

Deirdre O'Regan SAILMAKING IN NINETEENTH CENTURY SOUTHERN NEW ENGLAND (Under the Direction of Dr. Timothy Runyan) Department of History, October 2001.

This thesis examines the issue of sailcloth supply in New England and discusses the “typical” sailmaker. American colonists sought to reduce their dependence on England and Europe by producing domestic sailcloth with varying levels of success. They succeeded in making cotton canvas of sufficient quality and quantity to meet the demands, just as the age of sail was coming to a close.

During the 1800s, the evolution of sailing ship design climaxed with the launch of extreme clipper ships in the 1850s. By the end of the Civil War, steam-powered vessels threatened commercial sail's economic viability and rendered sailing warships obsolete. With this transition came a reduced need for sailmakers, and their numbers dropped correspondingly.

The sailmaking industry has been somewhat neglected by studies in New England maritime history. Research on sailcloth production included a study of secondary sources regarding American manufacturing history and primary sources including the American State Papers and business records from southern New England sail lofts to determine how and who produced sailcloth. American cloth manufacturers and the United States government sought to improve the quality of domestic cloth to encourage use by mariners. This included the switch from flax linen to cotton canvas; it was not a smooth transition.

New England sailmakers have been studied sporadically, but as individuals, not as a group. This thesis examines and identifies individuals making up the profession through federal and state census records, city directories, and business records.

SAILMAKING IN NINETEENTH CENTURY SOUTHERN NEW ENGLAND

A Thesis

Presented to

The Faculty of the Maritime Studies Program

Department of History

East Carolina University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Arts in History

By

Deirdre O'Regan

October 2001

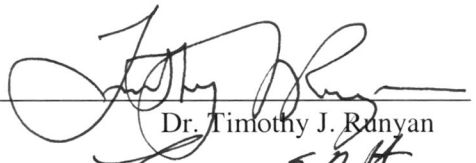
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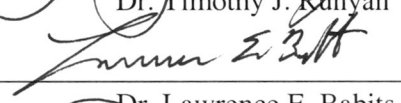
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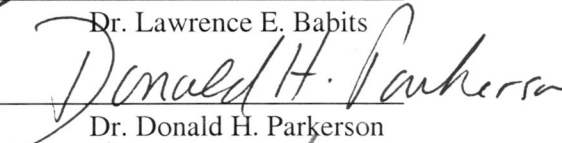
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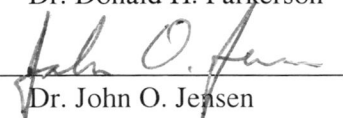
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Dr. Lawrence E. Babits

COMMITTEE MEMBER _____


Dr. Donald H. Parkerson

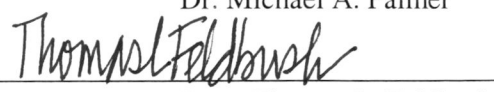
COMMITTEE MEMBER _____


Dr. John O. Jensen

CHAIR OF THE DEPARTMENT OF HISTORY _____


Dr. Michael A. Palmer

DEAN OF THE GRADUATE SCHOOL _____


Dean Thomas L. Feldbush

1-8-02

For Nat

ACKNOWLEDGEMENTS

Preparing this thesis was hardly a solitary effort. In this regard, I would like to thank several individuals and institutions that supported me. First, I would like to thank Nathaniel S. Wilson, sailmaker, for his inspiration, knowledge, access to his records, collections, and personal sailmaking tools, and his friendship. Researching sailmaking was his idea from the outset. I admire and respect his dedication to learning and retaining traditional sailmaking skills at the highest level for his entire career.

My research depended on the services and recommendations of several libraries and their staff, including East Carolina's Joyner Library, G. W. Blunt White Library at Mystic Seaport Museum, the New Bedford Whaling Museum Research Library, the New Bedford Free Public Library, the Newport Historical Association, the National Archives and Records Administration, Northeast Region in Waltham, Massachusetts, and Rhode Island State Archives and Public Records Administration, Providence, Rhode Island. In particular, I would like to thank Andy Price and Linda Hurteau, at the G. W. Blunt White Library, Mystic Seaport, for their patience and good humor over the course of months of retrieving manuscripts from their stacks. Also at Mystic, Library Director, Paul O'Pecko facilitated and approved the scanning of several documents for use as figures.

At East Carolina University, I am grateful to Dr. Timothy Runyan, my advisor, and my committee members Dr. Lawrence Babits and Dr. Donald Parkerson, for their advice on research techniques, thesis organization, and editing. Also, I thank Dr. John Jensen, my outside reader from the University of Connecticut for his efforts in getting me through the final draft and defense. In this regard, I extend tremendous thanks to my brother Richard O'Regan who spent a great deal of time editing every chapter. His advice and support were of more value than he may

realize. His contributions and ideas made me feel more confident and enthused in writing up the results of my research.

I would like to thank my family for their enduring support in everything I pursue. In particular, my brother-in-law Jeff Mase deserves special recognition for his financial assistance by suggesting and paying for my son's babysitter last summer so I could work. Finally, and most especially, I would like to thank my husband, Brian Andrews, and my son, Aidan Andrews, for their encouragement and patience through the long period of time that my thesis seemed to take over our lives.

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INTRODUCTION

As a young teenager, Henry Bull Almy left his parents' home in Newport, Rhode Island to move to nearby New Bedford. There, he began his apprenticeship as a sailmaker under the tutelage of his older brother, Job, and Job's partner Shipley Bumpus. In the 1850s, Henry Almy alternated between shoreside sailmaking and shipping out on merchant vessels plying the waters between New Bedford, New York, and the West Indies. During the Civil War, when many sail lofts closed down or reduced their crew size, Almy joined a group of New Bedford sailmakers traveling to Philadelphia to lend their skills to the war effort by making canvas army tents. Returning to New Bedford after the war, he re-established himself as a sailmaker, opening a sail loft in partnership with New Bedford neighbor Obed L. Hitch.

Henry Almy's story is neither remarkable, nor particularly noteworthy; rather, he represents the typical sailmaker working in southern New England during the nineteenth century. A New England native, he learned his trade by an apprenticeship obtained through family connections. While some sailmakers combined their talents and business acumen to build personal fortunes, most, like Almy, ventured out on their own, opening modest businesses after gaining training and experience at an established loft or from time served aboard ship. Almy did both.

In the nineteenth century, the age of sail came to an impressive climax mid-century, and then dwindled to a few select trades by 1900. Likewise, support industries with skilled professionals rose and fell with the demand. Sailmakers in nineteenth century New England, the center of shipbuilding and maritime trade since colonial times, found steady employment and opportunities to achieve a good standard of living for themselves and their families. By century's end, their numbers had dropped with the corresponding decline in the number of

sailing ships putting to sea from New England ports. As a group, sailmakers were getting older and some began to experience periods of unemployment. Others changed occupations entirely.

Sailmakers and their craft in southern New England have been, for the most part, left out of the studies most historians have conducted on shipping, ship construction, and general New England maritime history. This thesis examines both the nature of the industry during the nineteenth century, from sailcloth manufacturing to the evolution of sail design, and the sailmakers themselves. General histories of shipping, manufacturing, and material culture were investigated along with primary records from sailmakers and public records regarding both their professional and personal lives. From these sources, this study explains the issues of sailcloth supply in this country during the nineteenth century and describes sailmakers demographically. Later chapters also examine and explain basic sailmaking techniques and its material culture.

Why sailmaking? Wooden sailing ships carried explorers, immigrants, fishermen, and trade for hundreds of years. On their decks and in their holds, the isolated worlds became globally connected. Historians have meticulously studied ship construction techniques and materials, navigational tools, maritime economies and politics. Support industries, such as sailmaking, have been studied only superficially. The sails that propelled these ships called for trained craftsmen and designers to build them. The volume required was incalculable. A single frigate the size of the USS *Constitution* required a minimum of two full suits of sails, with each suit measuring $\frac{3}{4}$ of an acre of canvas. Ships required forests and acreage to supply them with timber for shipbuilding and flax, hemp, or cotton for their sails. Once shipowners obtained sailcloth, which was not necessarily an easy task in eighteenth and nineteenth century America, they needed skilled artisans to design and construct the sails.

The first reference to a sailmaker concerned Odysseus rebuilding his shipwrecked boat with the help of Calypso. Together, the two also made sails and cordage. According to Homer,

Calypso “brought him a web of cloth to make him sails; and these too he fashioned very skillfully.”¹ Over four thousand years ago, Egyptians used a simple square sail on their vessels as later did the Phoenicians. Greeks and Romans added a triangular topsail and the artemon. The Vikings made great strides in hull design as their vessels ventured across the North Atlantic and throughout Scandinavian waters, but they contributed little, if anything, to sail design. Twelfth century Arabs developed the fore-and-aft lateen sail in the Mediterranean.² Until the nineteenth century, ships required little in specialty design from their sailmakers. Most sails were used to catch the wind, propelling vessels in a downwind direction. Made primarily from flax linen, sails were billowy and porous. They most certainly needed strong cloth and quality craftsmanship to keep from blowing out in all but the worst weather.

Part of England’s motivation to establish North American colonies was to alleviate her dependence on the Baltic countries for timber and naval stores. Both a manufacturing state and a maritime world power, England had few raw materials and nearly no naval stores within her shores. North America provided both. In colonial New England, geography and business minded colonists led southern New Englanders to the sea for their livelihoods. Marine talent collected there to make it the top shipbuilding and merchant shipping region both before and after American independence. These pursuits demanded sails, and lots of them.

Sailmakers and sailcloth manufacturers, while neglected by most historians, were highly sought out by their contemporaries. They provided the sole means of propulsion for the nation’s merchant and military fleets. Making sails required years of experience and durable sailcloth that could perform in all kinds of weather and hard use. This study examines both sailcloth and

¹ Homer, quoted in Ernest A. Ratsey and W. H. de Fontaine, *Yacht Sails, Their Care and Handling*, rev. ed. (1948; reprint, New York: W. W. Norton and Company, Inc., 1957), 146.

² Edgar L. Bloomster, *Sailing and Small Craft Down the Ages* (Annapolis: United States Naval Institute, 1940), 249.

sailmakers in a century that witnessed the greatest development in the age of the sailing ship and its ultimate decline when steam propulsion and inland transportation rendered them unprofitable commercially and obsolete militarily. By the end of the century, only specialized trades, such as fishing and bulk cargoes, and yachting sustained the sailing ship, albeit in greatly decreased numbers. The demand for sailmaking dwindled as well.

CHAPTER 1 HISTORIOGRAPHY

Sailmaking, as an historical subject, has not been the topic of much inquiry — American sailmaking, even less. Perhaps as part of a larger compendium about maritime artisans and crafts, or a paragraph or chapter in an analysis of sailing ship rigs and rigging, sailmaking has been mentioned often but rarely is the focal point of its own study. For example, in Sam Svensson's book *Sails Through the Centuries*,¹ despite its title, the author used the word *sails* to mean *sailing ships* and traces the development of hull design, not sail design. In *Mystic Built: Ships and Shipyards of the Mystic River, Connecticut, 1784-1919*,² Bill Peterson included a discussion of sailmaking in his chapter, "Supporting Trades and Industries." Specifically, he used the Charles Mallory sail loft records to explain that facet of the maritime community. In fact, the examples of studies explicitly focused on sailmaking or sailmakers are so few, there is room to examine them briefly.

In 1937, James Franklin Briggs presented a paper to the Old Dartmouth Historical Society [Massachusetts] called "Sails and Sailmakers"³ in which he used the records of New Bedford sailmaker Simpson Hart as the basis of his overview of the profession. Briggs's paper's greatest value stems from his personal remembrances [no reference in it as to his age at the time] of ships and sailmakers during the time when they were still an active part of the commercial New Bedford maritime community. He offered anecdotes that could not have been quantified by accounting records or census data. He recalled knowing a man "who when he was an apprentice was not allowed at the table with the family [with whom he boarded]." He also discussed the

¹ Sam Svensson, *Sails Through the Centuries* (New York: The MacMillan Co., 1965).

² William N. Peterson *Mystic Built: Ships and Shipyards of the Mystic River, Connecticut, 1784-1919* (Mystic, CT: Mystic Seaport Museum, 1989).

³ James Franklin Briggs, "Sails and Sailmakers," *Old Dartmouth Historical Sketches*, no. 65 (April 1937).

protocol of how seamen from whaling ships would bring sails to the sail lofts for repairs: what they would call out, how the sail loft workers would hoist sails to the upper stories of the building using a capstan. While valuable for their cultural significance, these details cannot explain the broader history of sailmaking and sailmakers as a group. Nonetheless, since no nineteenth century sailmakers survive today to recount their own stories, Briggs's presentation stands as a welcome contribution to the literature.

Marion V. Brewington, former director of the Kendall Whaling Museum, published "The Sailmaker's Gear" in the *American Neptune* in 1949 and thirty-one years later, "Chesapeake Sailmaking," in the *Maryland Historical Magazine*.⁴ In "The Sailmaker's Gear," as its title suggests, he described the details of sailmakers' tools and placed them in a chronological context. "Chesapeake Sailmaking" provides a good overview of sailmakers and their industry in the Chesapeake area and analyzes the local history of sailcloth supply and sailmakers in early America. The subject of his article parallels this thesis, but in a more cursory manner and, of course, a more southerly geographic range. A 1968 University of Delaware master's student, Elton Hall, wrote a thesis titled, "Sailmaking in Connecticut Prior to 1860."⁵ He included chapters on sailcloth, sailmakers, and tools, topics included in this thesis. Hall's research included an examination of only a few Connecticut sailmakers.⁶ Hall's thesis provides a good introduction to the topic, but his purpose was descriptive rather than analytical. In general, this thesis will expand significantly on his work.

⁴ Marion V. Brewington, "The Sailmaker's Gear," *American Neptune* 9 (1949): 278-296 and "Chesapeake Sailmaking," *Maryland Historical Magazine* 65, no. 2 (summer 1970): 138-148.

⁵ Elton Wayland Hall, "Sailmaking in Connecticut Prior to 1860" (master's thesis, University of Delaware, 1968).

⁶ John Kingsbury Pimer Papers and the Mallory Family Papers. G. W. Blunt White Library, Mystic Seaport Museum.

Biographical studies of individual sailmakers provide a glimpse into the nineteenth century sail loft in a number of essays. A few historians have researched the life of James Forten, a famed sailmaker from Philadelphia at the turn of the eighteenth century because of his efforts to end slavery, his success as an entrepreneur, and his political activism. Their works, however, focused on his contributions to society rather than his work as a sailmaker.⁷ Others wrote essays on individual sailmakers whose records survived and are accessible in research libraries. For example, William Peter Sprague's essay, "Charles Ware, Sailmaker" in 1943, William King's "The Sailmakers and Ship Chandlers of 79 Commercial Street, Boston" in 1955, and Rachel Beane's "John Kingsbury Pimer: Nineteenth Century New London Sailmaker" each used existing records to describe the sailmakers' respective business practices.⁸ Sprague based his essay on Charles Ware's petition to the U. S. Navy in the early 1800s to become a warranted sailmaker after the 1831 navy decision to replace civilian sailmakers with naval personnel. King and Beane's subjects were civilian sailmakers in southern New England in the nineteenth century. Their essays describe the nature of the sailmaker's business based solely on the individual sailmakers whose records they studied. In 1972, James Baughman published, *The Mallory's of Mystic: Six Generations of American Maritime Enterprise*.⁹ Head of the family, Charles Mallory started out as a sailmaker, but early in the family's maritime "enterprise," he abandoned sailmaking for more profitable pursuits. These works all contribute to the whole and,

⁷ Esther M. Douty, *Forten the Sailmaker: Pioneer Champion of Negro Rights* (New York: Rand McNally and Company, 1968); and Julie Winch, *Philadelphia's Black Elite* (1988).

