her new captain, Samuel DeWolf, when steamer *New World* challenged her to a spontaneous race—the sleek new *Brother Jonathan* was the victor (Bowers 1999:204-5). Between 1861 and 1865, the Civil War was raging on the west coast. Northern and southern California were on opposing sides, and although there was widespread fear of Confederate piracy among the Union, *Brother Jonathan* was never boarded or commandeered. During this time, she was back on her northern route to Oregon and Victoria, British Columbia (Sowden 2006:24).

In the 1850s, the money made by steamships was mostly from passengers. Once these people reached their destinations, they settled in and began needing goods. Therefore, by the 1860s, cargo had become the moneymaker. *Brother Jonathan*'s two main ports at the time were Portland, Oregon and Victoria, British Columbia which were both growing rapidly and needed goods to continue. Because Portland had no manufacturing of their own, tools and hardware, machinery, equipment, food, shelter, clothing, liquors, soap, pianos, powder, brooms, musical instruments, chemicals and so on was shipped in from San Francisco, and Portland would send back produce, gold, lumber, and wool. During this time, the ports in San Francisco were so laden with cargo that it often got left behind until the next trip. Ships were routinely overladen in order to deal with the vast amounts of cargo (Bowers 1999:206). It was this need for commodities—and the greed of the cargo masters—that would help along the demise of *Brother Jonathan*.

The End of *Brother Jonathan*

After a collision with *Jane A. Falkenburg* in early July, 1865, Captain DeWolf wanted to dry dock *Brother Jonathan* and fix the resulting hole in the bow. The cargo had been piling up on the dock, however, and the owner would not allow for a delay in transport. DeWolf was given two days to make the necessary repairs, and the *Daily Alta California* (1865c) newspaper announced on July 22nd that Brother Jonathan would depart for Victoria on July 28th. She was overladen by the dock master with wool mill machinery, a 200-ton piece of mining machinery, as well as two camels, and General George Wright's dog and horse. In addition, there was $200,000 payroll money for troops, and over 200 passengers and crew members. Captain DeWolf realized the safety threat and vowed to quit if load was not lightened, but the cargo master insisted he could simply find someone else to captain the vessel, so DeWolf backed down. It was reported that the ship was so overladen that she had to wait for high tide to leave San Francisco (Lomax 1959:343); however, local newspapers only list 500 tons of cargo, but that was from an official manifest and practices at the time did not necessarily conform to those lists (Daily Alta California 1865c:4). Bowers (1999:255-7) asserts that tales of the overloading of the ship are greatly exaggerated and these accounts are false, but offers no point of reference for his findings besides that he read "dozens of articles and thousands of words of text," and even contradicts his assertion by admitting that the published cargo list was incomplete.

It headed north from Crescent City, California on July 30th with its customary cannon salute, making it about twelve miles into a strong storm before Captain DeWolf decided to turn around and head back to Crescent City for safe harbor. Just eight miles northwest of Crescent City, she ran up and over rocks. Passengers and cargo were thrown about and a large gouge was taken from the hull at the engine room. The foremast fell through the deck to the yard arm, and ship was turned about. DeWolf ordered 3 cannon shots to notify those on land; Native Americans and townsfolk gathered on the cliffs and watched as the steamship sank in a mere forty-five minutes, completely powerless to help. Although all six lifeboats were launched, five were swallowed by the raging sea. Only the third mate, James Patterson, who loaded ten crewmen, five women, and three children into the only lifeboat, made it ashore. Reportedly, DeWolf's last words were: "Tell them that if they had not overloaded us we would have got through all right and this would never have happened" (Lomax 1959:345-7). Rescue efforts were made, but no other survivors were found. Forty-five bodies were found washed ashore in the first weeks of August, along with ship debris, cargo, and personal belongings. With a death toll over two hundred and financial losses at half a million dollars, this was the largest loss of life and the greatest calamity to hit the Pacific coast (Delgado 1995:8-6).

Conserving History

Although the wreck never left public memory, *Brother Jonathan*'s final resting place remained unknown until 1993 when Deep Sea Research, Inc. located the ship using manned submersibles. Over the years, they salvaged 1,200 gold coins and other artifacts, including at least two large shipping crates. In 1994, the state of California sued Deep Sea Research, Inc. for rights to the ship and everything recovered; the Supreme Court ruled in favor of Deep Sea Research, Inc. who was granted the rights to the shipwreck and its continued salvage operations, but they were asked to provide the state with the crates and other artifacts of cultural importance that had been recovered. DSR continued to work with the Del Norte Historical Society and Museum in its efforts (Bowers 1999:319-21). The two shipping crates have since been sub-contracted to the Conservation Research Laboratory at Texas A&M University to complete excavation and conservation work on their contents. The first crate, opened by graduate student Carrie Sowden (2006), contained tools such as axes, door sheaves, meat grinders, scythes, belts, and knife sheaths. The second of these crates was sent to CRL in June 2016. As mentioned previously, most of the cargo on *Brother Jonathan* was going to Portland, Oregon, a town which needed manufactured tools and hardware for building homes, businesses, furniture, and other necessities for survival. The items recovered from this crate, like the other, are the things a growing town would need. Locks and keys, tool handles, screws, tap and die sets, hammers, sledges, chisels, and packages of files would all be required for homes and shops. The conservation and study of these items will shed light on the needs and living conditions of settlers along the western coast after the Civil War, and act as a guide for the future conservation of historic artifacts of this type.

CHAPTER III

SHIPPING CRATES

First Shipping Crate

The first *Brother Jonathan* crate was sent from the Institute of Western Maritime Archaeology to the Conservation Research Laboratory (CRL) at Texas A&M University in October 2000 for excavation and conservation by graduate student Carrie Sowden (2006). She and the staff at CRL set up a stainless steel storage tank with a hoist suspended over the crate to easily raise it out of the vat. There was open workspace around the four sides, and a continuous water flow over the crate to keep it from being damaged by air-drying. In addition, there was strong lighting for photographing and even a webcam recording the excavation process (Figure 1).

When not being worked on, the crate was submerged in the large stainless steel tank filled with 5% sodium sesquicarbonate in tap water solution to stop any further degradation of the metal artifacts. Four cargo straps were attached to a fiberglass grate which the crate rested on. The straps were hooked to an electric chain hoist installed onto an overhead beam. This allowed the conservator to raise and lower the crate out of the vat with ease. Once the grate with the crate on it cleared the top of the steel tank, two 2x4 beams were placed across the tank beneath the grate, then the grate was lowered onto the beams. The straps could then be unclipped from the hook and the beam raised out of the workspace. A pump system was connected to the vat and provided steady water flow for the crate while it was not submerged. Fluorescent lights and a white curtain were hung to provide an adequate backdrop for taking photographs. A webcam was installed on the end of a 2x4 (seen above and to the left of the vat in Figure 1) for the public to view the ongoing excavation which began in January 2001 (Sowden 2006:51-2).

Figure 1. First crate with steel container and hoist *Photographed by C. Sowden*

The first crate was originally constructed from juniper wood lined inside with sheet tin; the crate itself was badly degraded. Nothing remained of the tin lining besides the iron seams, and the original dimensions and orientation of the juniper walls could not be determined; once disassembly began, it became obvious that it was upside down and being excavated from the bottom down to the top, so the items were removed in the order in which they were originally packed (Sowden 2006:53-4).

Mostly architectural hardware and tools, along with some fur traps, meat grinders, and personal items, were recovered in such quantities that it was obvious that the crate was not intended for a single individual. Aside from the leather belts, all of the artifacts in the crate were listed in the 1865 *Illustrated Catalogue of American Hardware of the Russell and Erwin Manufacturing Company.* Sowden's (2006:155-7) research led to the conclusion that the items were ordered from the catalogue by a general store in a small town; Russell and Erwin had a warehouse in San Francisco at the time that would have packed and shipped the crate. The actual destination of the crate is unknown because cargo records from *Brother Jonathan* are not available and the great earthquake and fire of 1906 destroyed the Russell and Erwin warehouse and records.

The contents of the box were all everyday use items that would have been needed in a town of any size, but their numbers and variety imply they were headed to a general store which served a well-established population. Some of the pocket door and shutter finishing hardware were luxury items for a home of some affluence while the rest of the hardware was very basic. Fur trapping would have been done in the wilderness, not in a large city. The knife sheaths and belts would be worn by lower class working men, and the tools were common and found in many households (Sowden 2006:155-7).

Second Shipping Crate

The second of the two *Brother Jonathan* shipping crates received by the Conservation Research Laboratory at Texas A&M University was sent in June of 2016. The same workspace setup used by Sowden (2006:51-2) was redeployed for the work on this crate (Figure 2). The only differences were that there was no white backdrop curtain and the webcam was not active. There was also no water pump; the conservator remoistened the crate with solution from the vat by hand with a pitcher. The goal was to fully excavate and document the crate and its packing order, identify the objects inside and evaluate their condition, make a plan for conservation of the contents, and compare the findings to the first crate. Due to the lengthy nature of conservation, most of the items were not conserved by the author, but were identified, photographed, x-rayed, and placed in separate containers of 5% sodium sesquicarbonate and tap water to halt degradation and allow for future conservation. Only the hammerheads, wood tool handles, and hammers were fully conserved.

The crate itself was constructed from five solid lengths of unidentified wood. The front and back sides were nailed directly to the bottom piece; the two shorter sides on each end were positioned on top of the bottom plank and nailed to the front and back sides. The interior of the walls and bottom were lined with packing paper, and some form of grass or hay (referred to from this point as dunnage) was packed between the layers of items and filled open spaces. The items packed last in the top layers were removed first. The following is a description of the excavation of the contents in reverse packing order (not removal and numbering order) and the status of the artifacts.

Excavation Approach

The second crate's field designation with Deep Sea Research, Inc. was 97-0042, but was re-christened as BJ2-100 at CRL. From this point, the artifacts will be referred to by number without the BJ2 prefix. A small, lidded plastic container of unprovenanced tool handles came along with the crate; their original designations also derived from 97-0042. Although likely, it is unknown if they came from the crate, and were designated 101.1 through 101.6. Because there were other loose tool handles and other items still on top of the crate, 101.1-101.6 were considered separate and not included in this analysis. All of the packages in the crate were wrapped in paper and secured with twine or string; the individual items were not wrapped at all.

The sides of the crate were designated as 102 with decimals identifying each individual plank. The side of the crate closest to the conservator when originally hoisted out of the tank was assigned as the front and given the number 102.1, then the numbering ascended clockwise; left side as 102.2, rear 102.3, right 102.4, and bottom 102.5. The fiberglass grate could be rotated as needed to allow for access to the back side of the crate, but the orientation remained the same. Artifacts were numbered in the order in which they were removed. Loose items on top were not secure and had moved around too much for their original packing location to be determined with certainty; these were considered one group and numbered 103.1-103.6. The rest of the items were assigned whole numbers with decimals added to packages to differentiate their various parts. For instance, the first package contained screws. The entire package is 104, the twine around it is 104.1, the paper wrapping is 104.2, and the screws are 104.3.

This crate was not excavated upside down like the first crate was, and its lid had completed eroded away. This exposed the top layer of its contents and those packages experienced the most degradation. Two of these packages, 106 and 107, both contained door locks and keys; two keys and one shattered door lock were amongst the loose items floating around on top of the crate. It can be assumed that these came from either 106 or 107. An attempt was made to clean the concretion from the sides of the crate to determine the dimensions of the box, but it soon became clear that the wood was too badly compromised for that analysis. Excavation was attempted in a top-down fashion beginning in the front left corner of the crate, but this proved to be difficult and possibly harmful to the packages. Therefore, the sides were removed from the crate with an electric saw as work progressed. The artifacts were still mostly removed from the top down and clockwise from the front left corner, but exceptions were made as required. A ten-inch stainless steel lab spatula with a spoon end and flat round end was the main tool used in this excavation (Figure 3), but a common trowel proved useful as well.

Figure 2. Conservator removing final package at the workstation

Figure 3. Lab spoon/spatula used for excavation

Contents in Reverse Packing Order

DOOR HARDWARE

One of the last items to be placed in the crate was Package 106 which contained three sets of upright rim knob locks. Specifically "JANUS FACE, LIFT-LATCH, WITH CAM FASTENER. The Cam Fastener secures the latch bolt at pleasure, giving entire protection against opening of the door from outside (Russell and Erwin Manufacturing Company 1865:17)," item No. 900, Size 4¼ x 3¼ inches with two iron bolts and an iron key (with Mineral Knobs) in the catalogue. Though the top of the package was worn away and the locks were visible, the package was x-rayed for further identification, which showed the knobs. The locks were actually wrapped separately from the six knobs and placed on top of them. The six knobs indicate six sets of locks, but there was only one left intact in the package. Some disassembly of the package was performed to see the knob and lock types. They were cleaned with tap water and the package was reassembled.