⁸ William Peter Sprague, "Charles Ware, Sailmaker," *American Neptune* 3, no. 3 (July 1943): 267-268; William F. King, Jr., "The Sailmakers and Ship Chandlers of 79 Commercial Street, Boston," *American Neptune* 15 (1955): 220-231; Rachel Beane, "John Kingsbury Pimer: Nineteenth Century New London Sailmaker" (research paper, Munson Institute, Mystic Seaport Museum, May 1992).

⁹ James Baughman, *The Mallory's of Mystic: Six Generations of American Maritime Enterprise* (Middletown, CT: Wesleyan University Press, 1972).

together, help provide a broader understanding of the sail loft as a place of business. No published study, to date, includes a detailed examination of sailmakers.

Texts that have dealt most extensively with sailmaking include the collection of treatises and trade manuals published since the mid-seventeenth century. Of the twenty-five (Table 1) most noteworthy treatises or manuals (in English) which encompass or contain sections on sailmaking published between 1644 and 1994; nine focus specifically on sailmaking; ten of the twenty-five are American publications. Most are manuals on seamanship designed for use by naval or merchant officers who achieved their rank without having to pass through the hawsepipe. Darcy Lever explained in his tome, *A Young Sea Officer's Sheet Anchor* (1808), that “it is intended solely as a key to the leading of rigging and to practical seamanship [to officers] ... who may not have been long enough at sea ... [and] might be too embarrassed to have to ask for fear of showing his ignorance or fear of ridicule and this way, he could figure out what he needs to know in privacy.”¹⁰ Despite its London publication, Lever's *Sheet Anchor* contains four endorsements from masters of American ships showing its appeal across the Atlantic. Its 1819 reprint was also published in Philadelphia.¹¹ Americans, prior to independence, obviously referred to English publications. Like Darcy Lever's *Sheet Anchor*, *The Seaman's Vade-Mecum* (1783) by William Mountaine, William Brady's *The Naval Apprentice* (1841), and B. J. Totten's *Naval Textbook* (1841)¹² guided novice seaman and officers through the maze and particulars of sailing ship rigging and seamanship.

¹⁰ Darcy Lever, *A Young Sea Officer's Sheet Anchor; or, a Key to the Leading of Rigging, and to Practical Seamanship* (1808; reprint, Boston: Charles E. Lauriat Company, 1930).

¹¹ Craig Hardin Jr., “An Anchor to Windward: Manuals for Young Americans in the Days of Sail,” *The American Neptune* 30, no. 1 (January 1970): 40-45.

¹² William Mountaine, *The Seaman's Vade-Mecum* (1781; reprint, Salem, MASS.: Historic Reproductions and Reprints, n.d.).

Table 1. Treatises on Seamanship and Sailmaking 1644 – 1994

- 1644: *The Sea-Man's Dictionary* by Henry Manwayring (London)
- 1655: *The Sizes and Lengths of Riggings for All the State's Ships and Frigates* by Edward Hayward (London)
- 1769: *A New Universal Dictionary of the Marine: Being a Copious Explanation of the Technical Terms and Phrases.....* by William Falconer (London)
- 1781: *L'Art de la Voilure* by Charles Romme (Paris)
- 1783: *The Seaman's Vade-Mecum and Defensive War by Sea: Containing A Maritime Dictionary.....* by William Mountaine (London)
- 1794: *Steel's Elements of Mastmaking, Sailmaking and Rigging* by David Steel (London)
- 1801: *British Mariner's Vocabulary of Technical Terms and Phrases* by J. J. Moore (London)
- 1805: *The Mariner's Dictionary, or, Americans Seaman's Vocabulary of Technical Terms, and Sea Phrases* by anonymous (U.S.)
- 1808: *A Young Sea Officer's Sheet Anchor; or, a Key to the Leading of Rigging, and to Practical Seamanship* by Darcy Lever (London)
- 1811: *Seamanship in Theory and Practice* by Edmund M. Blunt (U.S.)
- 1817: *Narrative and Documents Relative to the Preservation of Mildew in Sailcloth* by Browell & Co. (U.S.)
- 1841: *The Naval Apprentice's Kedge Anchor, or Young Sailor's Assistant* by William Brady (U.S.)
- 1841: *The Seaman's Friend* by Richard Henry Dana (U.S.)
- 1841: *Naval Textbook* by B. J. Totten (U.S.)
- 1847: *Elements of Sailmaking* by Robert Kipping later published as *Elementary Treatise on Sails and Sailmaking* and *Sails and Sailmaking* beginning in 1857 (London)
- 1849: *Nautical Routine* by John M. Murphy and W. W. Jeffers (U.S.)
- 1858: *A Supplement Containing the Art of Sailmaking, Book-Keeping, Method of Keeping Ships' Accounts, &c. &c.* by Ware Branson, Jr. in *The Merchant's and Mechanic's Assistant, Being a Collection of Rules and Practical Tables, ...* by Isaac Ridler Butts (U.S.)
- 1863: "Improved Method of Making and Working the Courses of Square Rigged Vessels" by S. H. Gardiner 1863 (U.S.)
- 1875: *The Young Seaman's Manual* by D. Van Nostrand (U.S.)
- 1883: *The Young Sailor's Assistant* by Emory S. Taunt (U.S.)
- 1892: *The Art and Science of Sailmaking* by Samuel B. Sadler (London)
- 1948: *Yacht Sails: Their Care and Handling* by Ernest A. Ratsey and W. H. de Fontaine (U.S.)
- 1984: *The Rigger's Apprentice* by Brion Toss (U. S.)
- 1994: *The Sailmaker's Apprentice* by Emiliano Marino (U.S.)
-

France's Charles Romme may have been the first to publish a text dedicated strictly to sailmaking with the publication of *L'Art de la Voilure* in 1781. It was a general overview for the sailmaker, not a history or technical manual. In *Steel's Elements of Mastmaking, Sailmaking and Rigging* (1794), David Steel, an Admiralty agent for charts and publisher of several nautical works, combined these three disciplines into a compendium.¹³ Steel included an historical overview of sails and ships from ancient times to the late eighteenth century, plus definitions, explanations, and a detailed "how-to." Complete with mathematical tables and figures, it could walk the sailmaker or knowledgeable mariner through the steps of making a sail for any vessel then underway in the western world. In his preface, Steel explained that he consulted "actual workmen in each art" and employed artists to draw what seamen could "describe, but not delineate." He also claimed contemporary publications were "few and incorrect." In his definitions section, Steel described the tools and equipage of the sailmaker in detail, cloth particulars, and the names and descriptions of every kind of sail then in use. Next, he laid down the "rules and directions." One might assume that with the wide range of vessel types, dimensions, rigs, et cetera, that individual sails could not be subsumed under a general how-to. Steel noted that he did not include tables for the merchant service because the masting and corresponding sails "often depends upon the fancy of the builder or owner."¹⁴ Yet, in the eighteenth and nineteenth centuries, all square topsails on naval vessels, for example, followed the same guidelines for design and construction. All required a severe roach in the foot to allow for the forward leading stay. They all required the same placement of grommets, reefs, bellybands, buntlines, and mast cloths according to their dimensions. With tables provided for

¹³ David Steel, *Steel's Elements of Mastmaking, Sailmaking and Rigging* (1794; reprint, New York: Edward W. Sweetman, 1932).

¹⁴ Steel, *Steel's Elements of Mastmaking, Sailmaking and Rigging*, vi, 67, 112.

gore allowances, length and number of canvas panels, a sailmaker could make a sail without lofting it in its entirety on the floor or deck. These tables could provide the know-how for any square sail, fore-and-aft sail, and most small boat sails used at that time. Steel recommended that the navy and merchant marine design as many sails as possible of the same size so that, in case of emergency, they could be used interchangeably. The expense of spare sails and spars – and the precious space they took on board – he suggested, would be reduced greatly if they did not have to carry a set of spares for each kind of sail, rather store a number of spares that could go to any part of any mast. He even proposed they be adapted for use as awnings.¹⁵ It was a rather practical idea, but no evidence suggests anyone adopted it. Excerpts from his book found their way into many histories of sailing ship development from his own time to today. An American manual from 1811 titled *Seamanship in Theory and Practice*, written by the author of the *American Coast Pilot* and publisher of Bowditch's *Navigator*, is thought to have been plagiarized from Steel.¹⁶

Nearly a half-century later, Robert Kipping published *Elements of Sailmaking* (1847) in London. Later re-titled as *Sails and Sailmaking*, it comprised nearly the same text and enjoyed much success with multiple printings and editions published well into the twentieth century. In his preface, Kipping addressed his book to the “foreman or master sailmaker.”¹⁷ Like Steel, he introduced his topic by providing a brief account of the history of the development of the sailing vessel from the ancient Mediterranean to the “moderns” of three masts. His treatise served the contemporary sailmaker best by the inclusion of tables and explanations. He cautioned that, in the end, design and “allowances for the sails are left to the judgment of the sailmaker.”

¹⁵ Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 112.

¹⁶ Craig, “Anchor to Windward,” 41.

¹⁷ Robert Kipping, N. A., *Sails and Sailmaking: With Draughting, and the Centre of Effort of the Sails* (19th Impression. London: The Technical Press, 1936), preface.

Nonetheless, “without the calculations laid down, therein being well observed, no sails or parts of sails in which there is a large amount of gore, can be properly cut.”¹⁸ None of the records for sail lofts I obtained included an inventory with reference manuals. It is impossible to know for certain, that nineteenth sailmakers in Southern New England used them. Judging by the multiple printings and the technical nature of the texts, it is reasonable to conclude that they did.¹⁹ From an analysis of census data discussed in later chapters, Southern New England sailmakers were all literate. Thus, at the very least, sailmakers were able to read the texts. In addition, the tables would have demanded some mathematical and drafting skills.

Shortly before the outbreak of the Civil War, Isaac Ridler Butts published a less widely known book on seamanship titled *The Merchant's and Mechanic's Assistant, Being a Collection of Rules and Practical Tables, ...* containing a separate section called “A Supplement Containing the Art of Sailmaking, Book-Keeping, Method of Keeping Ships' Accounts, &c. &c.” by Ware Branson Jr., a U. S. Navy sailmaker. Branson's preface noted that he wrote it with the intention that shipmasters would take it to sea.²⁰ He addressed it to the “young sailmaker, who not infrequently at the termination of his apprenticeship, finds that he has never been instructed in draughting and cutting...”²¹ A much shorter text than Steel's and Kipping's, it contains very similar instructions on the basics of measuring, cutting, and constructing sails without the extra chapters on history, rigs, design, and tools. The last true treatise on sailmaking written in the nineteenth century was Britain's Samuel Sadler's *The Art and Science of Sailmaking* published in 1892. A sailmaker from the loft of Ratsey and Lapthorn in England (whose firm became one of

¹⁸ Kipping, *Sails and Sailmaking*, 1, 5, 36.

¹⁹ The 1936 edition of *Sails and Sailmaking* marked its 19th edition.

²⁰ Ware Branson Jr., “A Supplement Containing the Art of Sailmaking, Book-Keeping, Method of Keeping Ships' Accounts, &c. &c.,” in *The Merchant's and Mechanic's Assistant, Being a Collection of Rules and Practical Tables*, by Isaac Ridler Butts (Boston: 1858).

²¹ Branson, “A Supplement,” v.

the most famous yacht sailmakers with lofts both in England and in the United States), Sadler dedicated his book to the mechanics of sailmaking. It includes the same practical information on the calculation of gores with tables, seam allowances, measuring, construction and roping, but Sadler expanded his text to explain the scientific principles of finding the center of effort and center of gravity of sails, plus a chapter on the behavior of sailcloth off the bolt and in the rig. While Kipping and Steel's books had the potential to engage the traditional sail enthusiast, Sadler's book had no entertainment value; it was strictly a manual for professional use. In general, most of these texts had multiple printings. Because of the technical nature of their contents, it seems unlikely that general readers supported a mass market for their publishers. These works must have been acquired by sailmakers in volume and can, therefore, give us a look inside the sailing industry.

The twentieth century has yielded numerous books on seamanship, rigs, and sails. With the resurgence of the appreciation for classic sailing vessels, interest in "Tall Ship" events, and the popularity of cruising vessels, manuals abound. Interest in the history of ship construction and the evolution of the sailing ship has produced a wide range of texts on those subjects. Notable American treatises on sailmaking include Ernest Ratsey and W. H. de Fontaine's *Yacht Sails: Their Care and Handling* (1948) and Emiliano Marino's *The Sailmaker's Apprentice* in 1994. *Yacht Sails* described a history of yachting in America and the designs that came out of that enthusiasm. Ratsey and de Fontaine explained the basics in a non-technical manner and, like others before them, included sections on sailmaker's tools, sailcloth, and basic sail construction. The more recent treatise by Emiliano Marino aims to guide the amateur sailor through sail construction and repair fundamentals. Gone are the sections on square sails and their respective tables for gores and allowances; instead, he discussed new high-tech sailcloth and hardware. In the glossary, basic terms such as gore, roach, and grommet are noticeably absent. Where these

particulars of sail construction warranted their own section or chapters in Steel, Kipping, and Sadler's works, they do not appear in *The Sailmaker's Apprentice*. Like his predecessors, Marino looked back at sails through history to provide context, but history was not meant as the focus.

Within the classification of treatises and manuals, one must not exclude the books designed to guide ship-model builders. While they do not contain analyses of the history of sailing ships and their design and construction, their authors did extensive research and provide authoritative detail of techniques of shipbuilding, naval architecture, and rig design that the historian of these topics should not overlook. Harold Underhill used the plans of numerous historic ships in three volumes dedicated to model builders in the first half of the twentieth century: *Sailing Ship Rigs and Rigging* (1938), *Masting and Rigging: The Clipper Ship and Ocean Carrier* (1946), and *Deep-Water Sail* (1952). Historian R. C. Anderson, former editor of *The Mariner's Mirror* and co-author of *The Sailing Ship: Six Thousand Years of History* (1963), wrote *Seventeenth-Century Rigging: A Handbook for Model-Makers* in 1955.²² Each provides the minutiae of sailing ship construction with as much accuracy as their historian-authors could convey on paper. None of the treatises examined can be called historical analyses of sailmaking, but they belong in its historiography because they were some of the only publications before the twentieth century that examined sailmaking. They also appear as references in most historical investigations on sailmaking and sailmakers in England and the United States.

²² Harold Underhill, *Sailing Ship Rigs and Rigging* (Glasgow: Brown, Son and Ferguson, Ltd. Nautical Publishers, 1938); *Masting and Rigging: The Clipper Ship and Ocean Carrier* (Glasgow: Brown, Son and Ferguson, Ltd. Nautical Publishers, 1946); *Deep-Water Sail* (Glasgow: Brown, Son and Ferguson, Ltd. Nautical Publishers, 1952), Romola and R. C. Anderson, *The Sailing Ship: Six Thousand Years of History* (New York: Bonanza Books, 1963), R. C. Anderson, *Seventeenth-Century Rigging: A Handbook for Model-Makers* (London: Percival, Marshall, and Co., Ltd., 1955).

One step away from treatises and guides remains the large and varied collection of books aimed at more true historical analysis of the evolution of the sailing ship, its design, rig, and classification of vessels. Certainly of use to the model-maker and of interest to the sailmaker, these texts are addressed to the student of maritime history. Only the books that included studies of sails and sailmaking were considered for this analysis, with a few notable exceptions. Distinguished American maritime historian Howard I. Chapelle's library of publications serves as the most well known collection on the development of sailing craft.²³ He studied plans of thousands of ships and boats to trace the evolution of American sailing craft from small boats to clipper ships in a systematic, meticulous manner. Although a prolific writer on sailing ships, he neglected the sails and mentioned them only in passing in support of a description of rigs or of hull design.

R. C. Anderson, previously noted for his contribution to ship model guides, published with Romola Anderson in 1963, *The Sailing Ship: Six Thousand Years of History* and *The Rigging of Ships in the Days of the Spritsail Topmast, 1600 – 1720*.²⁴ The book traced the evolution of the sailing ship in general terms without delving into sail development. Aimed at the general reader, its content is not technical in form. Replete with diagrams and excerpts from ship's plans, the first work details the ships rigging without much historical analysis. The latter detailed the minutiae of the rigging of ships as declared in its title.

As the means of production became increasingly mechanized in the twentieth century,

²³ Howard I. Chapelle, *Yacht Designing and Planning* (New York: W. W. Norton and Co., Inc.: 1936), *The History of American Sailing Ships* (New York: Bonanza Books, 1935), *The History of the American Sailing Navy: The Ships and Their Development* (New York: W. W. Norton and Co., Inc., 1949), *The Search for Speed Under Sail: 1700 – 1855* (New York: Bonanza Books, 1968), *The American Fishing Schooner* (New York: Norton Publishers, 1973); *The Baltimore Clipper* (New York: Dover Publications, Inc., 1930).

²⁴ R. C. Anderson, *The Rigging of Ships in the Days of the Spritsail Topmast, 1600 – 1720* (Mineola, New York: Dover Publications, 1994).

historians recognized the need to document artisan trades before the last masters passed on. Beyond the range of the written page, re-enactors began learning crafts from the old artisan mechanics to demonstrate their skills and traditions to younger generations. Today, one can observe them at their work in a number of “living” museums and sailing ships. A number of historians have documented the sailmaker’s tools and trade. M. V. Brewington’s article “The Sailmaker’s Gear” (1949) details sailmaking tools and equipment, piece by piece. The *Chronicle of Early American Industries* published “Sailmaking and Sailmaker’s Tools” by Bob Mikelson in 1971 with photos of aging sailmakers at work in the Ratsey and Laphorn sail loft on City Island, New York. Elton Wayland Hall’s master’s thesis “Sailmaking in Connecticut Prior to 1860” (1968) also documented sailmakers’ tools, in addition he included historical references to them and traced some of their origins and manufacture through the use of business records, inventories, and manuals. Before the twentieth century, the sailmaker’s tools were uniform in both type and design; therefore, texts describing the material culture of the sailmaker would be similar in content. In *Tools of the Maritime Trades* (1978), John E. Horsley undertook the task of documenting several craftsmen’s tools.²⁵ In his chapter “The Sailmaker and Rigger” and an appendix on sailcloth, Horsley provided an excellent resource explaining, not only the tools themselves, but also how they were held, manipulated, and used to accomplish particular tasks.

Unique to the historiographical assemblage on sailmaking, Janet Cutler Mead’s publication of her sailmaker father’s autobiography, *Bent Sails: A Sailmaking Saga Written in the Words of a New England Craftsman of Square Rigger Days* followed the professional life of Alexander Munro Cutler of Round Pond, Maine in the nineteenth century.²⁶ Cutler grew up in a

²⁵ John E. Horsley, *Tools of the Maritime Trades* (Camden, ME: International Marine Publishing Co., 1978).

²⁶ Janet Cutler Mead, ed., *Bent Sails: A Sailmaking Saga Written in the Words of a New England Craftsman of Square Rigger Days* (Cincinnati, Ohio: Mail IT, Inc., 1962).

family of sailmakers, and his personal story illustrated the nature of the sailmaking business as a small family firm. When his business as a sailmaker collapsed with the onset of the Civil War, he used his canvas sewing skills as a tent maker for the Union Army. After the war, he returned to sailmaking. He and his family moved from one seaport to another in Maine according to the availability of sailmaking work. While Cutler made no attempt to generalize about any other sailmakers outside of his family, his autobiography proves a valuable source against which to test hypotheses. Like James Briggs's paper about New Bedford sailmakers, Cutler's account contributes to the record personal remembrances that cannot be extracted from public records. By recording the traditions of how sailmakers interacted, conducted their business, handled their tools, and sought contracts, material culture specialists can use *Bent Sails* as a substitute for interviews with sailmakers who have long ago passed on and cannot offer their recollections in person.

Certainly within the parameters of this topic fall the well-documented practices and tools of the sailcloth manufacturer. From the agricultural traditions of the flax, hemp, and cotton farmers, to the home industries of spinning and weaving, to the factory and even the development of industrial machinery, sailcloth owes its existence. Historians and traditional craft enthusiasts have documented the processes of linen production in this country. Examples include "Flax Processing in Pennsylvania: From Seed to Fiber" by Ellen J. Gehret and Alan G. Keyser and *The Magic of Linen: Flax Seed to Woven Cloth* by Linda Heinrich. These works, and many like them, describe the tools, equipment, and processes it took to make linen from planting to the finished product. Before the development of synthetics, sailcloth was made from linen and later cotton canvas — and both flax and cotton could be grown in American soil. While it is difficult to separate the history of sailcloth production from general textile production, for the study of the

material culture of sailcloth manufacturing, the distinction is unnecessary. The process was the same.

The investigation of sailcloth manufactories and technology, as it related to sailcloth manufacturing, proved difficult to isolate from general linen manufacturing. Lawmakers specifically addressed sailcloth in a number of legislative records, but the general history of textile manufacturing subsumes the history of sailcloth manufacturing and, thus, must be studied.²⁷ The first major work was J. Leander Bishop's three volume set *A History of American Manufactures from 1608 to 1860* published in 1868, followed in 1929 by Victor Clark's *History of Manufactures in the United States: 1607 – 1860*. Both works painstakingly outlined the seeds of manufacturing and trace their development in antebellum America. Specific to sailmaking, these works examine flax, hemp, and cotton cloth within the context of textile manufacturing. They identified early incentives local colonial governments provided and also identified obstacles in the form of the Navigation Acts laid down by the Crown to impede their growth. While these publications provide significant amounts of detail, particularly regarding legislative action on manufacturing enterprises, their usefulness is limited to anyone interested in a subset of the industry to which the laws were addressed. The volumes are organized by state, industrial categories, etc. The authors did not organize them to satisfy the researcher interested in highly specific categories within broad topics. It is difficult to establish a chronology of textile, and specifically sailcloth, manufacturing.

A variety of articles on early American manufacturing focus on the influence of Alexander Hamilton and Tench Coxe, pervade history and economic history journals.²⁸ These

²⁷ *American State Papers*, Rhode Island and Massachusetts State Records, etc.

²⁸ John R. Nelson Jr., "Alexander Hamilton and American Manufacturing: A Reexamination," *The Journal of American History* 65, no. 4 (March 1979): 971-995; James E. Cooke, "Tench Coxe, Alexander Hamilton, and the Encouragement of American Manufactures," *William and Mary Quarterly* (1975); John G. Glover

articles illuminate the complexities and the impact of governmental incentives and legislation on the industry. The resistance of the post Civil War Navy to adopt steam propulsion for their vessels was examined by Lance C. Buhl's "Mariners and Machines: Resistance to Technological Change in the American Navy, 1865 – 1869" and Elting E. Morison, *Men, Machines, and Modern Times*.²⁹ The Navy's decision to retain sail power as a means of propulsion naturally affected the livelihood of sailmakers and sailcloth manufacturers. Morison claimed that the Navy chose to stick with sail over steam because it could not give up the customs in which it had been formed; its officers were "victims of fixed attitudes."³⁰ He saw steam as a threat to naval traditions. Buhl, on the other hand, saw a power struggle between line officers and engineers. The navy, he claimed, reverted to sail after the Civil War because its line officers, men trained in sail, desperately tried to hold onto their rank and status by quashing the growth and acceptance of steam – and with it the careers of those whose mastery of steam technology would have given them claim to professional advancement. "Line officers deemed a certain class of technological developments ... as a threat to their tradition-bound authority." Reconversion to sail was one of many ploys used as "a strategic blow against the claims of engineers for equal status and authority."³¹ Both the navy and merchant marine were eventually forced to make the leap from sail to steam.

Warren C. Scoville's research on the geographic expansion of technology as it relates to linen and sailcloth manufacturing resulted in two articles: "Spread of Techniques: Minority

and Rudolph L. Lagai, eds., *The Development of American Industries: Their Economic Significance* (New York: Simmons-Boardman Publishing Corp., 1959).

²⁹ Lance C. Buhl, "Mariners and Machines: Resistance to Technological Change in the American Navy, 1865–1869," *The Journal of American History* 61, no. 3 (December 1974): 703-727; Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge, MA: 1966).

³⁰ Morison, *Men, Machines, and Modern Times*, 38-44.

³¹ Buhl, "Mariners and Machines," 726.

Migrations and the Diffusion of Technology” in *the Journal of Economic History* (1951) and “The Huguenots and the Diffusion of Technology” in *The Journal of Political Economy*” (1952).³² Both articles used the exodus of the Huguenots from France and their migration into England and Ireland to explore how technological knowledge and skills transferred from one geographic location to another — in this case, the technology of linen and sailcloth manufacturing. In “Spread of Techniques,” Scoville used the Huguenots’ example to explain the process as “diffusion by radiation and diffusion by migration” dependent on lines of communication and, in maritime industries, transoceanic travel.³³ “The Huguenots and the Diffusion of Technology” connects the development of linen manufacturing in England and Ireland to the migration of the Huguenots from France. American sailcloth supplies and technological knowledge came directly from England and Ireland before a domestic supply developed which could sustain the commercial and naval fleets.

While many works of maritime history touch on the topic of sailmaking, most only mention it in a caption or paragraph — a chapter at best.³⁴ The sources for this study include the works cited above and others, complemented by one very significant primary source — the New England censuses. Together they form the basis for an expanded portrayal of southern New England sailmakers.

³² Warren C. Scoville, “The Huguenots and the Diffusion of Technology,” *The Journal of Political Economy* 60, no. 4 (August 1952): 294-311, and “Spread of Techniques: Minority Migrations and the Diffusion of Technology,” *The Journal of Economic History* 11, no. 4 (autumn 1951): 347-360.

³³ Scoville, “Spread of Techniques,” 349.

³⁴ See Robert G. Albion, *Naval & Maritime History: An Annotated Bibliography*, 4th ed. (Mystic, CT: The Marine Historical Association, Inc., 1972).

CHAPTER 2 OVERVIEW OF SOUTHERN NEW ENGLAND SHIPPING TO 1900

The Europeans who settled New England became mariners because they had no choice. Confronted with a cold climate and stony soil, the colonists found that their new home could not grow enough food to sustain them, let alone permit them to grow and prosper. New England's thick forests, the natural harbors that peppered its long, jagged coast, and the rich fishing grounds just offshore provided them a blessing of another sort. The ocean would be their bounty. Fishing, maritime trade, and shipbuilding soon made New England a valuable and prosperous region. Until the turn of the twentieth century, that prosperity was powered by the wind. Sails harnessed that wind.

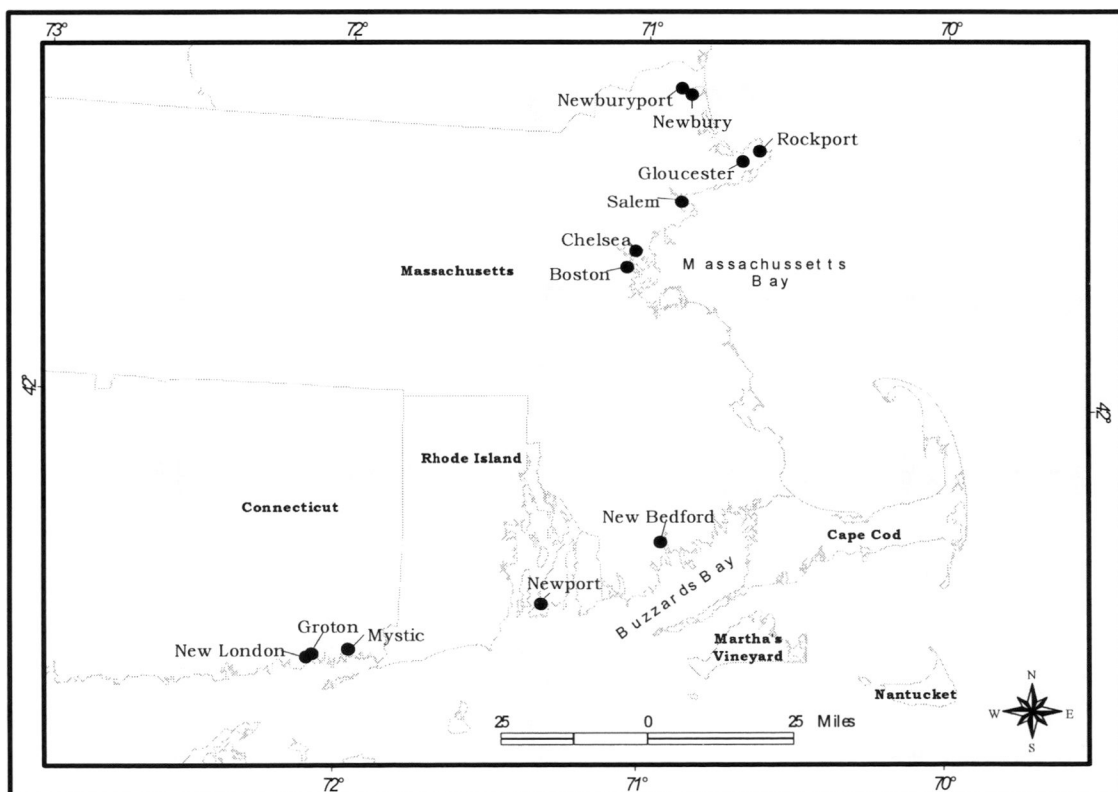


Figure 1. New England seaports. (Map by Brian Andrews.)

No records of vessels in pre-contact North America have been found that document Native Americans using sails. Native Americans in New England used smaller vessels for coastal travel and inland transportation. They did not venture far from shore, nor build vessels too large for men to power them. The first European colonists, however, needed to trade amongst their scattered settlements and with their homeland to maintain their way of life. They wasted no time in building sailing vessels to navigate the coastline. In 1608, English settlers built the thirty-ton pinnace *Virginia* near the mouth of the Kennebec River, Maine. The Dutch colonists in New Amsterdam were not far behind as they launched a sixteen-ton yacht in Manhattan in 1614. That same year, in Maine, Captain John Smith and his crew built seven fishing vessels.¹ No early records describe sailmaking, except Captain John Smith's passing mention of his men repairing a sail with a shirt.²

The first American ships were small and so were the shipyards. Even so, shipbuilding quickly became a trade at which a man could make a living. By 1629, the governor of Massachusetts Bay documented six shipwrights in the colony and requisitioned supplies to construct fishing vessels. The first vessels were built for fishing near shore and to trade and travel between nearby settlements. Those settlements, at first, remained dependant on European ships to sustain them and to bring new colonists across the Atlantic. Nonetheless, a generation of civil war in England between 1640 and 1659 left colonists to their own devices to build the sea-going vessels a distracted mother country could no longer provide.

¹ Howard I. Chapelle, *The History of American Sailing Ships* (New York: Bonanza Books, 1935), 5; J. Leander Bishop, *History of American Manufactures From 1608 to 1860*, 3d ed. (1868; New York: Augustus M. Kelley Publishers, 1966), 1: 37; Bob Mikelson, "Sailmaking and Sailmaker's Tools," *The Chronicle of Early American Industries Association, Inc.* 24, no. 3 (September 1971): 30.

² Marion V. Brewington, "Chesapeake Sailmaking," 38.

In 1642, Massachusetts governor Winthrop recorded a 300-ton ship constructed in Salem. Boston soon followed with a 150-ton vessel.³ Ironically, one of the first ocean-going vessels built in the colonies — the Maine-built *Virginia* — was promptly used to evacuate Fort Popham and repatriate its residents to England. Nonetheless, many more came than went, and the shipbuilding industry grew with the population. By the mid-1600s, New England's shipbuilders were not only producing oceangoing vessels for local owners, they were building them for Europeans as well. New England's virgin forests provided timber for the vessels of a quantity and quality that had long since vanished from England. Even though New England shipwrights had to import rigging and sails, they could still produce vessels less expensively. While some attempts were made to supply American-built vessels with homegrown hemp for cordage, at this stage, most was brought in from Europe.