Package 107 was a second set of door locks and keys of simpler design but did not have any knobs, although they were made for knobs and not just night latches. It is possible that some of the knobs in 106 were meant to be used with these locks as well. As with 106, this package was damaged due to its position on the top layer of items in the crate, and there were only two locks with one key each remaining. Package 107 was also x-rayed, disassembled, cleaned, and put back together for better identification, but no corresponding lock could be found in the Russell and Erwin catalogue.

The next package removed was a set of twelve door hinges. This package was so well-wrapped and in such good shape that it was only photographed and x-rayed. The x-rays easily identified the contents of package 108 that corresponded with its two neighboring packages of door locks, keys, and knobs. They are still awaiting conservation (See Appendix B & C).

WOODEN HANDLES

Handles meant for various tools were packed on the top layer and removed next. All of the handles were photographed, mechanically cleaned using tap water and dental tools. They were then rinsed in successive baths of deionized water and then dehydrated in solvent solution in order to be consolidated with silicone oil by Helen Dewolf at CRL (Dewolf 2017:412). These handles appear to be for screwdrivers, awls, and chisels found on page 216 of the catalogue (Russell and Erwin Manufacturing Company 1865) (See Appendix A).

METAL FILES, AWLS, AND CHISEL PACKAGES

Packages 118, 123, and 124 were all on the top layer of the crate. They were removed, photographed, and x-rayed for identification. Packages 118 and 124 are heavily damaged and the not much metal is left in the tools as indicated by the x-rays. Package 118 contained what appear to be half round chisels or gouges that could be used with the wooden handles (Russell and Erwin 1865:200). Package 123 is a large, much concreted package of steel files (Russell and Erwin 1865:167). The smallest package was the most corroded, but may be awls (Russell and Erwin (1865:210)(See Appendix B & C).

Dunnage was packed beneath all of the aforementioned items and removed prior to the excavation of the second layer which starts below.

RATCHET DRILL

A single metal tool was just below the package of chisels or gouges (118) under a layer of dunnage. At first, this cylindrical tool was not identifiable because it had come apart and there were missing elements. A ratcheting gear was obvious and x-rays revealed threading on the inside of the cylinder which had an opening at each end. Photographs and the x-rays were posted on CRL's Facebook page to enlist the help of the public in its identification, but there were no solid leads. After poring through the Russell and Erwin catalogue (1865:243) and other tool compendiums to find something similar, it was identified as a ratchet drill with no accompanying handle (Figure 4). Ratchet drills are used to drill holes in metal by hand (See Appendix B & C).

Figure 4. Blacksmith ratchet drill

HAMMERHEADS

Nine cast steel hammerheads and two hardies, all for blacksmithing, were removed from the second layer of items. Some of these were manufactured by a forerunner of blacksmith tool making in San Francisco—Nelson & Doble—and stamped with its insignia (San Francisco Journal of Commerce Publishing Company 1891:143). The others bore no insignia. The steel hammerheads were blacksmith sledges, fullers, and flatters of different weights and sizes that would be hafted to a handle; these are used to shape metal. Hardies are inserted into a hole in an anvil and used to cut and shape metal (Wood 1990:106). These were not found in the Russell and Erwin catalogue, so they were likely ordered from different manufacturers. Most were in good condition, but the hardies were badly deteriorated and some of the surface metal washed off every time they were rinsed.

All of the heads and hardies were conserved by John Hamilton at CRL using electrolytic reduction to remove the chlorides, coated with tannic acid, and placed in microcrystalline wax (Hamilton 1999:68-72)(See Appendix A).

HEADING TOOLS

Two tools not listed in the 1865 catalogue appear to be blacksmith heading tools. These are used for "finishing the shouldered ends formed on round bars" (Expert Blacksmith 1902:39). These tools are used and made by blacksmiths; the steel is forged into two rounded, enclosed ends and resembles an oversized box end wrench. This weakens the steel, especially at the ends where the most shaping is done; unlike the hammerheads and other solid metal objects, these two tools were heavily corroded and falling apart. They were photographed and x-rayed (See Appendix A).

CHISELS, PUNCHES, AND GOUGES

Packed on the same layer with the hammerheads were a set of eight one-piece solid steel blacksmith chisels and punches, and two gouges with wooden handles. Chisels, punches, and gouges are struck with a hammer to chisel, punch, and gouge hot metal (Expert Blacksmith 1902:29-34). For some reason, both of the gouges had corroded so badly that they were crumbling and were not hafted to their handles any longer. These were both cast with silicone rubber in situ as it was obvious they would just continue to fall apart when handled. A couple of the smaller, pointier chisel surfaces had softened and were leaving corrosion product everywhere. The others were pristine, however. These were not found in the catalogue, but illustrations of each are shown in *Old Tools and Locks, Keys, and Closures* by Jack Wood (1990:135). All were photographed, and x-rays showed that the chisels are still solid with a very thin layer of concretion (See Appendix A).

All of these blacksmith hand tools were packed on top of another layer of dunnage above the third and final layer of items in the crate.

AXE HANDLE

One wooden axe handle with no corresponding head was packed in the box. This was removed easily and in perfect condition. Photographs were taken and it was left in sodium sesquicarbonate. This axe handle looks identical to ones pulled from the first crate and labeled in the Russell and Erwin catalogue as "Polished, Hickory Broad Axe Handle" (1865:215)(See Appendix A).

HAMMERS

Five complete hammers—one sledge, one claw, and three ball peen—rested on the bottom of the crate between the final four packages. With the exception of the sledge, all of the hammer faces had deteriorated moderately and were soft to the touch. The sledge's girth kept it in fine condition. The full conservation of these is outlined in a later chapter. Hammers are listed on pages 236-239 of the Russell and

Erwin catalogue (1865), but an imprint reading "EUREKA TOOL Co CAST STEEL" found on ball peen hammer 147 may point to another source. Unfortunately, no information on this specific manufacturer was found (Figures 6 – 11).

COE'S PATENT WRENCH PACKAGE

The only tool in the crate that was wrapped was a Coe's patent wrench is depicted under the blacksmiths' and machinists' tools section of the Russell and Erwin catalogue (1865:241). This is a screw wrench made in a factory; a nut on the threaded stem of the wrench is twisted to move the bottom jaw up and down to clamp down on nuts (Salaman 1990:530). It was assumed to be another hammer, but x-rays proved it was a wrench; even the style of wrench is evident. Its size and the weight of the objects on top of it caused it to crack at the handle. It was left wrapped after being photographed and x-rayed (See Appendix B & C).

STOCKS AND DIES WITH TAPS PACKAGES

Two large packages of iron stocks and dies with taps were packed at the front of the crate with the smaller one on top. These implements are used in threading bolts and nuts. Taps are threaded bolts that cut threads in a nut, and dies are threaded holes that thread the bolts. Stocks clamp the dies and taps between two handles that are rotated to form the threads (Salaman 1990:449). These were wrapped in paper and string like all of the packages. Some of the paper had worn away, revealing the taps. This is how these packages were recognized as stocks, dies, and taps. Still, x-rays were performed to evaluate the condition of the items inside. Both sets are in good shape, but one of the taps is missing from the larger set which was labeled as having six taps. They are both found in the Russell and Erwin catalogue (1865:244) and were left intact after being pictured and x-rayed (See Appendix B & C).

SCREWS PACKAGE

After the front board of the crate (102.1) was removed, the first package stood out plainly at the front left bottom corner of the box. Nothing had been placed on top of it besides dunnage. Though it sat on the bottom of the crate, this package—104—was the first extraction as it was not concreted to anything else around it. Twine secured the neatly folded paper package which had to be x-rayed prior to opening to determine if opening the package was a worthwhile task or if the package should be conserved as a whole. X-ray images showed that it contained 1¼ inch screws, some of which seemed to be intact. The package was carefully opened where the twine was already broken. The paper was surprisingly supple and did not break apart. Unfortunately, the screws were mostly broken and no metal remained; all that was left were concretion molds of the screws. A couple of these were complete, however, so these were simply consolidated with three thin coats of Krylon Clear Acrylic 1301 (Hamilton 1999:13). Very similar screws are sold from the Russell and Erwin Manufacturing Catalogue, listed as #11 patent gimlet wood screws (1865:127). The tips of the screws were all present, 100 total. Iron corrosion from the screws had leached into the paper package; it was reassembled without the contents, sewn up in mesh box and placed in 5% sodium sesquicarbonate to remove the chlorides and keep it from deteriorating further (See Appendix B & C).

STOCKS AND DIES WITH TAPS LABEL

When the screw package (104) was removed, it revealed a paper label on the larger tap and die set. The first package had been protecting this label, so it was numbered as 105 and removed. Using a cotton swab and tap water, the label was carefully cleaned of sludge caused by the wet dunnage and corrosion products from the surrounding artifacts. It read: “JM KING & Co. No. 9, …ight Hand, 6 Tap..” (Figure 5). Damage obscured the rest. This also identified the package that the label was attached to, which was also located in the Russel and Erwin catalogue (1865:244); No. 9 1¼ inch to ½ inch Right Hand , with 6 Taps and 3 Sets of Dies. The catalogue does not identify the stocks and dies as JM King, however. Photographs were taken of the label and it was left in deionized water.

Figure 5. Stocks and dies label 105

AUGERS BITS

The final package removed from the crate, and possibly the first one packed in it, was a large paper-wrapped set of iron auger bits positioned at the very back right corner. Again, x-rays alone shed light on what was within this package. Auger bits are drill bits made for boring holes, usually in wood, by hand. The bits seemed to be individually wrapped in the larger package which had one open end. They were packed so that the tangs, where the handle fits to the bit, were facing the opening (Salaman 1990:31). Therefore, these were badly deteriorated. They vary in size and similar boring implements are listed on page 194 of the Russell and

Erwin catalogue (1865). The package was undisturbed after photos and x-rays were taken (See Appendix B & C).

Status of the Artifacts

As mentioned previously, only the hammerheads and hardies, wooden handles from the top layer, and complete hammers were conserved in full. The rest of the artifacts were identified, photographed, x-rayed, and left to soak in 5% sodium sesquicarbonate in tap water. Conservation will be continued by students at CRL.

The Two Shipping Crates

Construction and packing method of the two crates differ. Sowden's (2006:54) crate was large with soldered tin lining the interior while the second crate was simply nailed together at the ends and had a paper lining. Pine needles and wood chips were used as packing material for the first crate (Sowden 2006:69), but grass or hay acted as dunnage between the layers of the second crate. Packages in both were wrapped in paper and tied with string (Sowden 2006:56). The first crate contained hardware, tools, and personal items in numbers that implied it was heading to a general store in a small town with a varied population, and all of the items aside from the leather belts were ordered out of the Russell and Erwin Manufacturing Company catalogue of 1865. While the contents of the second crate were similar—hardware and tools—their quantities do not point to delivery at a general store. Indeed, there is one set of hammerheads, one set of auger bits, one package of screws, etc. This smaller crate appears to have been intended for one person, household, or business. Since most of the tools were intended for a blacksmith, it could be that this person was opening or already running a smithy. If it was going to a general store, then it was ordered specialty by the store for an individual. The woodworking tools, axe handle, screws, and door hardware were all everyday use items. All of the hardware and some of the tools were found in the Russell and Erwin catalogue, but most of the blacksmithing tools were manufactured by different sources. Perhaps all of the items for this crate came from a large general store in San Francisco that carried multiple different manufacturers' wares. Both Russell and Erwin and Nelson & Doble had warehouses in San Francisco, so this is not a stretch. As with the first crate, the actual origin and destination are unknown as the records are no longer available.

On its own, the first crate highlights the industrial prowess of the New England coast and its exchange of material goods based on the needs of the burgeoning west coast. The shift of people and manufacturers to the west coast is embodied in *Brother Jonathan's* history and the crates. The analysis of both crates shows just how far that shift had come. General stores and individuals were ordering hardware and tools from San Francisco where these goods were now starting to be manufactured due to the growing demand and population. The northwest had become so well-established that there were general stores that served these fairly young townships, and manufacturers in California—rather than New England—

were now the ones supplying those stores and the population they served (Sowden 2006:158).