Seaport life, naturally enough, revolved around the waterfront. Unlike more southern colonies, farmland and acreage meant little to New England's people. Good wages and fair weather in which to work mattered more. Employment in the late seventeenth century was plentiful and the population — both native-born and immigrant — grew rapidly, sustained by a diet of fish. To meet the demand, New England fishermen pressed further out to sea and began regular trips to offshore fishing banks.⁴ New England's shipbuilding industry was well established — helped not only by domestic demand but also by European turmoil. By 1675, Massachusetts Bay supported thirty master shipwrights.⁵ During King William's War (1689-1697) and Queen Anne's War (1702-1713), New Englanders profited significantly from shipbuilding. Their inexpensive, high-quality timber enabled them to produce vessels at least

³ Bishop, *History of American Manufactures*, 1: 38.

⁴ Gary Nash, *The Urban Crucible* (Cambridge, MA: Harvard University Press, 1986), 6; Albion, Baker and Labaree, *New England and the Sea*, 27.

⁵ Bishop, *History of American Manufactures*, 1: 62, 47.

thirty percent cheaper than their English competitors. Europe's incessant warfare only added to the demand. England needed new vessels and both English and local owners needed replacements for vessels captured or sunk in the conflicts. When delivering new vessels to Europe, savvy builders made extra money by loading them with profitable cargoes.⁶ Wartime also kept maritime support industries regularly employed; artisans could avoid military service but were taxed heavily to fund the war. During this time, New England's population exploded, tripling between 1690 and 1740.⁷

To the south, the Dutch colony of New Amsterdam had a slower start in shipbuilding. For one thing, its population was not growing nearly as fast. For another, the Dutch East India Company, which ran its colony like a company store, built ships elsewhere. Even so, by 1696 the Dutch on Manhattan had a fleet of forty square-rigged vessels, sixty-two sloops, and sixty boats supporting a population of less than six thousand.

While most New England shipbuilders relied on sailcloth and cordage sent from Europe, by the turn of the seventeenth century the colonies to the south, primarily Virginia, had begun producing naval stores such as tar, pitch, and rosin.⁸ The trade with Virginia was only one part of a robust economy that began to develop amongst the colonies themselves — both on the North American continent and the Caribbean. New Englanders began making fortunes by trading with the West Indies. Those cargoes were carried in the holds of American-built vessels; the larger the hold, the more lucrative the voyage. Merchants involved in the West Indian trade demanded their shipwrights provide them with larger and more capacious sloops and schooners. At the same time, the need for fishing vessels and smaller craft for coastal and inland waterways

⁶ Albion, Baker and Labaree, *New England and the Sea*, 25.

⁷ Nash, *Urban Crucible*, 34, 35, 33.

⁸ Jacob M. Price, "A Note on the Value of Colonial Exports of Shipping," *Journal of Economic History* 36, no. 3 (September 1976): 710.

boomed with the population. At the beginning of the 1700s, New England's whalers began venturing further and further offshore. They started placing orders for heavy-duty square-rigged ships that could stay at sea for a year or more.⁹

Other than the occasional enterprising voyage, however, the northern colonies never managed to develop returns, other than the ships themselves, for trade with England. Instead, it developed markets with other regions: Newfoundland and Nova Scotia bought fishing tackle, salt, provisions and West Indian rum; Madeira and the Canary Islands exchanged wines for barrel staves, foodstuffs, and live animals; and Spain, Portugal, and Italy imported codfish. New England seaports handled Southern tobacco, hardwoods, indigo, and rice.

The thriving American trade was often in direct competition with English shippers who did what they could to stifle the competition — relying on the mercantilist philosophy that the colonies were meant to be useful sources of raw materials, not commercial rivals. The Navigation Acts passed by the English beginning in 1660 were the fruit of the English merchants' influence in Parliament. The Navigation Acts were designed to maintain the mother country's primacy — and particularly to ensure a favorable balance of trade with the colonies themselves. Enumerated articles were created to secure the flow of colonial raw materials to English markets and quash competing upstart colonial manufactures. Once colonies became more self-sufficient (and self-confident), such mercantilist policies became more difficult to enforce.

The friction between British commercial interests and the growing American population and economy simmered for years. In 1726, sixty years after the first Navigation Act was passed,

⁹ Albion, Baker, Labaree, *New England and the Sea*, 31; Peter Charles Hoffer, ed., *American Patterns of Life: Selected Articles on the Provincial Period of American History* (New York: Garland Publishing, Inc., 1988), 142, 709.

a member of the British Board of Trade still felt it necessary to assert that: “all advantageous projects or commercial gains in any colony which are truly prejudicial to and inconsistent with the interests of the mother state must be understood to be illegal and the practice of them unwarrantable.”¹⁰ New England shipowners, for the most part, ignored or worked around the mother country’s restrictions. A ship built in New England at the time was almost certain to end up carrying contraband of one kind or another. Throughout the 1700s, the Crown tried to keep matters under control with a series of increasingly restrictive laws, which, of course, eventually provoked the colonists to rebel. New Bedford and its neighboring villages sustained themselves as shipbuilding centers for New Bedford’s growing fleet of vessels for the cod, mackerel, and whale fisheries.

Through it all, Boston maintained its pre-eminence on the eastern seaboard, but, within southern New England, smaller port towns sprang up and thrived on the overflow and on specialty trades such as cod fishing, whaling, shipbuilding, West Indian trade, and voyages to the Far East. For a time, these ports – Salem, New Bedford, Gloucester, Newport, New London, and New Haven, for example – survived by maintaining competitive rates. The largest of Boston’s rivals was Newport, Rhode Island. Newport’s economy blossomed in the seventeenth century by capitalizing on a different and more tolerant culture than that of Puritan Massachusetts.

Rhode Island was particularly well suited to those whose transactions and cargoes were forbidden by the English crown. Roger Williams founded Providence and Rhode Island in 1636 to escape Massachusetts religious constraints, but many residents came to escape commercial restraints as well. Since the colony chose its own governor, it was “free of close imperial

¹⁰ Louis M. Hacker, “The First American Revolution,” *Columbia University Quarterly* (September 1935): 272, 267, 263.

inspection.” This meant it was easier to avoid customs taxes and trade regulations in Newport than in any other northern seaport; Newport “seemed drawn to illicit trade.” Clearly there were substantial profits to be made in such trade. By 1700, Newport had become a major commercial center. Throughout the eighteenth century, Newport prospered from rum distilleries and from slave trafficking.¹¹ Newport was not Boston’s only rival, though, and after 1740, when Boston’s population growth slowed considerably for thirty-five years, New York and Philadelphia rose to challenge it. In those same years, the populations of both cities doubled. Within New England, Salem increased its tonnage cleared for foreign voyages and was second only to Boston by 1748. Its neighbor to the north, Newburyport, also became an important shipbuilding town around this time.

Boston had been hit particularly hard by the eruption of hostilities between Britain and Spain in 1739. Spain was one of Massachusetts’ most important customers for fish.¹² Through it all, though, orders for ships never abated. Conflict is almost always a boon to the shipbuilding industry, and eighteenth century Europe continued to oblige with an almost unbroken string of wars. The War of Austrian Succession (England v. Spain et al, 1744-1748) and the Seven Years War (England v. France, 1756-1763) provided a flood of orders for privateering vessels and replacements for merchant vessels seized by French privateers. Massachusetts alone authorized more than 300 privateers during the latter conflict — which was fought, in part, in North America, where the conflict was called the French and Indian War. Crews for privateering vessels came from both the fisheries and merchant ships and resulted in sharp wage increases for

¹¹ Hoffer, *American Patterns of Life*, 145, 149; Albion, Baker, Labaree, *New England and the Sea*, 8.

¹² Hoffer, *American Patterns of Life*, 144, 143.

mariners. During these wars, Massachusetts also commissioned armed vessels to patrol and protect its fishing and merchant fleets.¹³

By the mid-1700s, New England had about one thousand sailing vessels engaged in the fisheries, nearly all home-built. At the same time, foreign merchants maintained their demand for New England built vessels. According to Dr. William Douglass, writing in 1750, approximately two-thirds of the cost of a new vessel fitted for sea represented income to the builders with the remaining third going to English iron, cordage, sailcloth, and appurtenances.¹⁴ Southern New England's maritime trade completely dominated the colonies just before the American Revolution. By 1769, registered tonnage in Massachusetts was more than three times that of any other colony. New Hampshire was next, followed by Connecticut and Rhode Island.¹⁵

While the British Crown was grateful for New England's ships, however, it was not so pleased that Americans themselves were sailing them commercially. When the British tried to suppress American trade, the colonists rebelled. In New England, that rebellion began as a boycott of goods imported from Britain. Soon, Boston's shipbuilders, shipowners, and merchants were suborning acts of more open rebellion. The tea dumped in Boston Harbor during the Boston Tea Party was just the most dramatic of many cargo seizures.

Even before the rebellion against taxes and trade restrictions turned, in earnest, into a war for independence, the Continental Congress expressed its resolve by deciding to build ships. Although Americans did not declare their independence until July of 1776, Congress decided to form a navy in 1775. In the spring of 1776, it declared American colonial ports closed to British

¹³ Benjamin W. Labaree, William M. Fowler, Jr., Edward R. Sloan, John B. Hattendorf, Jeffrey J. Safford, and Andrew W. German, *America and the Sea: A Maritime History* (Mystic, CT: Mystic Seaport Museum, Inc., 1998), 82-85.

¹⁴ Bishop, *History of American Manufactures*, 1: 46; Dr. William Douglass quoted in Price, "Colonial Exports of Shipping," 711.

¹⁵ Bishop, *History of American Manufactures*, 1: 42, 48.

ships — a gesture not only of resolve, but of confidence that American mariners could, in fact, maintain a blockade against the hitherto invincible Royal Navy. The war itself was, of course, a plus to those shipbuilders whose yards were not put to the torch. Nonetheless, the years of the American Revolutionary War and those that followed were also difficult for New England's maritime economy.

In the forty years between 1775 and 1815, New Englanders suffered through twenty-nine years of war. In those years, the threat of invasion and coastal attack weighed heavily on ships and seaports. Enemy warships and privateers preyed on merchant ships and fishing vessels. Shipowners continually had to make adjustments and create new markets to stay in business. New England port towns fell back on their geography to find a specialty that would keep them in business. In Connecticut, New Haven, New London, and Stonington used their deep-water anchorages to establish themselves as harbors and transshipment points for deep-draft ocean-going vessels. New London developed its whaling fleet; New Haven focused on the West Indies and coastal trades. Coastal trading also grew in river ports such as Middletown and Norwich, which thrived because of their access to agricultural communities. In 1807, Middletown had more registered tonnage than any other port between Cape Cod and New York City.

On the high seas, of course, the British were in no mood to make things easy for the mariners of their lost colonies. They banned Americans from selling fish to the British West Indies, costing the Americans a significant portion of their market. Other commodities such as whale oil, tobacco, and rice were either banned altogether or subject to enormous duties. American commodities that the West Indians really needed — lumber, grain, and livestock, for example — could be sold there, but only if carried by British vessels. The restrictions contributed substantially to a post-war economic depression that affected the whole nation, but

struck New England particularly hard. Many traditional merchant families folded their operations.

Abolition represented another economic factor affecting maritime commerce. In the first decade following the Revolution, every New England state abolished slavery. Rhode Island and Connecticut held on the longest and, even after abolition, a number of merchants continued to reap profits from the slave trade. Many others profited from the slave trade indirectly by continuing shipments of fish to West Indian plantation owners for slave food and by importing slave-produced sugar and molasses for New England's rum distilleries.¹⁶

In the end, New England's merchants prospered in the face of political adversity as they nearly always had. Ships forbidden to sail old routes were sent on voyages to develop new ones; goods banned in old markets were sold to new customers. With the rise of new and specialty trades, some smaller seaports became large maritime centers in their own right. The American government did what it could to sustain one of its most important domestic industries. In 1789, Congress passed its own trade law — the Tonnage Act of 1789 — which levied variable duties on foreign and domestic ships entering United States ports. Although British laws restricted American access to Britain's West Indian colonies, American sovereignty brought with it the freedom to trade anywhere in the world. New Englanders soon wrested control of their commerce with the Far East from English competitors. In their quest for outbound cargoes, New Englanders developed a new trade in the Pacific Northwest in furs and seal skins. In the 1790s, Salem developed a lucrative trade in Sumatran pepper.

The Europeans also did what they could to help by going to war, once again, with each other — the outbreak of war between England and France in 1793 provided a profitable

¹⁶ Albion, Baker, and Labaree, *New England and the Sea*, 53.

opportunity for some American merchant shippers. While many ships lay idle in port, with the exception of “munitions voyages and the cruises of privateers,” quite a few, spurred by the sight of those idle ships, decided to flout the international “Rule of 1756,” regarding neutral shipping in wartime, and made tremendous profits by shipping West Indian produce to continental Europe.¹⁷

Finally, in the last decade of the eighteenth century, the Industrial Revolution came to New England. Outbound ships began to carry goods manufactured in New England in place of less-profitable commodities and bulk cargoes purchased elsewhere. When Moses Brown teamed with Samuel Slater in 1791 to open a textile mill in Pawtucket, the face of commerce and industry in southern New England changed forever.¹⁸ In Rhode Island, Newport was supplanted by Providence as Rhode Island’s leading port. While Newport continued to enjoy success as an entrepôt of goods obtained from other colonies, it lacked in natural resources. Newport more than made up in the aggregation of merchants who settled there and “facilitated the accumulation of capital and entrepreneurial and technical skills.”¹⁹ By 1800, however, Providence was the larger town. Its port benefited not only from the growth of local manufactures but also from the success of the Brown family’s mercantile business. Farmers also preferred Providence’s mainland location to Newport’s island. Connecticut’s maritime trade out of New Haven also reached new heights between 1790 and 1815 when the constant warfare between Great Britain and France pushed freight rates on commodities traded between New England and Europe higher and higher. During this same period, other New Haven shipowners developed a successful triangular trade between their homeport, the South Pacific for sealskins, and China.

¹⁷ Albion, Baker and Labaree, *New England and the Sea*, 54.

¹⁸ Albion, Baker and Labaree, *New England and the Sea*, 45-60, 96.

¹⁹ Hoffer, *American Patterns of Life*, 150.

Renewed American conflict with Britain, however, soon posed a new set of difficulties. After the 1807 Embargo Act prohibited American ships from engaging in foreign trade, much of New England's maritime commerce slumped. During the brief respite between its repeal in 1809 and the outbreak of war in 1812, many shipowners recovered and sent ships out to new ports. The Newburyport schooner, *Lydia*, for example, trading in the Mediterranean in 1810, detoured to Russia on its way home and brought a shipment of iron, cordage, and sailcloth directly to New England. This introduced a new trading partner and developed a new way to satisfy New England's appetite for flax sailcloth and hemp cordage – both valuable strategic commodities.²⁰

After the war, coastal trading in New England increased dramatically, especially after the passing of the Navigation Act of 1817, which restricted domestic shipping to American vessels. Within a few years, American-carried coastal tonnage exceeded that of foreign-flag vessels.²¹ Outlying Massachusetts seaports such as Newburyport, Beverly, Salem, Marblehead and Plymouth turned to manufacturing in the decades following the war, and, once again, New England's shipping concentrated in Boston harbor. Gloucester, Provincetown, Wellfleet, and New Bedford continued to prosper as maritime centers because of their specialization in whaling and fisheries.²²

At the same time, the advances in science and technology were having a far greater impact on mariners than simply changing the nature and value of the goods in their holds. At sea, mariners often owed their lives to newly invented instruments and to the publication of accurate charts, guides, and tide tables. By 1800, mariners, who could afford them, used a chronometer to determine their longitude at sea. (Latitude, taken from sun-sights, was never

²⁰ Albion, Baker and Labaree, *New England and the Sea*, 83.

²¹ Labaree, et al., *America and the Sea*, 245.