CHAPTER IV

CONSERVATION OF WATERLOGGED MATERIAL

Wood

Wooden artifacts that have been submerged in water for long periods of time will experience degradation of cell walls due to bacteria. Degradation occurs as the bonding materials like starch and sugars are leached away from the wood. Eventually even the cellulose and lignin can collapse as water replaces them. As the structural components of the wood are filled with water, the shape of the wood is maintained; however, the wood will become more porous as it is filled with water. Because of the way water is absorbed into wood, the artifact must remain wet. If it were to be removed from a marine environment and left to air dry, the wood would shrink and warp because the surface tension increases as water evaporates, causing the already unstable cell walls to collapse. Therefore, the water that maintains the original shape of the wood must be either replaced by an agent that will also hold that shape or removed by a process that eliminates the surface tension. Once the artifact has been treated with this type of material, the excess water must be removed or replaced in a manner that will not damage the wood through shrinkage or warping. Some of the common treatments are: polyethylene glycol (PEG), freeze-drying, sucrose (sugar), and acetone-rosin. Factors in determining which method to use can include: storage in a harsh environment; desired flexibility, degree of shrinkage, color, grain; whether the artifact is a composite with metal; condition of the wood; and the reversibility of the treatment method. A variety of treatments available should help in avoiding any problems with conserving waterlogged wood.

Waterlogged wood can be stabilized for many years if treated with the right method and stored in the appropriate environmental conditions. These wooden artifacts are a rare resource for museums and archives, and must therefore be analyzed as completely as possible, then conserved. However, the archaeologists will find that the methods of excavation in marine or wet environments and preservation of the artifacts cost much more in comparison to methods used during and after a terrestrial excavation. There is also a greater risk that these efforts will be in vain and the method chosen to conserve the wood is a failure. Previous projects in conserving waterlogged wood revealed the necessity to analyze samples of the wood before deciding on a method of conservation. Expediency is key when excavating, sampling, and treating artifacts from waterlogged sites. As a result, the services of a specialist in waterlogged wood is advised early on in the planning of the initial excavation (English Heritage 2010:3).

Because it is expensive to conserve waterlogged wood, it is recommended that the type of wood is determined, as well as the way the timber was sawn. Hardwoods, like oak, are much more tight-grained than softwoods such as pine. This means that these woods experience different levels of moisture absorption and loss, and therefore different levels of shrinkage. These factors can be crucial in determining a method for conservation. Flat-sawn planks are more likely to warp whereas quarter-sawn planks are not. In some cases, if the wood type and cut are more susceptible to degradation, no method of conservation will prove successful and the artifact will not last. This can be an expensive and time consuming failure, which is why it is best to determine these factors and whether or not conservation is even advisable (Hamilton 1999:22-3).

Although more costly than dry excavations, wet sites that have not seen much environmental fluctuation are more likely to produce wood that has been better preserved than what might be found at a site on land. This is because the wood has not been subjected to sunlight, oxygen, or high or fluctuating temperatures, and may even have been covered by protective silts. Artifacts from dry sites can generally be simply bagged and tagged for short-term storage, but waterlogged wood must be stored in much the same condition from which it was retrieved. This means that the artifacts are placed in bags or other containers where the air can be replaced with water, treated with an anti-fungal agent such as sodium borate, and then stored in a cool, damp, and lightless environment to prevent further damage (Werz and Seemann 1993:37).

Wood Degradation

Wood in marine or wet sites experiences bacterial degradation to its cellular structure. Sugars, salts, starches, and other water soluble materials are the first to be replaced with the water soaking into the wood. Later, the cellulose degrades; eventually even the cellular lignin begins to succumb. The cellular structure is permeated with water that now preserves the original shape of the wood with help from the remaining lignin. Now the wood is even more porous, with a much higher percentage of water, even though the volume of the artifact has not changed substantially. However, if the wood is removed from the water, the water will begin to evaporate; since the water is holding the wood's shape, the wood will warp and shrink. The percentage of water and amount of degradation in the wood are factors in the level of shrinkage. In some cases, it is justified to determine the percentage of water by taking a small sample of the wood and weighing it, then placing it in an oven at approximately 100º C until the wood is dry. The new weight, the oven-dry weight, is subtracted from the original weight, and the difference is the weight of the water. The percentage can be determined with the equation (Babinski, Izdebska-Mucha, and Waliszewska 2014:374):

$$\text{\% of water} = \frac{\text{weight of wet wood} - \text{weight of oven-dry wood}}{\text{weight of oven-dry wood}} \times 100$$

Woods are classified based on the water percentage: Class I contain 400% or more, Class II 185-400%, and Class III are less than 185%. At more than 200% water, Class I and II woods are considered degraded (Grattan 1987:67).

Preliminary Cleaning

Before any conservation method can be started with wood retrieved from saltwater environments, the soluble salts and surface dirt must be removed. This can be achieved through successive baths of water. The chloride levels in the baths can be tested with a conductivity meter in order to determine when to move on to the next bath. Hopefully the artifact is being stored in 100% saltwater like the environment it came from; it can then be submerged in a bath of 75% saltwater and 25% freshwater (or tap water) and allowed to soak until the chloride levels stabilize. The artifact would then be moved to a 50/50 mixture, then 25% saltwater, and finally 100% freshwater. The next baths will be mixtures of freshwater and deionized water ordered in the same manner until the artifact is soaking in 100% deionized water, at which time the conductivity meter should prove the absence of soluble salts. This process can be followed for supercritical wood artifacts but the usual practice but the usual practice is to go directly from seawater to tap water until the bulk of soluble salts are removed. Then one or two baths of deionized water is used as a final rinse.

The surface dirt can be gently brushed off with fingers, soft brushes, or other tools that would not inflict damage. It should also be noted that if the wood has been exposed to iron, sulfur from saltwater will react with the iron compounds and form blooms or crystals of sulfuric acid. This can be avoided through the use of chelating agents like ammonium citrate or ethylene-diamine tetra acetic acid (EDTA) which removes the iron compounds; the former is most commonly used. Caution should be exercised if the artifact is composed of both wood and iron as it can damage the iron (Pele, et al 2015:156).

Polyethylene Glycol Method (PEG)

The conservation of waterlogged wood includes two main steps: expulsion of water and the addition of a bulking agent. The bulking agent will be replacing the water, thus stabilizing the structure of the wood. Depending on the conservation method, these two steps may occur separately or simultaneously. When using polyethylene glycol (PEG), these two steps are usually simultaneous. PEG is a synthetic bulking agent that comes in a variety of molecular weights, low (300) to high (6000). The lower the weight, the lower the viscosity; PEG 300 is a liquid while the texture of PEG 6000 is similar to a hard wax. The higher weight PEGs have larger molecules, and will have more trouble permeating dense woods, but they are also less hygroscopic—they will be less likely to absorb moisture from the air in the storage environment. PEG is corrosive to all metals and cannot be used on any composite artifacts or be exposed to metals and the process can take decades for very large objects (like entire ships); even so, it has proved to be a reliable and relatively inexpensive method. It is soluble in both water and alcohols. Water—along with a fungicide like boric acid—is used as a solution when treating larger pieces due to its being considerably less expensive than alcohols. A water solution will produce heavier and darker wood. If the budget allows for it, alcohols are a better choice as they cut down on conservation time and do not require an additional fungicide. The results are also lighter in weight and color; these effects can be furthered by soaking the wood in successive baths of an increasing percentage of ethanol, 10 – 100%, which wicks out the excess water prior to treatment. The downsides to using alcohols are cost and the danger in heating flammable alcohols, and the treated wood undergoes more shrinkage (Parrent 1983:27-9).

There are multiple ways to impregnate waterlogged wood with PEG. Gregory (2012:S141) describes a one-step method starting with a 10% solution of higher weight PEG (1500+) and water that gradually increases (in increments of 5% over days or even weeks) to as high a percentage PEG as possible; the solution must be heated to no more than 60ºC once it has reached 50%. It is best to keep the solution liquid by heating until the item is removed so that the excess PEG can be more easily rinsed off with hot water. This method works well with Class I and II woods. The wood is malleable during conservation, can be glued after conservation, and the process is reversible. However, the solution must not be heated over 60ºC or the wood will be damaged; this means close observation. The two-step method begins with bulking the cell walls with a lower weight PEG (200-600) at 10% solution with an alcohol. The percentage should be gradually increased as described in the one-step process to 40%. The artifact should then be moved to a 50% solution of PEG (2000-3250) and alcohol; the percentage of PEG should be increased incrementally up to 100%, stabilizing the cell structure. Once the piece is removed from the solution, the excess PEG can be wiped off with rags damp with the alcohol used as solvent (usually ethanol). This works best on Class III woods in which the heartwood is not as badly degraded—this is because the lower weight PEG is able to penetrate the cell walls of the denser material. The problems with using low weight PEG are that it is quite hygroscopic and a liquid at room temperature. These two factors contribute to a sticky texture and the downward settling of the PEG. After PEG treatment, the artifact can be freeze-dried if desired.

Freeze-Drying Method

For given artifacts, freeze-drying is another option depending on the size of the available freeze-dryer. Pre-treatment with at least 20% PEG is recommended because it strengthens the wood for the freeze-drying process and eliminates fungal agents. Twenty percent PEG 400 is most commonly for Class III woods. PEG 400 is the standard for pre-treatment since it prevents the formation of large ice crystals and it provides a degree of pliability to the conserved wood. A mixture of 10% PEG 400 and 15% PEG 3250 works better for Class II woods; the PEG 3250 can be increased to 25% for Class I woods. The addition of the higher molecular weight PEG provides more rigid support. The PEG solutions generally start at 5%, working their way up to the desired percentages. The second step is to freeze the wood. For small artifacts, flash freezing in a vat of acetone and dry ice can be used. If these materials are not available, a simple frost-free freezer, like those found in homes, can be used; the artifacts are placed in the freezer on a raised wire mesh which allows for more uniform freezing. Once the wood is frozen—by either dry ice or domestic freezer—it is moved to a freeze-drying chamber at -32ºC to -40ºC. Once the wood temperature reaches -20ºC, a vacuum is applied (Grattan 1982:127).

During this freeze-drying process, the water is frozen and then expelled through sublimation, which means the ice crystals change from a solid straight to a vapor, and refreezes elsewhere in the chamber. This prevents the warping that might be caused by normal evaporation. Freeze-drying chambers are extremely expensive and this factor usually limits the size of the artifact to be conserved using this method. Most laboratories' freeze-dryers range up to 2x4 feet, but they can be as large as 40x8 feet like the one at CRL. A less expensive alternative would be the use of a domestic freezer for the entire process, but this method can take months to completely dry the artifacts. Freeze-drying can also be used without pre-treatment with PEG in order to simply dry out the wood, but this is more likely to cause cracking (Parrent 1983:116-7).

Sucrose Method

Using 99% pure sucrose—refined white sugar—in a solution with water is the least expensive method available to the conservator. It can result in a washed-out color and minute cracks, but is comparable to the PEG method. The object is first placed in a 15% sucrose solution; the percentage is increased in increments of fifteen each week until as close to 100% is reached. It is be easier to dissolve the sugar if the solution remains heated in a storage oven. Sucrose is quite effective, but will begin to absorb the water vapor in the air in the long-term; it is possible that the water vapor is absorbed and evaporates again when environmental conditions change, which could be damaging. This method also makes the treated wood inflexible (Parrent 1983:116-7).

Recent studies have been conducted showing that two analogues of sucrose, sucralose and trehalose, can be used as substitutes with the potential to avoid the hydrolytic effects seen in sucrose. As with sucrose, the trehalose solution begins at 15% and is raised incrementally up to 100%. In some cases, the higher concentrate performs better than sucrose as a bulking agent that prevents shrinkage; however, it does have a tendency to brown the wood and leave crystal blooms on the surface. Sucralose becomes saturated past 60% solution, so it performs better at lower concentrations. It does not prevent shrinkage as well as sucrose or trehalose, but it still prevents a great deal of the shrinkage and distortion seen in untreated wood and can potentially last longer than sucrose (Kennedy and Pennington 2014:197).

Acetone-Rosin Method

For well-preserved hardwoods, like oak, that have not degraded much, using lower molecular weight acetone-rosin is a viable alternative for PEG that would not be able to permeate this type of wood given the PEG's larger molecular structure. The first step in this case is to remove all of the water from the artifact. Rosin is not soluble in water, so the water must be expelled before treatment. To do this, the artifact must be soaked in three successive baths of 100% acetone. It is best for the artifact to remain in each bath for several days in order to ensure that all of the water is replaced with the acetone. Technical grade colophony rosin at 67% solution with acetone is fully saturated; this is what is used for the second step to bulk the wood. Rather than increasing the rosin's percentage incrementally as in other methods, the artifact should be sealed in a container with the saturated 67% solution and be controlled at a constant 52ºC.

This solution will form a thick layer of the rosin at the bottom of the container, so the artifact should be suspended above this layer. This excess is needed to be sure the solution reaches 67% even after the acetone from the first step has leached out into the mixture. The artifact can absorb up to half of the rosin in the solution which ends up evenly distributed within the wood, imbuing strength throughout the cellular structure. After approximately a week, depending on its size, the artifact can be removed and the surplus rosin can be cleaned off with lint-free rags and acetone. They may then be left to air dry for a week—under observation—to allow the acetone to evaporate; the entire process takes approximately six weeks, depending on the size of the artifact. This process typically produces good results and will usually darken the wood. The result should be a wood that more closely looks and feels the way it did in its original state (McKerrell, Roger and Varsanyi 1972:119-24).

Although acetone-rosin is a preferred method for treating sound hardwoods, it should be noted that it performs just as well with other types of wood, including composite artifacts—it is the preferred methods for treating wood/metal artifacts. When this method was being tested by Dr. Hugh McKerrell (1972:119-24), he measured the artifacts for shrinkage for months after treatment and saw no changes. The samples were also subjected to daily cycles of widely varying environmental conditions; one day the samples would be in a damp environment at 42ºC, the next day moved to a regular laboratory, and the next day a dry oven at 42ºC. Still, the conserved pieces showed no signs of shrinkage or physical change. One of acetone-rosin's main advantages is that it is not hygroscopic like PEG. The drawbacks to this method are in the cost of the two main materials and the flammability of acetone. The expense usually limits the size of the conserved material. Hydrochloric acid is a hazardous solution that should be used with the caution in the lab; safety garments are definitely required when handling it. Rosin treated wood is also rigid and inflexible.

Silicone Oil Method

Silicone oil can be used as a bulking agent with all types of waterlogged wood as well as most other organic materials. The silicone polymers displace the water and air that have occupied the wood and work with a crosslinker to fortify the wood cell carbonols. Once this is accomplished, the bulking is stabilized with a catalyst (Dewolf and Hamilton 2004:2). Proper dehydration before stabilization with the silicone oil is crucial for two reasons: first, silicone oil and water do not mix; second, the cells of waterlogged wood are fully supported by the water which is maintaining their diagnostic attributes. If improperly dried, the wood will lose its shape and durability. Therefore, water must first be displaced with organic solvents, then the silicone oil and crosslinker can be applied, followed by the catalyzation process which solidifies the bulking agent (Smith 2003:13). Successive baths of 50% deionized water and 50% ethanol, then 100% ethanol, then 100% acetone will sufficiently dehydrate the wood. The artifact can then be submerged in a solution of silicone oil and mix 4% crosslinking agent methyltrimethoxysilane (MTMS). The artifact can simply be left in the solution for a few days, or the immersed artifact can be placed under low vacuum for a day. Once this process is complete, the artifact can be wiped clean of excess silicone oil and placed in a sealed container with 10mL of dibutyltin diacetate (DBTDA) catalyst. The container should then be placed in a furnace and heated to 50°C so that the catalyst evaporates and sets the silicone oil. The DBTDA can be changed once a day until the silicone oil is sufficiently hardened (Dewolf and Hamilton 2004:2).

Waterlogged Char

There are circumstances in which an archaeologist might uncover burned wood, known as char, that has been waterlogged; if a ship caught fire before it sank or if a harbor burns down, for example. Due to the weak nature of charred wood, it is difficult to actually strengthen what is there. Extensive testing done by Caple and Murray (1994:32-6) has pointed to a few viable bulking agents that will replace the water without causing shrinking or warping. The char can be pre-treated in solutions of 5% PEG 400, 10% PEG 3250, or 25% glycerol. After the artifact has been saturated with one of these solutions, it is allowed to air dry over a long period of time. The small samples used by Caple and Murray (1994:32-6) were dried for forty days. While this drying process prevents deformation, it does not stabilize the char. The end results cannot subsequently be handled much. About the only way found to strengthen waterlogged char is with a mixture of a much higher percentage of PEGs 400 and 3250, but this might not prove enough for large pieces.

Preservation In Situ

Sometimes the excavation of the waterlogged wood from marine sites is not feasible financially—or even allowed, depending on the location. If the site is exposed on the seafloor, it is more likely to be attacked by teredo worms or other organisms, damaged by scour and currents, and will experience more rapid bacterial decay than a site covered with silt or sand. They are also more susceptible to treasure hunters and damage from other human activities. In these cases, it may be necessary to "preserve" the wood (and the rest of the site) in situ. In fact, UNESCO prefers that its shipwrecks and sites are protected where they lay. The site must first be surveyed fully to determine if the conditions will permit in situ preservation and obtain an estimation of the scope of such an endeavor. If the conditions of the sand and current are right, nets can be loosely draped over the entire site or plastic "kelp" planted around the site that will allow for the eventual formation of a seabed. These fixtures trap the sand in the water column, causing it to settle over the site in a mound. This has been tested on multiple shipwrecks, but requires further study. If the site is stable enough, sandbags can be placed on top of the exposed areas. This is not recommended in high currents as the nature of the labor poses a safety risk to divers. In the end, the fact remains that the wood will continue to deteriorate even covered with a protective layer. Any change in local environment will cause changes that introduce new agents of destruction; regardless of the in situ situation, deterioration processes of some sort continue (Gregory, Jensen and Strætkvern 2012:S145-7).

Conclusion

There are many different methods to conserve waterlogged woods, which is beneficial to the conservator given the wide range in characteristics and state of preservation of these woods. The most common methods currently being used are: polyethylene glycol (PEG), freeze-drying, sucrose (sugar), acetone-rosin, and silicone oil. Most of these conservation methods are invasive and can change the appearance of the wood, but the goal is to conserve these rare artifacts for as many years as possible so that others may study and learn from them, and these methods are quite reliable in achieving this goal. Factors in determining which method to use can include: whether the artifact is softwood or hardwood, how it was sawn, the ability to be stored in a harsh environment after treatment, desired flexibility, color, grain, whether the artifact is a composite with metal, condition of the wood, and the reversibility of the treatment method.

For example, although PEG is highly hygroscopic, which prevents a big problem, it is low cost and reversible; the PEG treated wood can be re-treated if necessary. In all stages of conservation, it is important to take the measurements and weights of the artifacts in order to chronicle the levels of shrinkage, loss of moisture, and density loss or gain when using specific methods on specific types and cuts of wood. These efforts will contribute to the knowledge already compiled on the subject of treating waterlogged wood, and will allow better planning for future projects, which will end up saving time and money on an already extensive and expensive project.

Metals

With any archaeological metal, it is necessary take the preliminary steps of documentation, pre-treatment storage, mechanical cleaning, and evaluation. Then the treatment shall be implemented, followed by the rinsing, drying, sealing, storage, and occasional inspection of the artifact. Some of the methods for treatment include: galvanic cleaning, electrolytic reduction, and chemical rinses and treatments. The conservation treatments specific to iron and some non-ferrous metals will be covered. While this chapter focuses on a brief review of alternative techniques of conservation of archaeological materials recovered from marine environments, it should be noted that any of the methods of conservation mentioned can be used on metals recovered from terrestrial environments as well; the only difference is that removal of chlorides and encrustations would not be necessary.

When tasked with the conservation of metal archaeological artifacts from any site, it is prudent to fully analyze the artifact and maintain detailed documentation on each step that will be taken. Before treatment can begin, the conservator must take measurements, visual inspection, photographs, x-rays, and any other analytical and diagnostic information obtainable. One of the main differences when dealing with artifacts from a marine site is the storage after excavation. Artifacts from terrestrial excavations can typically be placed in a plastic bag and put on a shelf, but waterlogged material must remain wet until conservation efforts can be made. This means that any metals recovered from marine sites must be placed in a container in which the oxygen can be replaced with water (Hamilton 1999:44-6).

Preliminary Cleaning

When metals are deposited at marine sites, the corrosion elements form hard encrustations around them. Once the artifact is ready for treatment, the first step is the removal of these hard deposits. Though seemingly crude, the best way to do this is manually with tools, like a hammer and chisel. If it is known what type of metal is encrusted, use a chisel that is softer than that type of metal to avoid damaging it. Many different tools can be used, as long as the wielder is cautious in their implementation. Smaller tools should be used for smaller artifacts. A solution of 5% hydrochloric acid has proven effective in dissolving encrustations in a bronze canon bore where leverage for mechanical cleaning with tools could not be easily gained, but it does create a safety hazard. After the acid was drained out, a copper rod was used to chip out what was left (Keith, Carlin and De Bry 1997:151).

Another option in removing encrustation from more fragile objects, like the pewter plates from *La Belle*, is electrolysis. Actually, it is a safe and reliable practice for any metal. This involves suspending the metal in a mixture of water and an electrolytic chemical—Carlin and Keith (1997:69) used 3% soda ash (sodium carbonate) and 1.5% ethylene diamine tetra-acetic acid. Hamilton (1999:58) recommends 2-5% sodium hydroxide or 5-10% sodium carbonate. It is connected to the negative terminal of a DC power supply as the cathode and is surrounded by an anode material, usually mild mesh steel, that is connected to the positive terminal of the DC power supply in a non-conductive container. When the power supply is turned on, the result is electrolytic reduction and the cleaning of the artifact. Upon removal of the encrustations, the artifact should again be analyzed and recorded in order to determine what course of conservation action to take.

Electrolytic Reduction

For waterlogged metal artifacts from marine sites, it is vital that the chloride be removed in order to halt or even reverse the further corrosion of the artifact. This can be done using electrolytic reduction as described for preliminary cleaning. This technique uses a non-conductive vat made of caustic and acid-resistant plastic—such as polyethylene—containing the anode (positive terminal), cathode (artifact/negative terminal), and conductive electrolyte solution. This setup is referred to as the electrolytic cell. An external source of direct current power is supplied to the electrolytic cell to create oxidation and reduction. Once this electric current is applied, anions, particles, and electrons are attracted to the positively charged anode; this is where oxidation and the evolution of oxygen occur and how the chlorides are drawn from the artifact. The current also attracts positively charged ions to the artifact which is acting as the cathode, or negative terminal. This causes hydrogen to evolve and reduction to occur. Electrolytic reduction has the potential to reduce the corrosion compounds in the artifact back to a metallic state; this means that this technique can remove chlorides and consolidate the corrosion (Hamilton 1999:49-50).

After Treatment

Once conservation treatment has concluded, all metals can be rinsed thoroughly in heated deionized water. With iron, once the rinsing is finished, it is best to paint artifacts with 20% tannic acid in deionized water to convert the iron surfaces to ferric tannate which makes them more corrosion resistant. It also gives artifacts an appealing, uniform, black color. To consolidate both ferrous and non-ferrous metals, the final step of consolidation with microcrystalline wax is recommended. The amount of needed wax is placed in a metal container that can be heated to 150°C; it is then melted and the artifacts are immersed in the wax. The melting point of the wax is approximately 82ºC; any lower and the wax will solidify around the object, and higher temperatures can potentially melt your artifact or start a fire. The level of consolidation can be told through the bubbles coming from the object; once they stop, the wax has penetrated it. The temperature of the wax upon removal of the artifact must be monitored because too high a temperature will cause the wax to simply roll off of the object, and too low a temperature will leave a thick layer of wax. Generally, the wax is cooled to 93-98°C before removal of the artifact to allow a coat of wax to remain on the surface. Iron is not a stable metal; it does not occur naturally as a solid and will constantly corrode if exposed to air and water, so the vapor impervious wax prevents this.

It is imperative that metal artifacts from a marine site be stored in optimum conditions in order to forestall retreatment. Storage and display in a relative humidity level below 70% (ideally 65%) should help prevent all metal artifacts from continuing to corrode. However, artifacts are still going to be exposed to sodium chloride, soot, dust, and other atmospheric pollutants, regardless of how well a building or storage container is sealed. Therefore, conserved artifacts must be inspected periodically for stability and to determine if retreatment is necessary (Hamilton 1999:68-72).

Conclusion

Though there are added steps to conserving metals excavated from a marine environment in comparison to a terrestrial site, the basics of mechanical cleaning, treatment, documentation, and analyzation remain the same. It is still important to evaluate the artifacts at each step of the process in order to determine what step to take next. The main difference can be seen in the concretions and encrustations that have formed around the metals from a marine environment. The most often used method for conserving any archaeological metal is through electrolytic reduction. This has proven to be one of the least expensive, most effective, least hazardous (to the conservator), and least damaging choice for all waterlogged metals. It is not always available to every laboratory, however, so some alternatives have been provided: sodium chloride for iron, alkaline dithionite for cupreous and silver metals, and anodic stripping for lead and lead alloys.