²² Samuel Eliot Morison, *The Maritime History of Massachusetts, 1783-1860* (1921; reprint, Boston: Northeastern University Press, 1961), 216.

much of a problem.) Edmund Blunt, a Newburyport publisher and bookseller, had recently published Captain Lawrence Furlong's *American Coast Pilot* and Nathaniel Bowditch's *The New Practical Navigator*, which became essential reference books aboard American ships. Vessels from New England could now find their way efficiently — and much more safely — to ports around the globe. The result was yet another expansion in New England's maritime industry.

At the end of the colonial period, Boston and Newport had stood out as the urban centers of New England. In the next few decades, specialization of trade in smaller New England ports allowed many to grow from small villages to flourishing seaports fully equipped with support industries.²³ Between 1800 and 1820, Boston's fleet engaged in foreign trade reached nearly the same levels as its domestic fleet.²⁴ Meanwhile, the port of New York had grown steadily in importance for many years. When the Erie Canal opened in 1825, it became the leading port linking inland waterways to coastal and transoceanic navigation. By 1830, New York supplanted Boston as the largest seaport in the United States. Boston remained a strong second and developed a large coastal fleet supplied by Boston's neighboring "satellite ports."²⁵ Taken together, the traffic in the Massachusetts ports and Rhode Island still dwarfed New York's for many years to come.

The nature of New England's trade was changing dramatically. New York might have taken the lead in shipping furs and commodities from the hinterlands; New England was now moving to an industrial economy — producing textiles and other manufactured goods. More and more ships were needed to take those goods to a worldwide market. New England fisheries continued to grow as well — from 37,000 tons in 1815 to 163,000 in 1860. By 1830, fishing

²³ Ibid., 45, 46, 50.

²⁴ Allan Kulikoff, "Progress of Inequality in Revolutionary Boston," *William and Mary Quarterly*, 3d ser., 28, no. 3 (July 1971): 379.

²⁵ Labaree, et al., *America and the Sea*, 250.

vessels regularly ventured far offshore to fill their holds on the Grand and Georges Banks. The heyday of American whaling was underway led by the fleets of Nantucket, and later New Bedford. In the 1840s, New England's maritime commerce reached new heights as shipbuilders and shipowners "succeeded in keeping up with the growth of American capital, population, and general prosperity."²⁶ The repeal of the British Navigation Acts in 1849 opened British markets

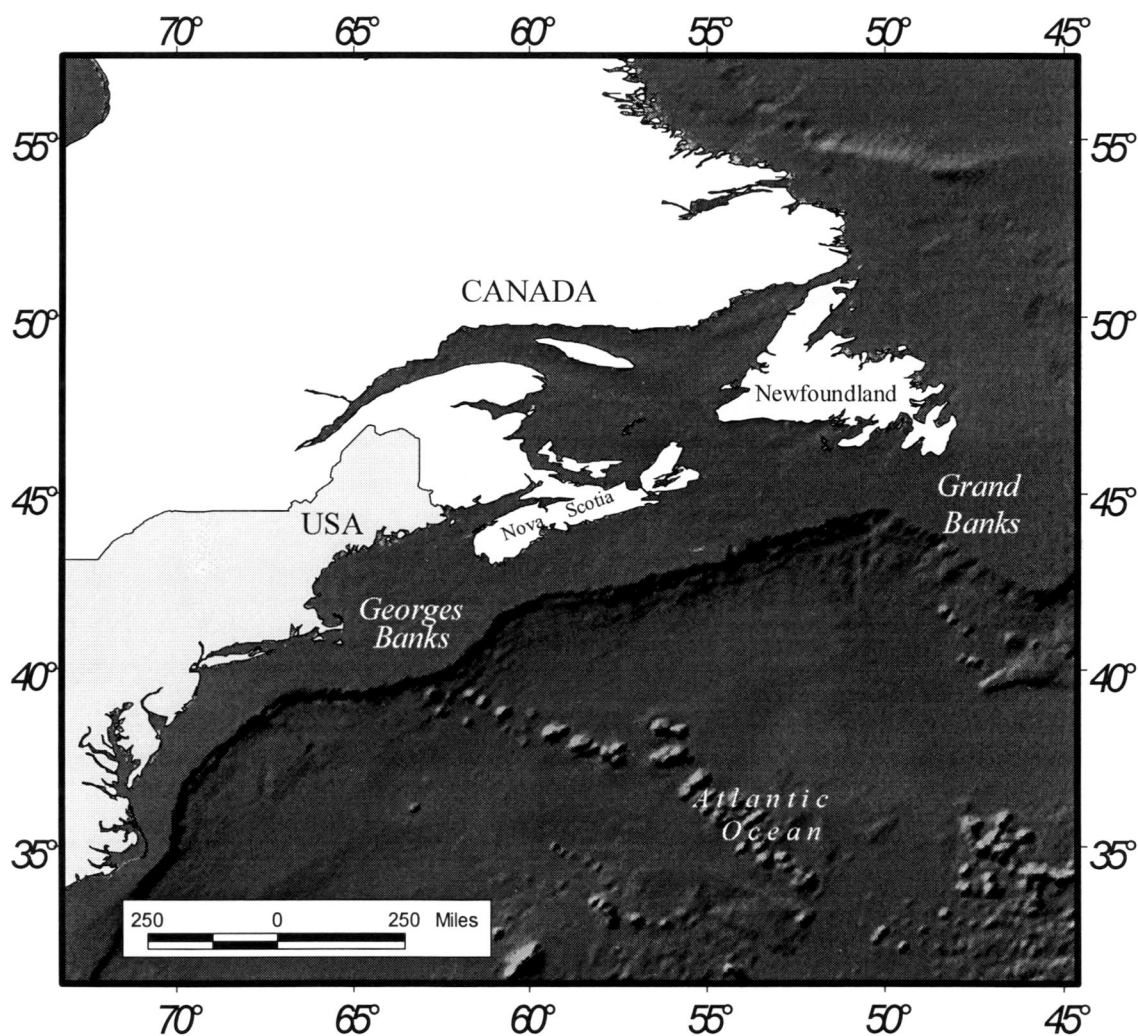


Figure 2. Fishing grounds: Georges Bank and the Grand Banks. (Map by Brian Andrews.)

²⁶ Samuel Eliot Morison, *Maritime History of Massachusetts*, 234, 328.

to American shippers and shipbuilders. When gold was discovered in California that same year, New England was primed to provide both the ships and the mariners to sail them. The great clipper ships developed in the 1850s are a development of that era.

The middle of the nineteenth-century was a bonanza for American transportation and trade of every variety. American railroads continued to expand, connecting inland communities with seaports. Once there, of course, the cargoes were transferred to ships, which, themselves, were growing larger, faster, and more reliable. In the 1840s and 1850s, most cargoes — even inter- and intrastate — were still carried by water. To facilitate that trade more aids to navigation were devised and constructed. Nearly 400 lighthouses and lightships were in place by 1852, and the publication of Matthew Fontaine Maury's *Wind and Current Charts*, not only added to the safety of ships navigating coastwise and off soundings, but reduced costs as well.²⁷ Fewer wrecks obviously saved shipowners their money and mariners their lives, but an increased knowledge of favorable ocean routes also reduced expenses by shaving time off the length of passages.

The invention of the steam engine and the screw propeller began, in the mid-1800s, to transform the shipping industry yet again. With the new use of iron in hull construction, ships became larger and stronger. Soon ships with composite hulls made of iron and wood, powered by steam, were successfully competing against the wooden sailing ship — although for a long time wind-powered vessels had a distinct advantage on all but short-haul routes. On certain routes, steamships could carry cargoes more quickly and reliably, and thus less expensively, than sailing vessels. The British led the way, in great measure because they lacked the timber to build sailing vessels, while they had plentiful supplies of iron and coal. By 1852, nearly all the British

²⁷ Labaree, et al., *America and the Sea*, 246, 273.

trade in the Mediterranean was carried on iron screw steamers, assisted by sails.²⁸ American shipping, however, maintained a viable merchant marine in wooden sailing ships because of a bountiful supply of timber for shipbuilding and the nature of its long-distance trade.

Each type of vessel, naturally, had its own set of problems. The bottoms of iron-hulled vessels quickly fouled; and fuel took up valuable cargo space. Wooden ships, on the other hand, could be copper sheathed and a couple of suits of sails were fuel enough for a voyage to China and back. Nevertheless, no one ever set their watch by the arrival of a sailing ship — so short hops with valuable or perishable cargoes came, increasingly, to be the domain of vessels that did not depend on the winds and could even make way against a tide. Nonetheless, economical shipbuilding and efficient passages on specific routes enabled the wooden sailing ship to continue carrying goods more cheaply than any other kind of vessel.²⁹ Once again, politics made a difference as well. The opening of Hong Kong to American ships in 1834 provided a market

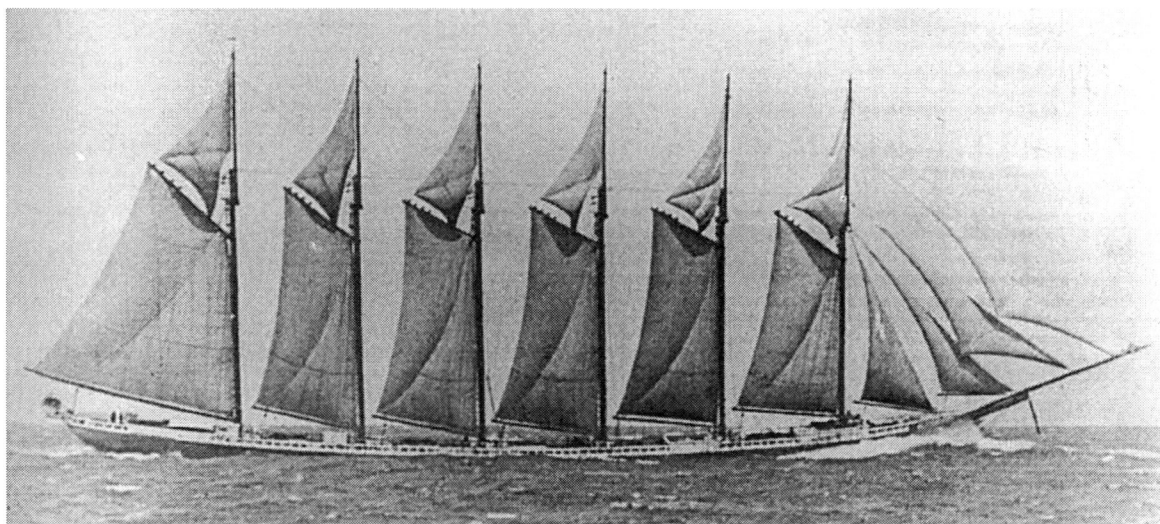


Figure 3. Six-masted schooner *Edward B. Winslow* of Maine, early 1900s. (David R. MacGregor, *The Schooner*, (Annapolis: Naval Institute Press, 1997), 149.)

²⁸ Gerald S. Graham, "The Ascendancy of the Sailing Ship: 1850-85," *The Economic History Review*, 2d ser., 9-10, no. 1-3 (1956-57), 74.

²⁹ R. and R. C. Anderson, *Sailing Ship*, 186; Graham, "Ascendancy of the Sailing Ship," 75, 76.

incentive for ships clearing for Asia. Boston's annual arrivals from foreign ports increased steadily until mid-century. Increased shipbuilding activity throughout New England also meant an increased demand for maritime artisans such as rope-, block-, spar-, and sailmakers, riggers, blacksmiths, coopers, chandlers, etc.³⁰

The 1849 California gold rush provided a shipbuilding incentive of another sort altogether. For the first time, speed was of the essence and that speed would be richly rewarded. Cargoes bound for California were consumer goods and passengers; pay was in gold. The greatest tonnage, of course, was still carried in smaller trading vessels, both coastwise and foreign. It was the clipper ship, however, that marked the pinnacle of marine talents in design, seamanship, and business acumen.

The early 1850s clippers carried five and six times more sail area than Boston's East Indiamen. Designers Donald McKay, William Webb, George Raynes, and John Griffiths built ships bigger and loftier than any that had ever sailed. Their standing rigging was still hemp and

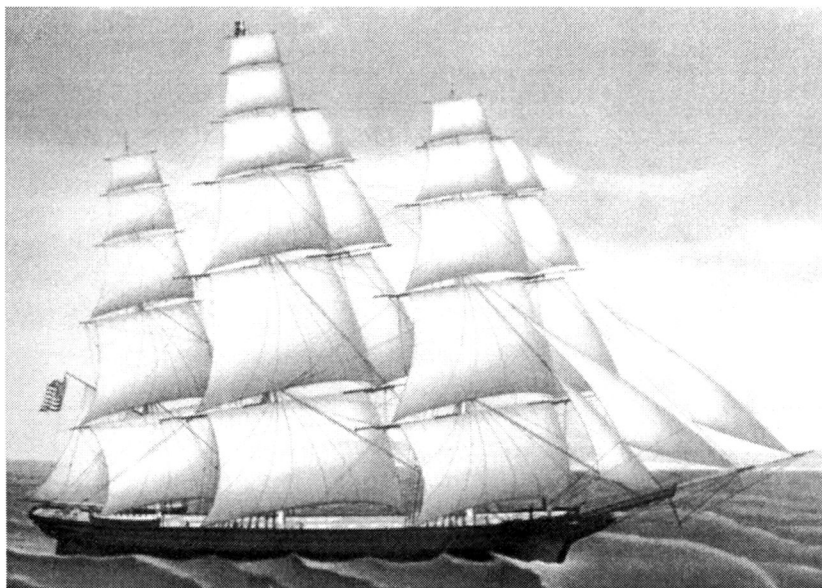


Figure 4. Huge sail area of the clipper ship *Ino*, built in 1851 in New York. (David R. MacGregor, *British and American Clippers* (Annapolis: Naval Institute Press, 1993), 19.)

³⁰ Peterson, *Mystic Built*, 101; Briggs, "Sails and Sailmakers," 3.

spars were wood. Royals had become part of a ship's standard complement of sails, and skysails were carried frequently as well. Sails were bent to jackstays instead of below the yards.³¹ While steam power ultimately supplanted sail, for a time, they enabled tremendous advances in merchant sailing ship design. Before the invention of the steam tug, naval architects had to balance a ship's speed at sea with its need to maneuver in a harbor's tight channels. Now a powered tug could manage the close work and the ships themselves could be designed "simply for speed and seaworthiness, without reference to the conflicting claims at handiness in narrow waters."³² The result was a new class of ships both huge and fast.

The glory days of the clippers ended almost as quickly as they began. The gold that paid for them also built a transcontinental railroad. The golden spike that symbolized its completion in 1869 represented the wealth that would reward those looking inland versus out to sea. The development of more reliable steamships did the same for those whose trade was confined to merchant sailing. The Civil War demonstrated the advantages of steam and "merely hastened a

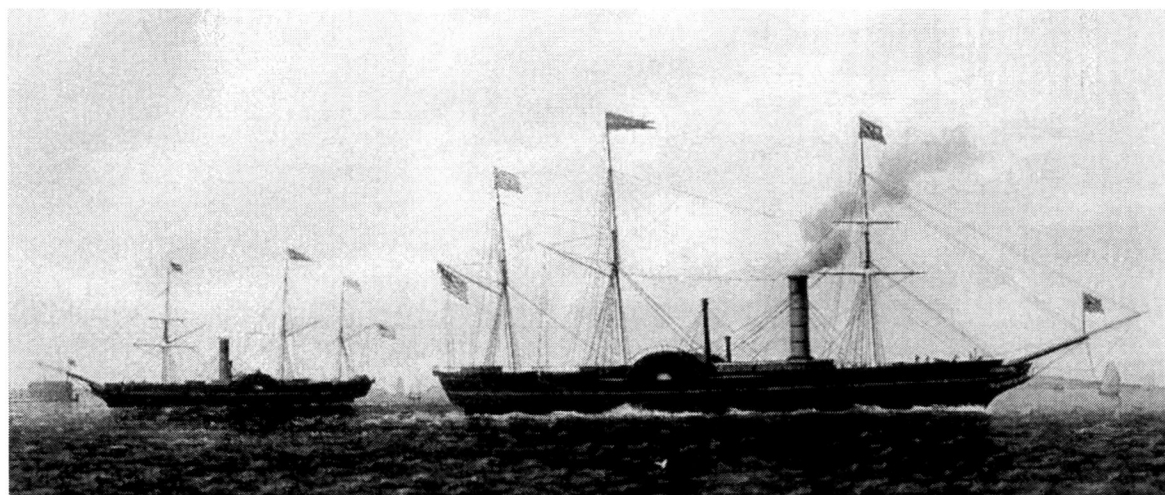


Figure 5. Steam vessel, auxiliary sail, 1847. (Labaree, et al., *America and the Sea*, 303.)

³¹ Samuel Eliot Morison, *Maritime History of Massachusetts*, 327; R. and R. C. Anderson, *Sailing Ship*, 193.

³² R. and R. C. Anderson, *Sailing Ship*, 188.

process that had already begun, the substitution of steam for sail.”³³ For ocean voyaging, steam vessels were still outfitted with sailing rigs to save fuel and serve as a back up in case of engine failure. These rigs were generally modest in size and suitable only for ancillary use. Steam vessels were built with a small length-to-beam ratio, making lofty rigs impractical. Placement of masts around machinery and problems associated with operation of engines when sails heeled a vessel over plagued combination steam and sail vessels. As engines improved, the top-hamper of auxiliary sailing rigs was cut down and ultimately eliminated.³⁴

With the establishment of bunkering depots across the globe, the development of the compound engine, and the opening of the Suez Canal to steam traffic in 1869, the range of steamships increased to the point where the only commercial cargoes that could turn a profit under sail alone were cheap, non-perishable, bulk commodities. Lugging wool, nitrate, grain, oil, and coal became one of the last niches of large ocean-going sailing ships — that, and voyages to ports so remote or poorly equipped that steam vessels could not afford to bother with them. An aging sailing ship could wait for cargo — sometimes for months — and still return to make a profit. The New England merchant sailing fleet suffered a sudden loss of tonnage during the Civil War, both from vessels lost in the conflict and also from ships whose owners transferred to foreign-flag registry to avoid seizure by Confederate raiders. Legislation from 1797 forbid repatriation of American vessels sold or transferred to foreign registry. The unforeseen effect of this law was the permanent exile of the great part of America’s antebellum merchant marine.³⁵

Boston’s registered tonnage of 414,000 in 1860 fell to 54,000 only five years later. By the end of

³³ Samuel Eliot Morison, *Maritime History of Massachusetts*, 369.

³⁴ Charles Singer, E. J. Holmyard, A. R. Hall and Trevor I. Williams, eds., *A History of Technology*, vol. 4 (New York: Oxford University Press, 1958), 593.

³⁵ Labaree, et al., *America and the Sea*, 355.

the 1800s, less than ten percent of American foreign trade was shipped in American vessels.³⁶ Domestic tonnage, however, continued to increase and steam tonnage did not surpass sail until 1894. “Even in 1900, sailing vessels represented more than 46 percent of the American fleet.”³⁷

Sailing ships also suffered the indignity of carrying coal to remote bunkering stations to fuel steam vessels calling there.³⁸ Another niche that kept smaller coasters in business was the domestic trade in everyday commodities and bulk cargoes such as lumber and granite. In the late 1860s, for example, New England lumber and other cargoes kept between two and three thousand sailing vessels employed, mostly schooners.³⁹ Compared to steam, sail was still the economical choice for these day-to-day uses. The cargo determined the type of ship that could carry it at a profit.⁴⁰

In the business of war, however, the age of sail was gone for good. The Confederate burning of the Norfolk Navy Yard in the first year of the Civil War, “created a funeral pyre” for ten sailing men-of-war and, in effect, for the age of the sailing warship.⁴¹ During the conflict, steamships steadily replaced sailing warships. Maritime historian Howard Chapelle explained that if the sailing man-of-war had only to do battle with the side-paddle steamer, she might have survived longer. Development of the screw propeller made the steam warship infinitely more maneuverable. In maritime combat, position is everything. The sailing ship remained useful to the Navy in non-belligerent capacities and new ships were constructed even during the war, particularly for use as transports and colliers.⁴²

³⁶ Albion, Baker and Labaree, *New England and the Sea*, 160.

³⁷ Labaree, et al., *America and the Sea*, 367.

³⁸ Graham, “Ascendancy of the Sailing Ship,” 84, 85.

³⁹ Graham, “Ascendancy of the Sailing Ship,” 82; Bishop, *History of American Manufactures*, 1: 46.

⁴⁰ Buhl, “Mariners and Machines,” 710.

⁴¹ Chapelle, *History of the American Sailing Navy*, 478.

⁴² Albion, Baker and Labaree, *New England and the Sea*, 150-151.

The sailing industry continued to make improvements both in technology and technique. On large, deep-sea sailing ships and smaller coastal sloops and schooners, labor saving devices eliminated the need for large crews, which helped to reduce the payroll. Henry Cunningham's patent-reefing gear, invented in 1850, enabled seamen to reef topsails from the deck by means of a yard that could be rotated by chains, thus rolling the head of the sail upon it, not unlike roller-furling headsails on today's cruising yachts. Linking small steam engines to power winches reduced the need for large crews to muscle halyards, sheets, and ground tackle.⁴³

By the end of the nineteenth century, huge iron and steel sailing ships could be manned by only a handful of men. When the clipper ship *Sovereign of the Seas* embarked on her maiden voyage in 1852 she carried 106 crewmembers. Just over a half century later, in 1904, the German steel, four-masted barque *Kurt* sailed with a crew of only 28. *Kurt* carried 45,000 square feet of canvas, over 10,000 square feet more than the famous clipper. *Kurt's* small crew was able to operate her by using engine-powered winches to set sails and brace yards.⁴⁴ Machine powered winches and innovations in the latter part of the nineteenth century, such as the spike bowsprit and the joining together of lower masts and topmasts as one long spar — made possible by steel masts — made sail handling workable for smaller crews. Even so, these technological changes forestalled, but could not prevent, the demise of merchant sailing.

By the end of the nineteenth century, merchant sailing vessels were on their way out. Some notable exceptions were represented by the continued development of the Gloucester fishing schooner and the growth of very large schooners from Maine. Built with fine lines, deep draft, and a large fore-and-aft sail plan, the Gloucester schooner continued to be refined well into

⁴³ Singer, et al., *History of Technology*, 593.

⁴⁴ *Kurt*, later changed to *Moshulu*. Eric Newby, *The Last Grain Race* (1956; reprint, Oakland, CA: Lonely Planet Publications, 1999), 92-95.

the twentieth century. The knockabout schooner, designed by Thomas McManus in 1901, was capable of greater speeds by increasing her waterline as she heeled over. It also kept seamen inboard by removing the bowsprit and moving the head stays aft to the stem without losing sail area. Although it took some years for fishermen to accept this modification (or to need a new ship), the knockabout schooner was a common design sailing out of Cape Ann by 1916.⁴⁵

Finally, while the merchant marine turned away from sailing ships, the growth of yachting helped sustain specific maritime industries, such as riggers, sailmakers, ropemakers, and blockmakers. The 1816 launch of the first ocean-going yacht, George Crowninshield Jr.'s brigantine, *Cleopatra's Barge*, marked the beginning of American yachting. The schooner yacht *America's* 1851 triumphs in British regattas introduced the eventual shift from sails for commercial ships to sails for racing yachts on which lightweight cloths, appearance, and design for speed were more important than durability, strength and cost effectiveness.⁴⁶

Until the nineteenth century, sailing ships changed very little over hundreds of years. A mariner from 1550 might have been able to sail a ship in 1750 without encountering anything dramatically unfamiliar. During the nineteenth century, however, ships and shipping changed a great deal, incorporating new technologies and adapting to new demands. The famous clippers, while representing the highest achievement of generations of sailing design and handling, were introduced only after the seeds of commercial sailing's demise had already been sown.

The American wooden sailing ship dominated the world's maritime trade from colonial days until just before the Civil War. After 1860, Britain led in constructing iron and wood composite ships and iron-hulled sailing ships until commerce was transferred to steam for good.

⁴⁵ Svensson, *Sails*, 79.

⁴⁶ Robert K. Cheney, "Industries Allied to Shipbuilding in Newburyport," *The American Neptune* 17, no. 2 (April 1957): 120.

In the second half of the nineteenth century, New Englanders continued to build and sail large wooden schooners that could handle huge cargoes while manned by small crews. By the turn of the century, however, the nation's commerce and attention were shifting inward. Railroads now linked the east and west coasts with the hinterland and each other. Most American cargoes were transported in internationally registered ships. The marine engine had come to stay. Sailing craft became vessels for recreation. The associated maritime industries that supported the sailing fleets dwindled to the few who could make their living servicing the remaining commercial sail and the growing yachting fleets.

CHAPTER 3 EVOLUTION OF SAIL DESIGN

Although wind-powered vessels were crucial to human commerce — and warfare — for centuries, little thought was given to better understanding how sails worked or how to improve them. Sail design evolved very slowly, changing little in hundreds, if not thousands, of years. Not until the end of the nineteenth century did scientists and sailmakers begin to understand aerodynamic principles of and apply them to sail plans. Although Bernoulli had published his principle regarding differences in air pressure on either side of a curved surface in 1738, it did not lead to general understanding and use in sail design. American engineer Octave Chanute, who was at the absolute center of aerodynamic research in the second half of the nineteenth century, published a book entitled *Progress of Flying Machines* in 1894. In it, he lamented, “We know comparatively little of the laws and principles, which govern air resistances and reactions.” With regard to how birds fly, “we know very little about it. Here is a phenomenon going on daily under our eyes, and it has not been reduced to the sway of mathematical law.” In his chapter on “Aeroplanes,” he did predict that “curved surfaces may prove more efficient than planes in obtaining support from the air.”¹

Today, the principle of airfoils is understood by anyone with a secondary education. The modern yacht sail is an airfoil. Sails prior to the twentieth century were airfoils too; most, however, were not very effective. Still, although aerodynamic principles were not understood until the close of the nineteenth century, mariners and sailmakers developed sails that worked more efficiently to windward through centuries of trial and error.

The first sails were likely made from animal skins or crude textiles spread across wooden

¹ Octave Chanute, *Progress in Flying Machines* (1894; reprint, Long Beach, CA: Lorenz & Herweg, Publishers, 1976), 1, 235.

spars. Making way to windward was not a consideration. The purpose of a sail was to let the wind reduce the strain on oarsmen by pushing the boat toward a downwind destination. By using the prevailing winds, mariners sailed throughout the Mediterranean and, eventually, across the world's oceans. They developed vessels and sails to maneuver in winds from various directions, but most sailed off wind. The fore-and-aft or lateen sails developed by the Arabs could actually

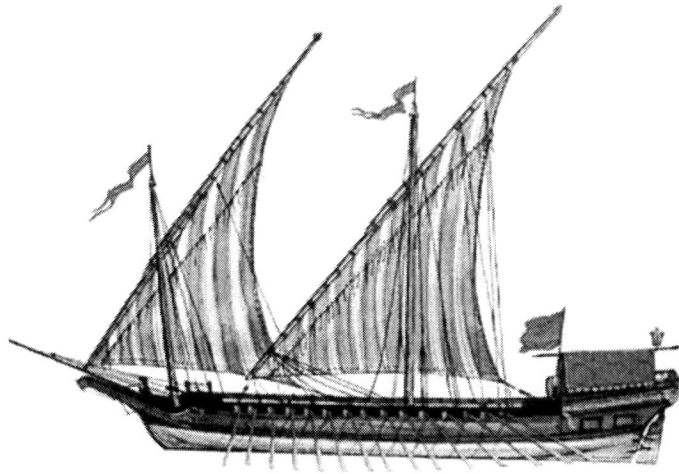


Figure 6. Turkish lateen-rigged galley. (Enzo Angelucci and Attilio Cucari, *Ships* (New York: McGraw-Hill Book Company, 1977), 55.)

make progress into the wind, but even the Arabs remained ignorant of the principles that made this possible. In the tenth century, Vikings stepped a single mast with a square sail nearly amidships. They could sail with the wind on a beam reach by using a pole to stabilize the windward leech. The Nordic knarr led bowlines off its square sail to a bowsprit. Not until the mid-fifteenth century did Northern European ships step multiple masts. In Columbus's time, ocean-going ships commonly carried two or three masts with a combination rig of square sails and a lateen, borrowed from the Arabs, set on the mizzen.²

² Svensson, *Sails*, 11, 12, 15.

Rigs changed just as slowly. Ships were a means of transportation that worked well and few were of a mind to make substantial innovations. For merchant vessels, mariners compromised their desire for speed with the need for efficiency. Their vessels needed to be maneuverable, but with sufficient cargo capacity and crew size to make them cost effective. Naval vessels carried crew, marines, and guns as their "cargo" and thus could be built more for speed and maneuverability. Within these parameters, sails themselves varied little from one ship type to another. Rigs, however, evolved to accommodate more sail area and more versatile sail types. As spars and sails grew larger, too large to handle effectively, they were divided into sections that could be handled independently, thus requiring fewer crew. Sails were constructed with reefs to allow mariners to shorten sail in a blow. Conversely, a bonnet could be attached to a sail to increase its area in lighter winds. The move to multi-masted vessels allowed many variations in rig design. Some ships carried squares on one mast and fore-and-aft on another. Some carried both on one mast. With additional spars, more standing rigging was added to support them. Mariners seeking to carry as much canvas as possible made sails to set on the stays, thus the fore staysail, main topmast staysail, and mizzen royal staysail, amongst many others.

In the early eighteenth century, the lateen mizzen on two and three-masted ships evolved into a gaff sail when the forward end of the spar was cut off beyond the mast. The gaff sail changed the configuration of sailing rigs once mariners came to appreciate its windward sailing abilities – again, without necessarily understanding why. Other fore-and-aft sails had been used on ships since the middle of the seventeenth century when triangular sails were set on the stays of masts and topmasts. On the bow, staysails made their appearance in the form of jibs in the English Navy in 1705. For a while, jibs and the spritsail topsail were carried together, but they fouled each other and mariners soon favored jibs and staysails over the clumsy spritsail rigs. A

jib boom and jibs in place of a spritsail “had a lifting effect on the bowsprit, quite different from the downward pull of the old spritsail.” To counter this effect, riggers added the bobstay underneath the bowsprit to hold it down.

As the size of ship hulls grew, so did the sails to move them. The power of the men handling these large sails, however, did not grow proportionately. When sails were cut so large that they could not be handled in the rig, American sea captain R. B. Forbes, in 1841, added another yard on the mast allowing them to split topsails in two sections. Twelve years later, Captain Frederick Howes improved Forbes’s rig with double-topsail yards, which became standard in large and medium-sized merchant ships in the following years. While mariners added sails up the masts, they also sought to increase sail area outwards. Swedish ships used studdingsails, or stunsails, in the late seventeenth century, but they were not set on American or English ships until the nineteenth century. Attached to stunsail booms that could be slid outboard from course, topsail, and topgallant yards, stunsails provided extra sail area aloft in light winds. They were so labor intensive, however, that mariners had largely given up on them by the Civil War.³ The ship’s top hamper increased in the nineteenth century when topsails and topgallants were proportionally much bigger than in the previous century. By the 1830s, the main topsail was bigger than the mainsail, and the topgallant was more than one-third the topsail. Before then, the mainsail represented about one-third of a ship’s total sail area. In the 1830s, it was less than one-sixth.⁴

With numerous choices between fore-and-aft sails and squares, several rig types developed. For transoceanic travel, the square-rigged vessel maintained its dominance as it could navigate using prevailing winds and currents to sail downwind. The advantage of a square sail is

³ Ibid., 29, 47.