Composites

When faced with the conservation of composite artifacts comprised of more than one material such as wood and iron, one must consider which treatment of each type of material would be best for each material without damaging the other materials; for example, PEG works well with wood but can be damaging to metal. Disassembly of the artifact has the potential to be permanently destructive, so it is not always a viable option; reassembly is not guaranteed, especially if the dimensions of each piece of the artifact are altered during the conservation process. Proper assessment and care are essential in forming a plan for conservation with composite artifacts (Cox 2008:9).

The conservation methods discussed in this chapter could have been used on the items recovered from the second shipping crate from *Brother Jonathan.* However, for the complete hammers the simplest techniques such as silicone oil for two of the hammers; a combination of electrolysis, PEG 200, and freeze-drying;

and acetone-rosin for two hammers were used. These methods of conservation are detailed in the next chapter.

CHAPTER V

CONSERVATION OF *Brother Jonathan's* HAMMERS

Pre-conservation Steps

Five hammers from *Brother Jonathan* shipping crate number two were conserved fully by the author and her peers. Four different methods were used on the five hammers: acetone-rosin, silicone oil, polyethylene glycol, and electrolysis. Pre-conservation photographs and x-rays were recorded for each hammer. In order to preserve diagnostic elements in case damage occurred during treatment, measurements and molds were taken of all the hammers beforehand. Weights, lengths, and thickness of heads and handles were recorded on clear sheets of Mylar plastic on which outlines of the hammers had been traced in pencil. Post conservation photos were taken and figures displaying each method are provided below.

In order to provide protection and to preserve stamps struck into the heads, silicone rubber molds of the hammers' heads were made by first forming a clay base around each head. Because the hammers had not yet been conserved, the handles had to be kept wet with soaked paper towels wrapped in plastic wrap. The hammers were mechanically cleaned of corrosion and debris with tap water, baking soda, pumice, scalpels, dental tools, and brushes. A thin platform of clay was rolled out and the head was turned on its side and gently pressed into it. Additional clay was carefully built up along the bottom half so that it is even with the midpoint of the head, then straightened as much as possible to form a good flash line for casting. Wooden dowels were used to press the clay evenly against the side of the head in order to keep the two halves of the mold flush. Then a clay dam was formed around the entire head, leaving a short distance between the head and dam wall where the silicone rubber was to be poured. Small divots were made with a dowel in a few places around the head for the silicone rubber to create keys that would aid in putting the two halves of the mold together.

An appropriate amount of Mold Max 10 silicone rubber and its catalyst were mixed at 10:1 ratio by weight and placed under a vacuum until all the bubbles collapse out of the mixture, eliminating their threat to the accuracy of the mold. The mixture was steadily poured into one spot inside the clay dam to ensure all the available space was filled and no bubbles formed; this was allowed to set for 24 hours. After the rubber cured, the mold was turned over and the base clay platform was removed without dislodging the head from the silicone rubber. A clay wall was then built around the first half of the mold to enclose the head for the second half of the mold. Vaseline in methylene chloride was painted on the already dried silicone rubber so the second half would not adhere to the first. More silicone rubber was mixed, added, and allowed to set, and then the clay and hammer were removed from the two halves of the mold.

Plaster casts were created in the molds to test their quality and clean the debris left behind by the hammers. Epoxy resin and 11% catalyst by weight were mixed and used to form final molds of all of the hammers' heads (Hamilton 1999:89).

Mercuric nitrate tests showed that chloride levels were nominal, about 10ppm, because the crate had been sitting in 5% sodium sesquicarbonate and tap water for over a decade—the chloride level were within acceptable levels. Still, the hammers were all left in deionized water for a few days to expunge as much remaining chloride as possible. Dehydration was accomplished through successive solvent baths: 50% ethanol and 50% water, used alcohol, 100% ethanol, and two baths of 100% acetone. Each bath took two to four days. This was also done in preparation for treatments using a solvent.

Sledge 143 and Ball Peen 153

The wooden handles of sledge hammer (143) and one of the ball peen hammers (153)(Figure 6) were both consolidated with acetone-rosin leaving the heads in place. Separately, both hammers were placed in two tall, cylindrical containers of 67% saturated acetone-rosin that was then covered in plastic wrap and placed in the furnace to keep the rosin in solution at 52°C. The handles were too long to be suspended in the solution, so they were flipped over after at least once a week to assure that the hammers would consolidate evenly. Upon removal, acetone soaked towels were used to remove excess rosin and photographs were taken.

Both hammers' dimensions did not change, they still felt solid. The ball peen is much lighter weight than the sledge, but was made that way. Each head's steel came out black and show no signs of rust or discoloration (Figure 7). The handles remained dark, but it is unknown if they were that way already. Initially, the ball peen hammer fared well and the head was no longer flaking or deteriorating, but there is not oxidation. The wood color had darkened a bit during treatment, but it still looked natural. Shiny spots were left on both the head and the handle, but it was not unsightly. After two years, however, the head appears to have continued to crack and crumble. It is possible that the acetone-rosin should have been allowed to process for a longer than three weeks to better permeate the steel. The sledge hammer was unintentionally processed in the mixture for over a year and was only flipped over one time after a couple of weeks. This left the hammer fully consolidated, but much darker in color at the base of the handle near the head due to the layer of rosin at the bottom of the container becoming thicker over time. There is zero flaking on the sledge head, and the wood is smooth and dark, but natural looking. It should be noted that the sledge was in much better shape than the ball peen at excavation. Acetone-rosin is one of the best methods for conserving composite artifacts because it is not likely to damage either the wood or metal, it is a simple process, and relatively inexpensive as far as conservation methods go (McKerrell, Roger and Varsanyi 1972:119-24).

Figure 6. 153 Before conservation

Figure 7. 153 After conservation

Ball Peen 147 and Claw 148

Silicone oil treatment was chosen for ball peen hammer 147 (Figure 8) and claw hammer 148. Consolidation was conducted separately in plastic sleeves cut to fit the hammers. These were filled with silicone oil and 4% methyltrimethoxysilane (MTMS) crosslinker, along with the hammers, and sealed with binder clips. One week later, the hammers were removed and wiped down with rags. Each hammer was placed in a fresh plastic sleeve with a small container of dibutyltin diacetate (DBTDA) catalyst and placed in the furnace at 35ºC for two days; the catalyst was changed three times during these two days. Excess silicone oil was removed with a dry paper towel.

The hammers feel light and sturdy, no loss of heft or bulk was experienced. The wood color on both is dark, but the wood species and original color are not known (Figure 9). Rust and discoloration are evident on the steel heads because the silicone oil prevents the use of tannic acid which would have obscured these and also further protected the metal. After two years, these two hammers have started to deteriorate. The handles are still in excellent shape, smooth and dark and natural. More rust has formed on the heads, however, and they have begun to flake; the handles are shrinking away from the heads.

Figure 8. 147 Before conservation

Figure 9. 147 After conservation

Ball Peen 152

For the final ball peen hammer (Figure 10), the head and handle were separated and conserved using two different methods. The wooden handle was pre-treated with polyethylene glycol (PEG) 200 and then freeze-dried. The steel head was treated by electrolytic reduction (ER) followed by rinsing, tannic acid, and a sealant of microcrystalline wax. At first the head could not be removed from the haft without damaging the hammer, so a container was fashioned for the handle out of a plastic sleeve and zip-ties and filled with a 15% solution of PEG 200 where it sat for a week. Care was taken to keep the head out of the PEG so that the metal would not be harmed. After this treatment, the entire hammer was put in the freeze-dryer. The temperature and vacuum settings were increased on a schedule every two days for two weeks (Grattan 1982:127). Freeze-drying allowed the wood to shrink so the head could be removed and set up in ER at a low current setting in 2% sodium hydroxide electrolyte for two weeks, then current was raised to a medium-high level for a few hours. Next, the head was cleaned with deionized water and brushes, and given two hot water baths. It was then dipped in three coats of tannic acid and consolidated with microcrystalline wax. The head was reattached to the handle with no issues (Hamilton 1999:68-72).

Of all the treatments, the results seen here were the best. The wood seems to have dried more fully and lightened up (although none of the wood species are known), and the head looks and feels much more stable than the others. Weight was added to the head from the microcrystalline wax, but it proved beneficial over time. After two years, there is no further deterioration to any part of the hammer. This looks like a hammer one would buy at a store today (Figure 11).

Figure 10. 152 Before conservation

Figure 11. 152 After conservation

Conclusions

With composite artifacts like these hammers, a plan must be made that is beneficial to each material without damaging the other. While all of these methods have been proven to work for years, not every artifact will fare well with each treatment. For the purposes of the hammers, those conducted with ball peen hammer 152 were most certainly the most beneficial and successful. The hammers treated with silicone oil and acetone-rosin may have needed to be consolidated for a longer time to see better corrosion protection. Analysis of sledge hammer 143 after a couple of years will help confirm this conclusion since it was in acetone-rosin for many months. A retreatment of these hammers using the same method for a longer period is recommended to stop their deterioration and test this hypothesis. For future treatment of a steel hammer with wooden handles, consideration should be given to freeze-drying of the handle before attempting to treat the head. The freeze-drying should shrink the handle so the head can be removed and treated separately.

CHAPTER VI

CONCLUSIONS

Brother Jonathan spent a year traveling from New York to Panama, then six years on the San Francisco, California to Nicaragua, and eight years going from San Francisco to British Columbia carrying cargo and passengers from the east to the west coast during the American Gold Rush. The steamer met its tragic fate in 1865 and now rests on the seafloor just outside of Crescent City, California. With the discovery of the shipwreck and recovery of some its goods comes enlightenment. This ship and its cargo crates that were recovered personify the shift of population, products, and industry from New England to California and the northwest. The growing western territories had demands that New England industrial manufacturers happily provided, and once the west flourished, these companies expanded westward as well. The Russell and Erwin Manufacturing Company started in Connecticut and were leaders of tool and hardware manufacturing, and continued to open warehouses across the country as it expanded; San Francisco was one of these locales. The items contained in the two crates entrusted to the Conservation Research Laboratory at Texas A&M University identify the demands of the western frontier. People need tools for building homes and businesses as well as everyday use, finishing hardware for doors and windows in the construction of homes, and blacksmith tools for forging metal for further industrial purposes.

The items in first crate excavated and conserved by Sowden (2006:158) were all purchased in multiples out of a catalogue from the Russell and Erwin Company from 1865 and were most likely packed and shipped from the manufacturer's San Francisco warehouse. The range of products and their quantities—along with the known route of *Brother Jonathan*—lead to the conclusion that this crate was bound for a general store in a growing, though clearly already established, town of a diverse population. The second crate, on the other hand, was filled with one set of blacksmithing tools and a few packages of hardware. It seems to have been intended for one customer. Some of the hardware and tools were also found in the Russell and Erwin hardware catalogue, but there were various other manufacturers' marks found on some of the tools. This box may have been ordered by an individual or small smithy from another general store in San Francisco that was able to provide all the goods that obviously were not available locally. Although thorough research was conducted, the specifics are unknown. Who originally packed and shipped both of these crates and where they were headed remains a mystery. In fact, these crates could have been unloaded at any stop and continued inland to any destination. Tools and hardware are needed in any town, small or large; but an educated and researched hypothesis has been presented.

Some of *Brother Jonathan's* history and artifacts have been preserved for the future to study and learn from with the research and conservation work done on these two shipping crates. Further study is always bound to yield more evidence to form progressively accurate hypotheses. As the opening and conservation of the individual parcels of tools proceeds, a complete item count and inventory will be completed.

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APPENDIX A

LIST OF CONTENTS

103 – Loose items in crate (2 keys, iron fragment, 2 wooden handles)
104 – First package (screws)
105 – Paper label on ninth package (stock and dies with taps)
106 – Second package (door locks and knobs with keys)
107 – Third package (door locks and keys)
108 – Fourth package (door hinges)
109 – Wooden tool handle
110 – Steel hammerhead
111 – Wooden tool handle
112 – Wooden tool handle
113 – Wooden tool handle
114 – Wooden tool handle
115 – Unknown item/scrap
116 – Steel chisel
117 – Wooden tool handle
118 – Fifth package (files or chisels)
119 – Steel hammerhead
120 – Ratchet drill
121 – Metal scrap
122 – Steel chisel
123 – Sixth package (large files)
124 – Seventh package (awls)
125 – Steel chisel
126 – Steel heading tool
127 – Steel hammerhead
128 – Steel hammerhead
129 – Steel hammerhead
130 – Steel hammerhead
131 – Steel hammerhead
132 – Steel hammerhead
133 – Steel hardy
134 – Steel hardy
135 – Steel hammerhead
136 – Steel heading tool
137 – Steel chisel
138 – Steel chisel
139 – Steel chisel
140 – Steel chisel
141 – Steel chisel
142 – Steel gouge

143 – Sledge-style steel hammer with wooden handle
144 – Steel gouge
145 – Unknown item, heavily damaged
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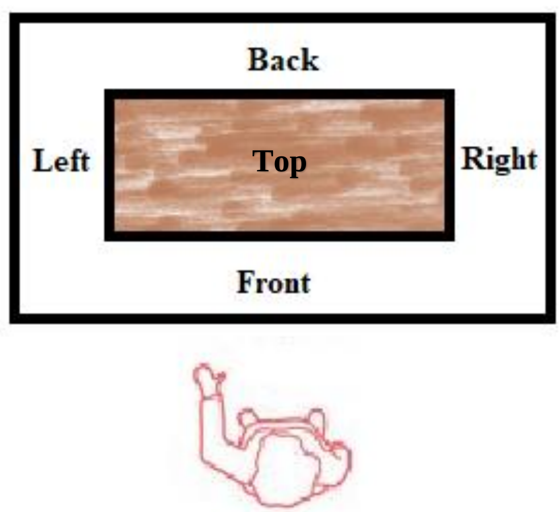
151 – Tenth package (wrench)
152 – Ball-peen style steel hammer with wooden handle
153 – Ball-peen style steel hammer with wooden handle
154 – Eleventh package (auger bits)

APPENDIX B

EXCAVATION TIMELINE

The following photographs give a chronological timeline of the excavation of the second *Brother Jonathan* shipping crate. For the most part, excavation was performed top-down and clockwise, starting at the "front left" corner of the crate from the view point of the conservator. Exceptions were made for stubborn packages or as dictated by common sense and overall ease of extracting the packed parcels in the most expeditious manner. Below is a diagram showing the original orientation of the crate on the workstation.



Left

Front

Back

Right

As received – Loose items removed after photograph taken. Top view.

All photography by K. Dollarhide

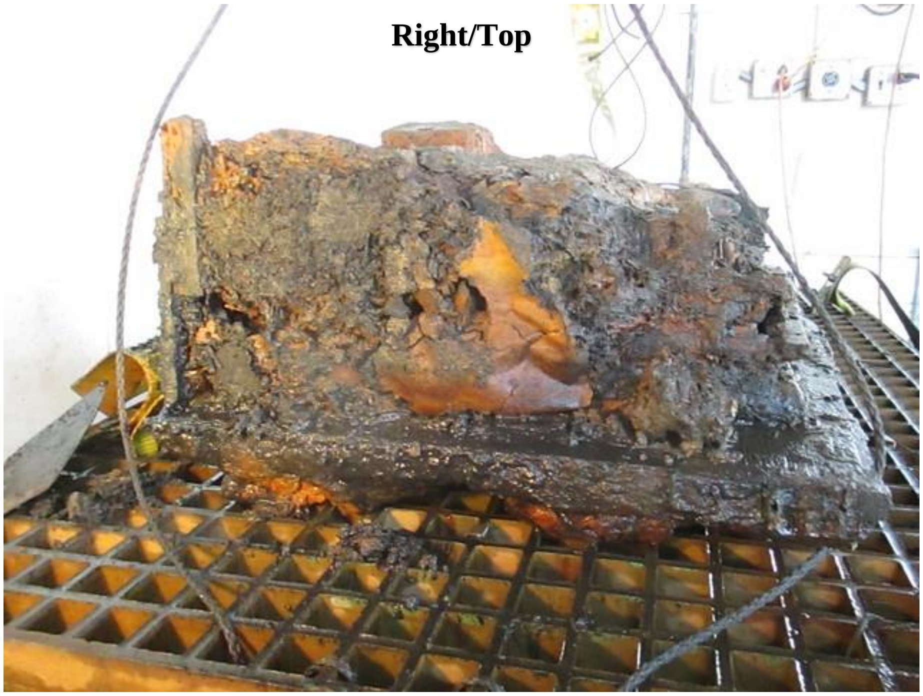
Top

Left

Right

Front

Removal of front side of crate for easier access. First package (screws) 104 seen on far left side. Front side view.



Removal of first package (screws) 104 and second wall of crate – paper lining the interior of the crate remained attached to the grass used as dunnage. Left side view.

Top

Back

Front

Left

Removal of excess dunnage. Left side view.

Second package (door locks and knobs) 106. Back left view.

Removal of second package (door locks and knobs) 106. Back left view.

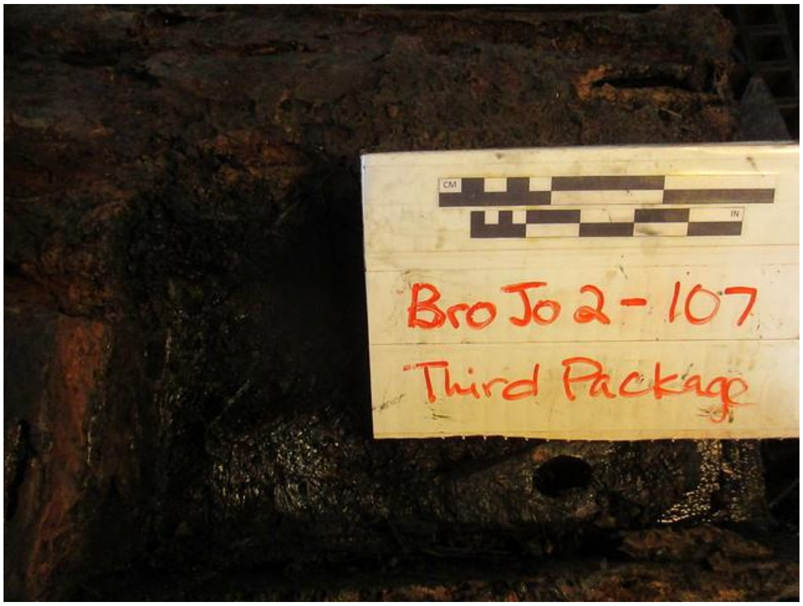
Back

Left

Right

Front Third package (door locks) 107. Top view.

Right



Left

Removal of third package (door locks) 107 and dunnage beneath. Top view.

Right/Top

Back

Front

Fourth package (hinges) 108. Left side view.

Left

Right

Removal of fourth package (hinges) 108. Front view.

Front

Right

Left

Back

Left

Right

Removal of one wooden handle (109) and one hammerhead (110). Top view.

Back/Top

Left

Right

Wooden handles 111-114. Front view.

Left

Right

Removal of wooden handles 111-114. Front view.

Front

Right

Left

Back

Chisel 116. Top view.

Left

Right

Front

Wooden handle 117. Top view.

Right/Top

Back

Front

Left

Removal of chisel 116 and wooden handle 117. Left side view.

Right/Top

Back

Front

Left Fifth package (files or chisels) 118. Left side view.

Back

Front

Right

Removal of fifth package (files or chisels) 118. Top view.

Back

Left

Right

Hammerhead 119. Top view.

Front

Back

Right

Ratchet drill 120. Top view.

Right/Top

Back

Front

Chisel 122. Left side view.

Left

Right

Removal of the hammerhead 119, ratchet drill 120, and chisel 122. Top view.

Front

Right

Left

Back

Sixth package (files) 123. Top view

Back

Front

Right

Seventh package (awls) 124 – numbered incorrectly in image. Top view.

Left

Right

Front

Chisel 125. Front view.

Back

Left

Right

Removal of sixth package (files) 123, seventh package (awls) 124, and chisel 125.

Top view.

Back

Left

Right

Heading tool 126. Top view.

Left

Right

Front

Removal of heading tool 126. Top view.

Back

Left

Right

Hammerheads 127 and 128. Top view.

Back

Front

Left

Hammerhead 129. Top view.

Back

Left

Right

Hammerhead 130. Top view.

Left

Right

Front

Hammerhead 131. Top view.

Right

Back

Front

Hammerhead 132. Top view.

Left

Right

Front

Hardy 133. Top view.

Back

Left  **Right**

Hardy 134. Top view.

Left  **Right**

Front

Hammerhead 135. Top view.

Left

Front  **Back**

Removal of hammerheads and hardies 127-135. Right side view.

Back

Left

Right

Larger heading tool 136. Top view.

Back

Right

Left **Front**

Chisel 137. Top view.

Back

Right

Left

Front

Chisel 138. Top view.

Left

Right

Front

Chisel 139. Top view.

Right

Back

Front

Chisel 140 (to the left of chisel 139, back wall of crate). Top view.

Right

Left

Removal of larger heading tool 136 and chisels 137-140. Back view.

Front

Right

Left

Back

Chisel 141. Back view.

Right

Left

Back

Gouge 142. Top view.

Right/Top

Back

Front

Removal of chisel 141 and gouge 142. Left side view.

Left/Top

Front

Back

Hammer 143. Right side view.

Left

Right

Front

Removal of hammer 143. Top view.

Back

Left

Right

Gouge 144. Top view.

Left

Right

Front

Removal of gouge 144. Top view.

Left

Front

Back

Axe handle 146. Right side view.

Front

Back

Removal of axe handle 146. Right side view.

Left

Front

Back

Hammer 147. Top view.

Right

Left

Back

Removal of hammer 147. Top view.

Front

Right

Left

Hammer 148. Top view.

Front

Back

Right

Removal of hammer 148. Top view.

Back

Left

Right

Eighth package (stock and die with taps set) 149. Front view.

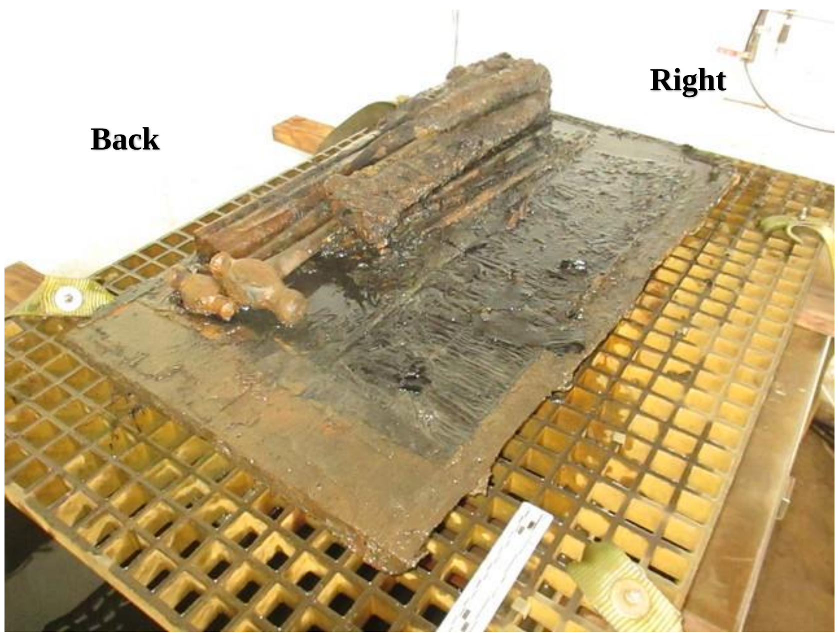
Right

Left

Front

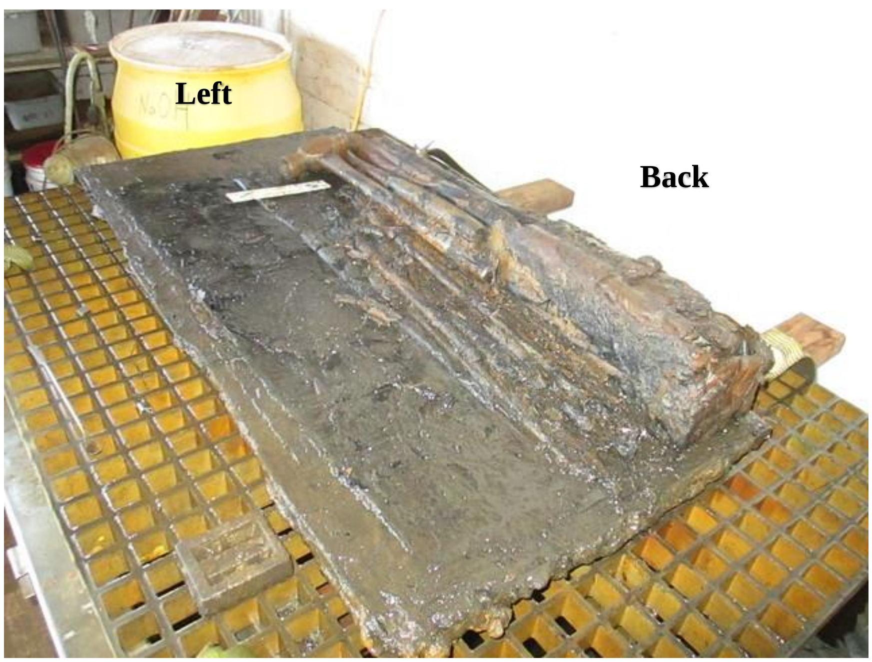
Removal of eighth package (stock and die with taps set) 149. Front view.