⁴ R. and R. C. Anderson, *Sailing Ship*, 194.

that it can be braced around easily to force the sails aback. On a brig, with one mast's sails set to draw and one set aback, a ship could heave to, pivot almost in place, or move forward or back.⁵ The navy favored brigs for their maneuverability. Barques, full-rigged ships, barquentines, brigs, and brigantines, spread large sail areas before the wind and made efficient passages as long as winds did not come from ahead.

For sailing to windward, fore-and-aft rig works much better. For coastal routes, schooners, ketches, and sloops used fore-and-aft sails to make good progress to windward. The gaff-rigged schooner gained popularity for yachts following on the proven

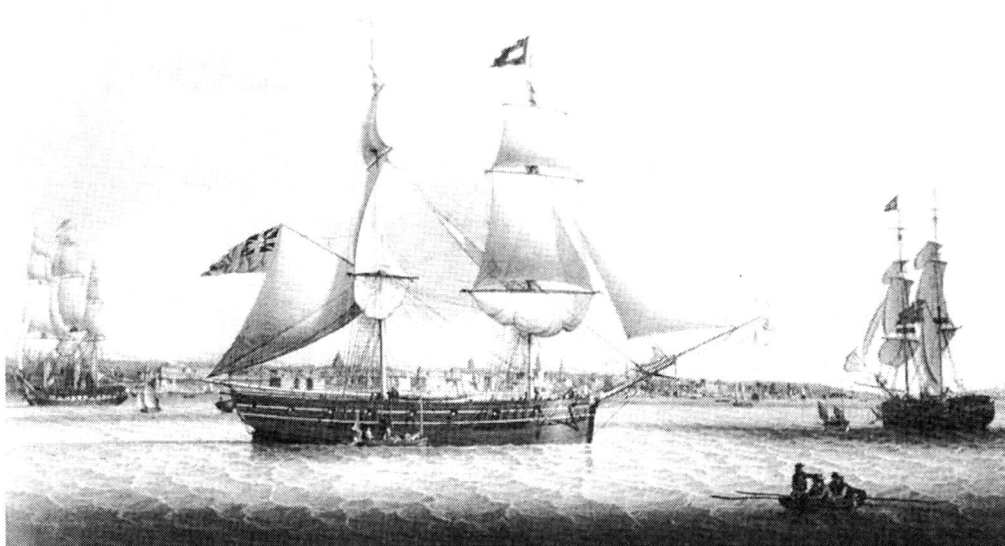


Figure 7. Brig hove to, 1811. (John Harland, *Seamanship in the Age of Sail* (London: Conway Maritime Press, Ltd., 1984), 68.)

success of privateers, slavers, and Baltimore clippers rigged as fast sailers. The leg o'mutton, or pole-masted, rig proved even faster than the gaff rig at the end of the eighteenth century.

⁵ Svensson, *Sails*, 48.

Nonetheless, without scientific theory to explain it, mariners usually stuck with gaff-rigged vessels because of their demonstrated reliability and speed.⁶

The competition between steam and sailing ships led to a huge increase in the size of sailing ships towards the end of the nineteenth century. Steel sailing ships built upwards of 2,300 gross tons and over 300 feet long carried cheap, bulk cargo around the world. While hull sizes increased exponentially, their corresponding rigs could not be built as high proportionately. Steamships won the battle for time-critical cargoes. For a sailing vessel, therefore, a huge hold and low rates became its selling points. Capacity was more important than speed, and cheapness outweighed all. Shipowners converted full-rigged ships to barques, which were easier to sail with a smaller crew. Studdingsails and skysails were left on the dock along with the sailors who would have handled them. Still, these enormous ships carried acres of canvas. Germany's Laeisz P-Line included ships like the *Potosi*, which carried twenty-four square and eighteen fore-and-aft sails.⁷



Figure 8. Four-masted barque *Pamir*, 1905. (Harland, *Seamanship in the Age of Sail*, 39.)

⁶ Ernest A. Ratsey and W. H. de Fontaine, *Yacht Sails, Their Care and Handling*, rev. ed. (1948; reprint, New York: W. W. Norton and Company, Inc., 1957), 44.

⁷ Svensson, *Sails*, 70, 83; R. and R. C. Anderson, *Sailing Ship*, 198.

Important changes in sail design came with the combined interest in yacht racing and scientific study in aerodynamics. Yacht racing blasted into popularity when the New York Yacht Club's schooner *America* crossed the Atlantic and stunned the English by winning a series of races against the best English yachts. These victories, in addition to starting the famed America's Cup races, sparked serious investigation into sail design and construction. The *America* raced with cotton sails, then practically unheard of in England, sewn with eleven-inch seams. The standard of the day were seams ranging from eighteen to twenty-eight inches across — with twenty-four the most common.

The sailing ability of a ship depends on many factors; the cut and material of her sails was an important — but not the only — variable. The shape of the hull below the waterline, “draft, stiffness, trim, and degree of cleanliness of the bottom” each have an impact on sailing quality.⁸ Sails, themselves, are flexible and subject to enormous stresses from the constantly shifting wind speed and direction — which can vary significantly from deck level to upper sails. Stresses on the sail and cloth can also vary dramatically within a given sail. The weather, chafing and other physical stresses can also damage a sail. How a sail was maintained and the quality of its materials and construction all affected a sail's performance. The most important factor in any ship's efficiency, of course, was the intelligence and experience of the ship's officers and crew. A mariner's decisions regarding which sails to set, which to leave stowed, and which to reef, determined a vessel's speed, stability and sailing efficiency. Those decisions were ultimately reflected in the designs of new ships, their sails, and rigs as owners, captains and crews all tried to tune their new ships to the ways they planned to work them.

⁸ Svensson, *Sails*, 61.

On merchant vessels, changes in design came slowly. London's Malcolm Cowan, writing in the first years of the nineteenth century, bemoaned that the construction of sails did not change because the "maritime world" was content to use them,

"everyone following the beaten path of his predecessor's, without examination. Thousands of ships and men ... have been lost, with immense property. Ships are driven onshore every winter by hundreds, that might, with proper sails, have escaped every danger. The loss of one sail, in many situations, is followed by the inevitable loss of ship and crew. Sails are often split in hauling up to reef, and it may be necessary to reef a sail that is worn to preserve it from splitting."⁹

While many designers and sailmakers held to practices they knew well, several innovators experimented with new designs, construction materials, and sailmaking techniques. Square-rig sailing off the wind required no innovations. The problem was how to sail to windward more efficiently and achieve greater speeds without falling off to leeward. Until the appearance of the schooner yacht *America*, sails were built with a certain amount of belly in them — a bulge that tended to grow with use. The advantages of flat sails were widely known, but sailmakers were unable to figure out how to make them. The standard flax canvas had many advantages — flax was light and durable, but stretched-out, linen sails left the idea of flat sails out of the picture altogether. Trying to use flat-sail techniques on a sail that was not up to the job only made things worse. A baggy sail, close-hauled, was useless. "The parts so bagging-out being scarcely struck at all by the wind, are filled only with eddies from the adjoining parts of the sail, which eddies have no force at all."¹⁰

Before they had the scientific understanding of why this was so, *America's* designers and sailmakers provided her with cotton sails, demonstrably "flat" when sailing to weather. (Even

⁹ Malcolm Cowan, *An Essay on the Construction of Sails of Ships in Vessels* (London: J. Peck, n.d.), 3.

¹⁰ Kipping, *Sails and Sailmaking*, 79.

using cotton, “flat” is a relative term. All sails made from textiles fill and belly out to leeward to some extent.) In the study of aerodynamics as it was applied to sail design, the goal was to determine the center of effort – “the point or place in a sail where the whole effort of the wind is supposed to be collected.”¹¹ With the *America*’s success, designers focused on her flat sails, which allowed for the most effective airflow. “It is only by the wind’s motion as it strikes the centre of a sail, and makes its exit out of the leech, that a vessel is propelled through the water when close hauled. Wind that is retarded in its course by uneven sails hinders the progress of a vessel, as it is so much force misapplied, and has a tendency to press the vessel down into the trough of the sea.”¹² Scientists, sailmakers, and yacht designers began testing materials, rig configurations, cutting direction of sail panels, new shapes and designs. Most experiments took place at the close of the nineteenth century and the beginning of the twentieth century — too late to be of use to merchant and military sailing vessels, but just in time for the growth of yachting.¹³

The greatest problem facing sailmakers, before the use of synthetics, was that sailcloth — even cotton — stretched. Stretching destroyed a sail’s shape and, thus, its efficiency. To compensate, sailmakers tried to anticipate the amount of stretch in different places within a given sail. By sewing a boltrope around the sail’s perimeter, they saved the sail from immediate stress, for the boltrope absorbed most of the load of spars, sheets, and halyards that pulled the cloth in opposing directions. Because the rope and cloth stretched at different rates, the sailmaker had to predict how much each would respond to use. He knew to make allowances when sewing one to

¹¹ Ibid.

¹² Samuel B. Sadler, *The Art and Science of Sailmaking*, 2d ed. (London: Crosby, Lockwood, and Son, 1906), 9.

¹³ Notable amongst experimenters were Harold Larner and E. F. Hewins who discovered, using wind tunnel experiments, that the pole-masted or leg o’ mutton sail attained eight percent more driving power when close hauled and twenty percent more when on a broad reach or off the wind. They determined that the problem with the gaff sail was due to its tendency to sag off to leeward. (Ratsey and de Fontaine, *Yacht Sails*, 65).

the other. The tolerances were tight — a sail that stretched beyond its designed shape was inefficient; a sail that stretched beyond the length of its spars was useless.

The schooner yacht *America* challenged conventional sailmaking wisdom. Curiously, after it had been sold following her victories, the new English owners had a replacement suit of sails made from flax and bent on loose-footed — demonstrating conclusively that they had no idea how the boat beat them in the first place.¹⁴ Sailmakers, however, agreed that a flatter shape was desirable, but they debated about the means to achieve it. Many thought, when looking at the *America*, that its cotton sails, with narrow seams and a mainsail laced to the boom, contributed to her superiority. Sails stretch very little along their seams. The narrower the panels, the less stretch, and the flatter the sail. Cotton sails were, at the time, a new technology. Using cotton for sails only became feasible after the invention of the power loom that could weave the fibers closer, harder, and more uniformly than had been possible on hand looms. “Patented methods were also developed and the hard, close-woven sailcloth became standard in American sailmaking between 1815 and 1831.” Those who particularly needed speed — privateers and blockade runners, for example — quickly adopted cotton sails; the American Navy ineffectively pursued them with linen sails.¹⁵ Cotton sails held the wind better. Mariners customarily wet their linen sails in light winds so the fibers would expand and make the sail less porous. With reputations on the line, sailors on the *America* “soaped or greased their sails for the race.”¹⁶

In addition to cloth changes from linen to cotton and in the width between seams, several sailmakers and mariners experimented with how sails were cut and sewn. Fore-and-aft sails were

¹⁴ William Collier, *Classic Sails: The Ratsey and Laphorn Story* (Cowes, Isle of Wight: Ratsey and Laphorn, Ltd., 1998), 30.

¹⁵ Chapelle, *Search for Speed Under Sail*, 211.

¹⁶ Kipping, *Sails and Sailmaking*, 190.

traditionally cut with vertical panels. Several innovators studied and debated crosscut sails — sails with panels running perpendicular to the leech. Sailcloth stretched vertically along the long

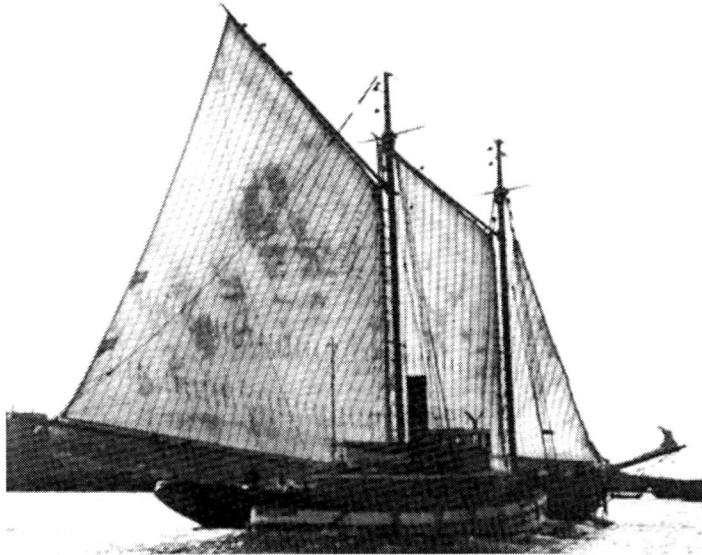


Figure 9. (above) Fishing schooner with vertical seams on sails. (Joseph E. Garland, *Down to the Sea* (Boston: David R. Godine, Publisher, 1983), 61.)

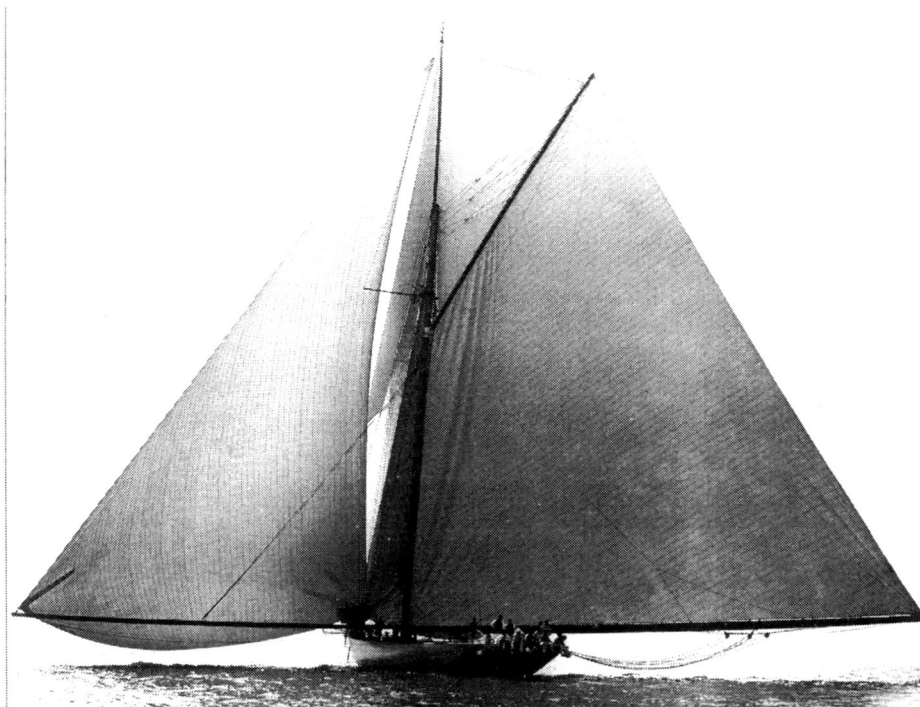


Figure 10. Crosscut mainsail on a ketch from 1899. (Collier, *Classic Sails*, 61.)

fibers of the warp, but almost not at all side-to-side along the shorter weft. As early as 1810, Malcolm Cowan observed that vertically cut sails had other disadvantages as well. The long vertical panels, he noted, were more likely to split their entire length “and to be blown to pieces, either when carrying a press of sail in a gale of wind, on a lee shore, or from the shaking of the sails. ...And a ship and crew might be lost from a few inches of a vertical seam giving way, when there might not be time to take the sail in to repair it.”¹⁷ On squares, crosscut sails were reported to last longer. Cowan published reports from the 64-gun ship *HMS Standard*, that in 1808 normal replacement of a topsail was expected after eleven months of use. With their experimental crosscut topsail, it lasted nearly eighteen months and sailed more efficiently on the wind.¹⁸

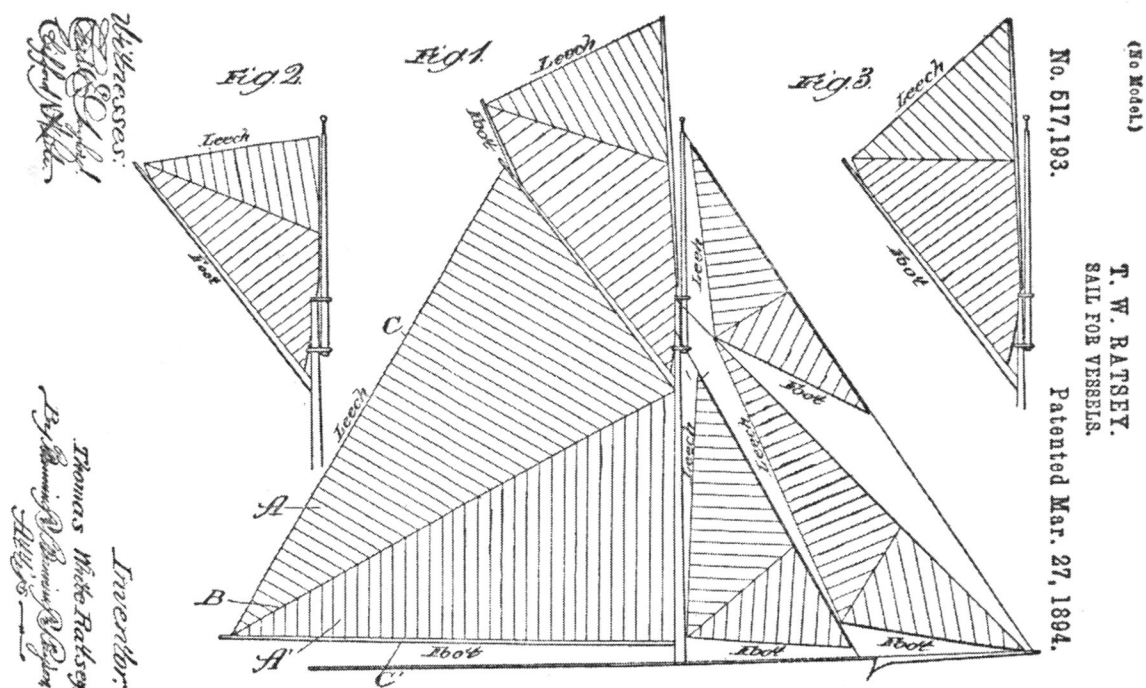


Figure 11. Ratsey's patented diagonal cut sails. (Ratsey and de Fontaine, *Yacht Sails*, 67.)