Ninth package (stock and die with taps set) 150. Front view.



Removal of ninth package (stock and die with taps set) 150. Front right view.

Tenth package (wrench) 151. Top view.



Removal of tenth package 151. Front right view.

Back

Left

Right

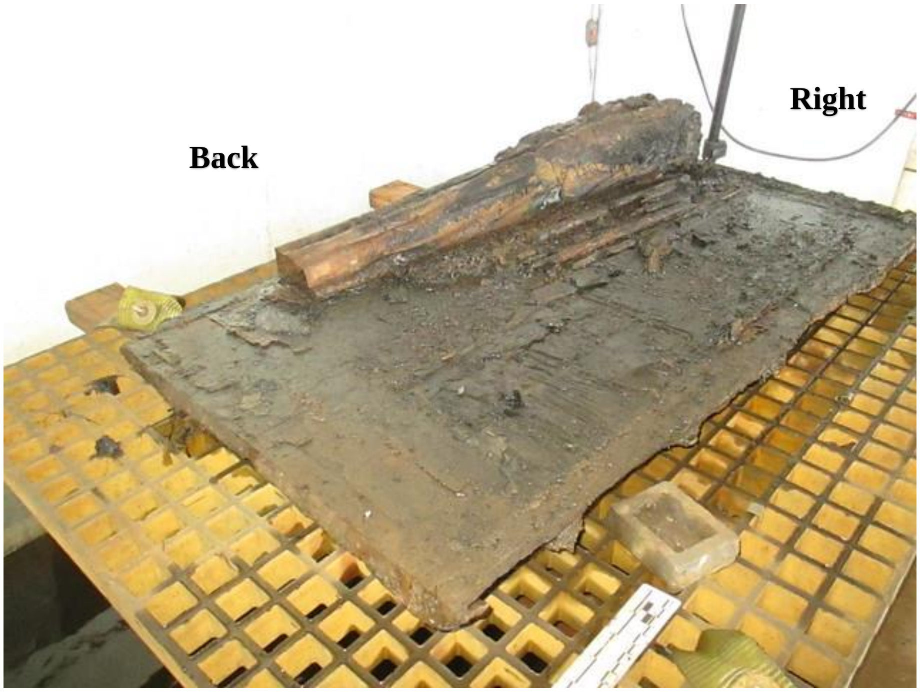
Hammer 152. Top view.

Back

Front

Left

Hammer 153. Left side view.



Removal of hammers 152 and 153. Front left view.

Left

Right

Eleventh package (auger bits) 154. Back view.

Back

Front

Removal of the final item – a momentous occasion at CRL. Left side view.

Back

Left

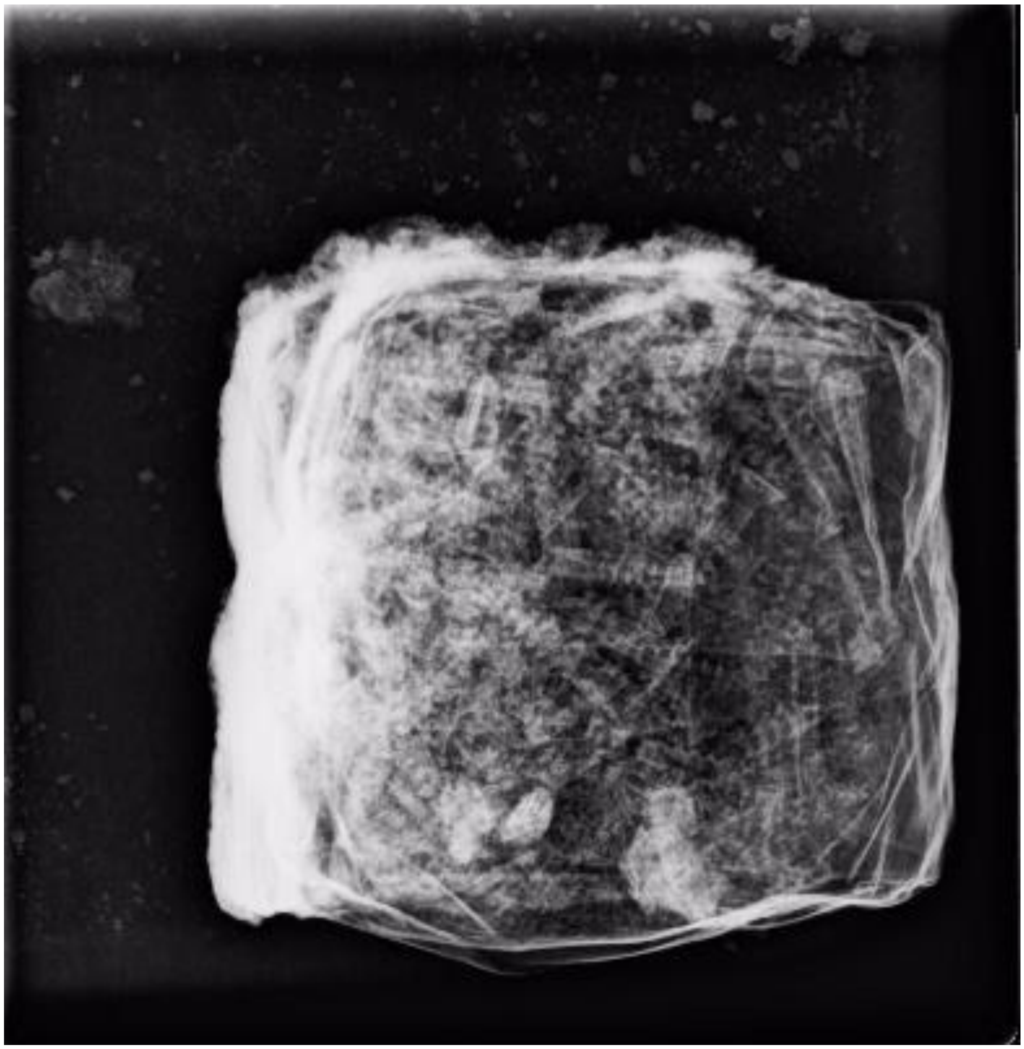
Right

Front

Empty crate bottom. Front view.

APPENDIX C

X-RAYS OF PACKAGES

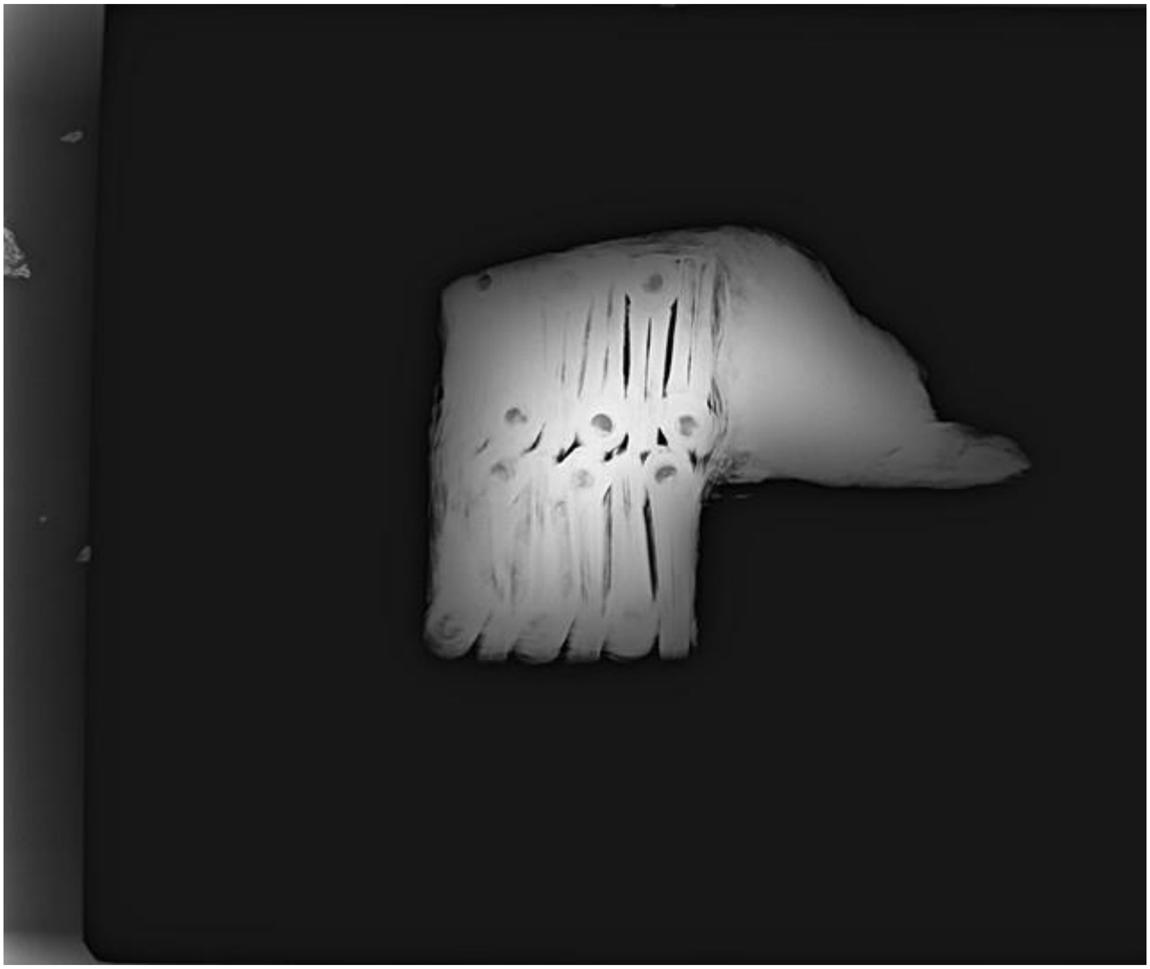


First package (screws) 104

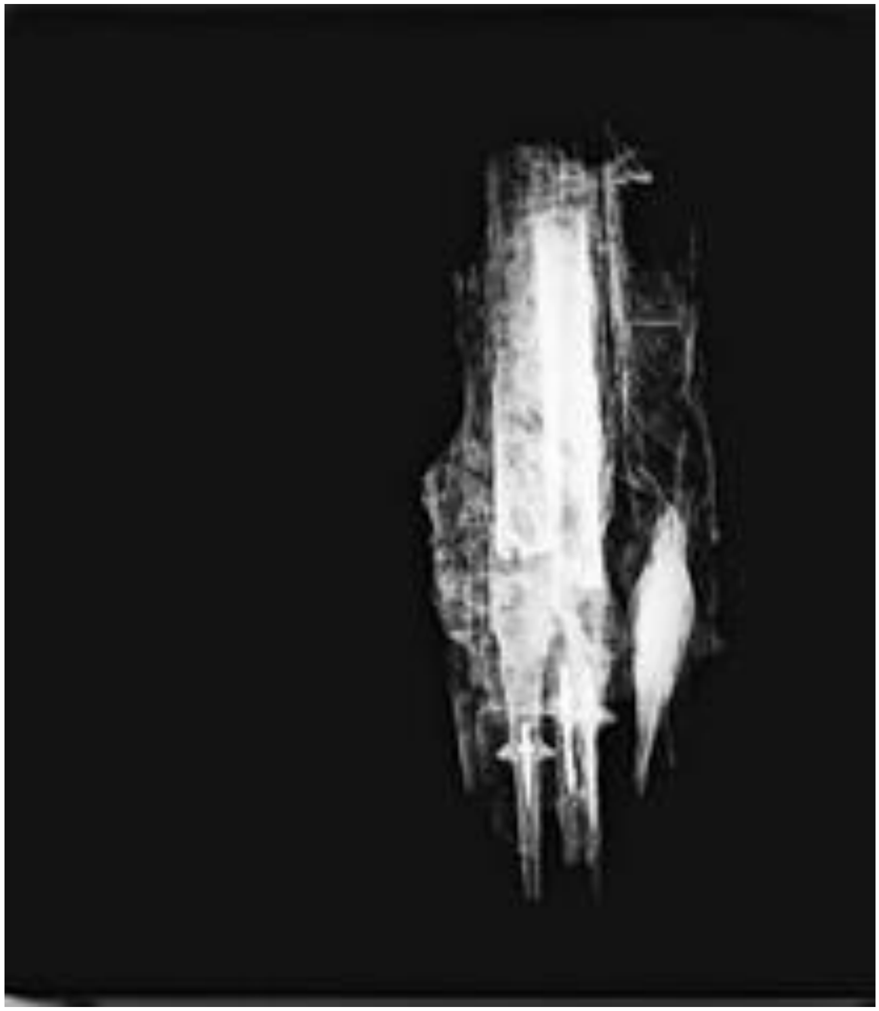
All x-rays by K. Dollarhide

Second package (door locks and knobs) 106

Third package (locks and keys) 107

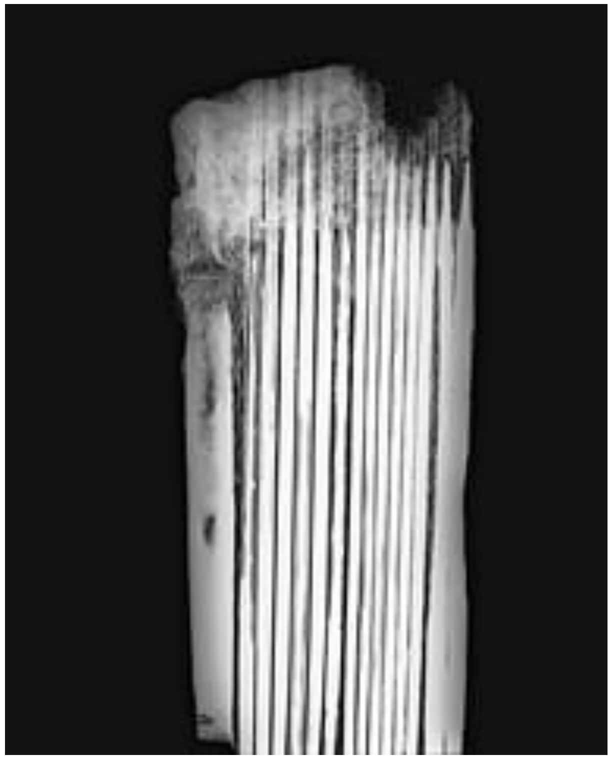


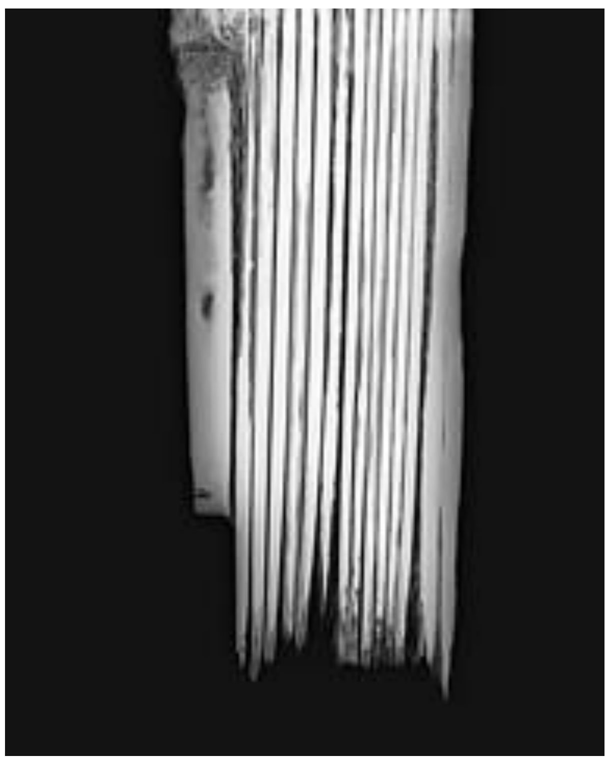
Fourth package (hinges) 108



Fifth package (files or chisels) 118

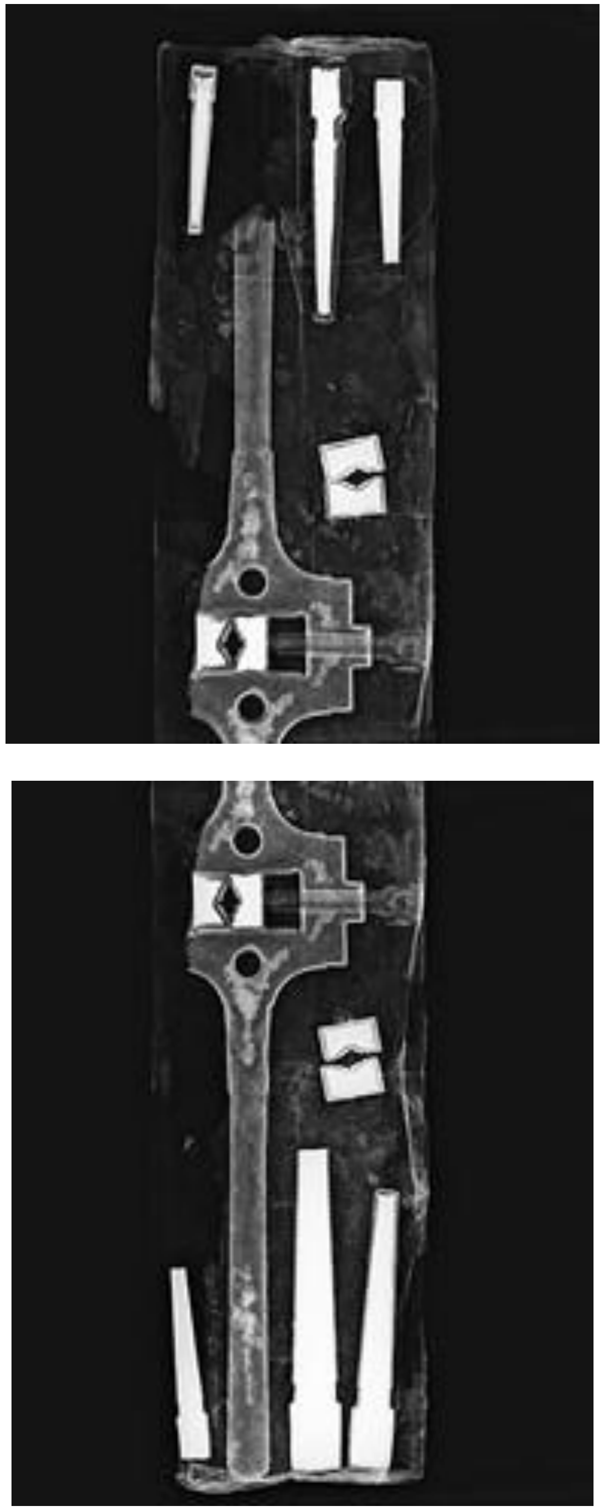
Ratchet drill 120



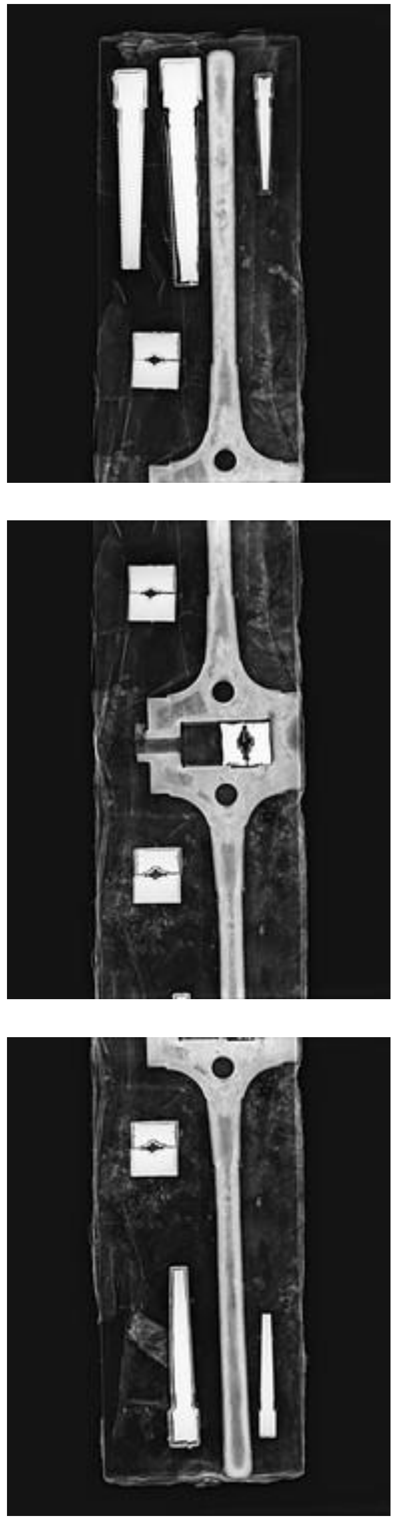


Sixth package (files) 123

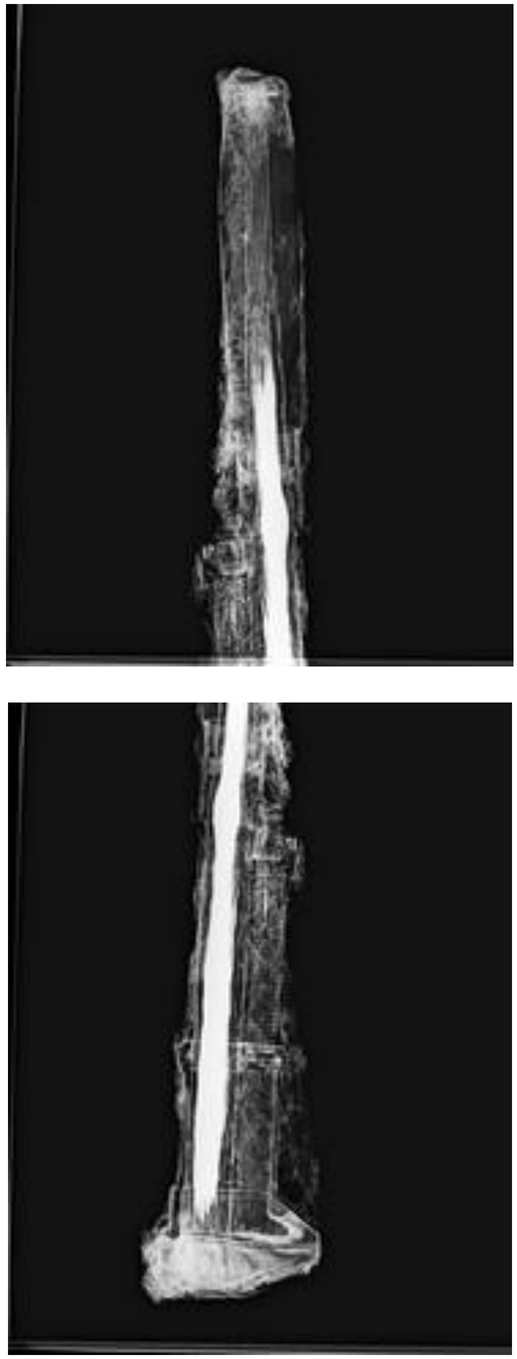
Seventh package (awls) 124



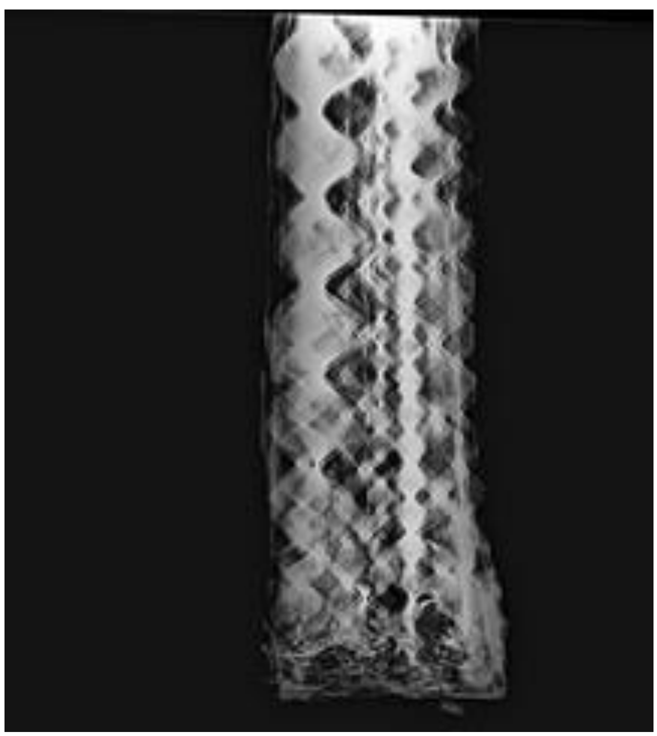
Eighth package (stock and die with taps set) 149



Ninth package (stock and die with taps set) 150



Tenth package (wrench) 151



Eleventh package (auger bits) 154