¹⁷ Malcolm Cowan, quoted in William Falconer, *A New And Universal Dictionary Of The Marine...*, (1784; reprint, London: T. Cadell and W. Davies in the Strand and J. Murray Bookseller, 1830), 423.

¹⁸ Malcolm Cowan, *Essay on the Construction of Sails*, 1.

Yacht sailmakers Ratsey and Lapthorn made many crosscut sails in the second half of the nineteenth century. In 1892 and 1894, they patented another innovation: diagonally seamed sails. Thomas W. Ratsey developed the technique of cutting sails where panels were laid perpendicular to both the leech and the foot, meeting in a diagonal seam from clew to throat. Understanding that cloth stretched very little along the weft, he sought to strengthen his sails along both edges. This method, along with crosscut sails, also allowed sailmakers to cut a roach into the leech, giving it a convex curve instead of concave. In yacht racing, this allowed greater sail power without breaking the rules for size. Leeches on crosscut sails tended to lie flatter. Traditionally, sails developed tight leeches that would curl and hinder the exit of wind. Remember that the optimum performance of a fore-and-aft sail required an equal amount of strain on all parts of the sail and “freedom of exit for the wind.”¹⁹ For headsails, Scotsman Matthew Orr developed the mitered jib with panels lying vertically along the leech and foot meeting on a diagonal from the clew to near the middle of the luff. This method became very

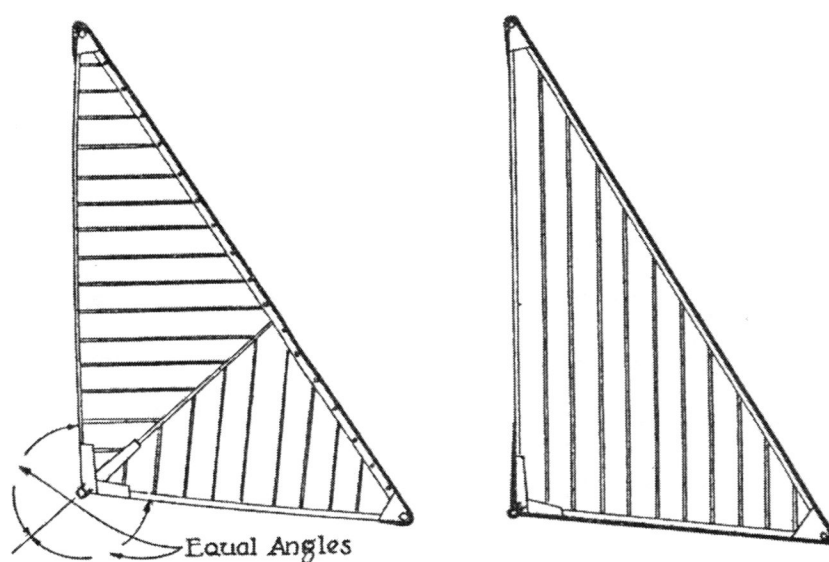


Figure 12. Mitered jib (left); vertical seams, no miter (right). (Ratsey and de Fontaine, *Yacht Sails*, 89.)

¹⁹ Sadler, *Art and Science of Sailmaking*, 2.

popular on ships of all rigs and sizes.²⁰ Towards the turn of the century, Robert Kipping published an appendix on “Pittard’s Improved Angulated Jib,” which included a diagonal miter, but had panels neither perpendicular, nor parallel, to the leech. Pittard claimed it would counter the strain from the jib sheets and reduce stretching along that line.²¹

With the study of airfoils came more dramatic changes in how sails and rigs were designed. Once it was determined that the length of the luff was more important than the total sail area, designers began sketching triangular mainsails set on very tall masts to maximize the luff without making the whole sail unwieldy. Sailmakers also came to understand that “two sails working together produce more drive than the sum of their parts.”²² Called the “slot effect,” wind exits a sail faster than it enters. If one sail is set overlapping the next, the after sail’s lee side receives accelerated wind off the sail ahead of it. This provides even more lift for greater speed and windward sailing ability.

Utilizing the slot effect depended on the crew’s sail trimming skills. If the slot were too narrow, air leaving the forward sail was trapped, and this both back-winded the after sail and caused turbulence on the forward sail’s leech. If the slot were too wide, wind off the forward sail had no effect on the next sail and the two would operate independently.²³ Still it was not until 1914 — a decade after Orville and Wilbur Wright had built an airfoil that could actually fly — that the Massachusetts Institute of Technology finally installed a wind tunnel in its laboratory. The next year Professor Harold Everett conducted experiments using models of yacht sails. Most of his model rigs used tall, narrow, overlapping sails to study and quantify the slot effect.²⁴

²⁰ Ratsey and de Fontaine, *Yacht Sails*, 66. Orr developed this method between the years 1825 and 1830.

²¹ Kipping, *Sails and Sailmaking*, 184-185.

²² Emiliano Marino, *The Sailmaker’s Apprentice* (Camden, ME: International Marine Press, 1994), 125.

²³ Bruce Banks and Dick Kenny, *Looking at Sails* (Boston: Sail Books, Inc., 1979), 23.

²⁴ Ratsey and de Fontaine, *Yacht Sails*, 48.

These experiments proved valuable to the yachting community, but by that time there was virtually no sailing merchant or naval fleet that remained to benefit from their insights.

The scientific study of aerodynamics literally took off in the twentieth century. That research profoundly changed sail performance, both in materials, shape, and construction techniques. The age of the commercial and military sailing ship had ended, but yacht racing had just begun. With the exception of a handful of patents for reefing systems,²⁵ most nineteenth century sailmakers made sails using time-honored techniques and designs. Nineteenth century innovators did make the transition from linen to cotton sailcloth, but by the time serious study of sail performance and aerodynamics arrived, the nineteenth century sailmaker had, himself, departed. The twentieth century sailmaker faced a trade more complicated with scientific theory than ever before. Although the age of commercial sail had drawn to a close, yacht racing now provided sailmakers with work and a challenge to produce sails that could outperform their competitors.

²⁵ Kipping listed several patent reefing systems in his appendices, plus an appendix for Pittard's Cutting Board or Table designed to get the sailmaker off his knees.

CHAPTER 4 HOW SAILCLOTH IS MADE: SEED TO CANVAS

How audacious is life and how full of wickedness, for a plant to be grown for the purpose of catching the winds and the storms...out of so small a seed springs a means of carrying the whole world to and fro....

Pliny, the Elder, first century A.D.¹

The strength of any sail originates from its cloth. In other parts of the world, evidence reveals the use of sail materials such as woven reeds in ancient Egypt, grass and bamboo matting in the Asia, leaves of the screw pine in Malaysia, and skins in South America. In nineteenth century America and Europe, sailcloth was manufactured from flax or hemp linen, and later, cotton duck. The supply of quality sailcloth was a problem for American shipowners, sailmakers, and the Royal Navy at the onset of the colonial period and was aggravated greatly during wartime when ships were in demand and sailcloth was hard to obtain. This was partly due to the means of production.

Artifacts from textile production, both tools and cloth, have been discovered in some of the world's most ancient archaeological sites including Egyptian tombs and Peruvian burial sites. In all regions of the world, people developed cloth production ranging from subsistence farms to organized manufactories. The first generation of American colonists engaged in flax and hemp production. *Flax* and *hemp*, by definition, refer to the plants themselves and unspun fiber, *linen* to the spun fiber and woven cloth.² The General Court of Massachusetts in 1641 instructed colonists to “gather and improve” wild hemp and that all masters of families direct their children and servants to work flax and hemp for clothing. The wild hemp noted was *Apocynum cannabinum*, an “indigenous plant growing in all parts of the United States, from Canada to

¹ Pliny, *Natural History*, Book 19, 423, quoted in Linda Heinrich, *The Magic of Linen: Flax Seed to Woven Cloth* (Victoria, B.C.: Orca Book Publishers, 1992), 1.

² Linda Heinrich, *The Magic of Linen: Flax Seed to Woven Cloth* (Victoria, B.C., Canada: Orca Book Publishers, 1992), 5.

Carolina. It is a very different plant from the Indian hemp which furnishes the intoxicating [hashish.]”³ Native Americans used wild hemp for cordage and linen clothing. Linen’s tensile strength made it well-suited for sailcloth. Mariners did not accept cotton as an



Figure 13. Flax, hemp, and cotton plants. (Charles G. Davis, *How Sails Are Made and Handled* (New York: Rudder Publishing Co., 1931), 20.)

alternative for sailcloth until well into the nineteenth century when it could be manufactured into a cloth durable enough for use on seagoing ships. Cotton, too, was indigenous to the United States, yet several varieties from abroad were used for canvas before domestic cotton agriculturists and duck producers developed cultivation and processing techniques that produced cloth suitable for sails. Nonetheless, in the first decades of European colonization in America, linen was the cloth of choice. Consequently, colonial leaders and families directed their attention to flax and hemp production.

Cultivation of flax and hemp flourished in Pennsylvania with its German and Scotch-Irish population, both rich in traditions of linen manufacturing. Germans in Pennsylvania grew flax and hemp and produced linen cloth within the first year of their settlement.⁴ By the 1650s,

³ Bishop, *History of American Manufactures*, 1: 302-303.

⁴ Donald Graves and Michael Colby, “An Overview of Flax and Linen Production in Pennsylvania,” *Pennsylvania Folklife* 35, no. 3 (1986): 109.

Swedes in the Delaware Valley raised, spun, and wove flax into linen. Between 1720 and 1750, a mass migration of Europeans arrived in Pennsylvania, bringing with them both the productivity of 30,000 laborers and the skills of flax cultivation and processing. Maryland and the southern states also grew hemp and flax in the eighteenth century. Reports from Peter Purry in 1731 Carolina noted that flax, hemp, and cotton “thrive[d] admirably,” but that few people there knew how to process it, so very little was cultivated.⁵ Before mechanization, linen production was a household industry. Flax and hemp plants grew on farms where men did the breaking and heckling, while women and children performed the spinning, weaving, bleaching, and dyeing. Most households produced linen for their own needs, particularly clothing, but in seaport communities, families produced linen for sailcloth as needed. In the eighteenth century, all of the colonies produced flax in various quantities. Farmers raised hemp more successfully in Pennsylvania’s climate and soil than in New England but, on newly tilled soil, grew it as far north as Maine. The Merrimac and Connecticut Valleys in New England were among the most important flax regions, along with the Hudson Valley, Delaware Valley, northern New Jersey, and Maryland.⁶

Flax and hemp are bast fibers — bast referring to soft fibers produced in the stem of the plant between its woody core and outer bark. “The fibers form a single band, several cells thick, in the periphery of the stem. This band houses approximately fifteen to forty fiber bundles joined by a matrix of pectinous substances.”⁷ Flax, *Linum usitatissimum*, is an annual plant that reaches a height of about forty inches and has delicate structure. Farmers grew two kinds of flax, one for fibers, and the other for seeds. Fiber flax, textile flax or linseed, oil seed, or seed flax

⁵ Bishop, *History of American Manufactures*, 1: 335, 351.

⁶ Victor S. Clark, *History of Manufactures in the United States: 1607 – 1860* (New York: McGraw Hill Book Company, Inc., 1929), 82.

⁷ Heinrich, *Magic of Linen*, 3.

refer to these designations. Fiber flax can be grown in most temperate regions, yet certain climates are more suitable than others. In addition, “careful crop management, harvesting and processing [were] essential to produce long luxurious fibers.”⁸

Fiber is extracted from the rest of the plant through retting, a processing step which dissolves the pectins binding fiber bundles together. After processing, flax fibers measure twelve to forty inches long, have a marked luster, and are yellowish in color. Linen was chosen for sailcloth because flax fibers are soft, flexible, and strong. During processing, flax fibers are separated into two groups: long, shiny, strong fibers are termed *line* flax, while the short, dull, weak fibers are known as *tow* flax. Flax is also cultivated for its seeds used as meal and linseed oil.

Hemp, like flax, has a lustrous fiber, but it is a coarse, strong plant yielding fibers three to eight feet long, steel gray to creamy white in color. Some of its finer grades are used for linen. The bulk of hemp was processed and spun into twine and cordage. Rope was made primarily from hemp, “not because it was stronger but because it was cheaper than flax” and resistant to salt water. Flax required more handling in the retting process to produce quality fibers, so it cost more. The processing steps of flax and hemp, nevertheless, were essentially the same.⁹

Flax linen production began as a home industry and later evolved into a large-scale commercial venture. It was a staple of household manufacturing because it could be raised, processed, spun, woven, and sewn on the farm. Particulars of selecting seeds, when to plant, and how to sow were debated amongst growers. Seeds from Cambray, France, for example, were

⁸ Ibid., 5.

⁹ Heinrich, *Magic of Linen*, 3; Dr. Isabel B. Wingate, *Fairchild's Dictionary of Textiles*, 6th ed. (New York: Fairchild Publications, 1979), 243, 291; G. Melvin Herndon, “A War-Inspired Industry: The Manufacture of Hemp in Virginia During the Revolution,” *The Virginia Magazine of History and Biography* 74, no. 3 (July 1966): 309; American Home Economics Association, *Textile Handbook*, 3d ed., rev. (Washington D.C.: American Home Economics Association, 1966).

considered so superior by the French government that they forbade their export. An 1822 study by the Linen Board of London concluded that the Dutch mode of cultivating flax was the most exceptional.¹⁰ Successful growers planted flax early because it could withstand light frosts. Hemp resisted drought, severe frosts, disease, and infestation, making it a more certain investment for those who cultivated it. Fiber flax plants were sown closer together than oil seed flax to produce taller plants with fewer branches and thus fewer seeds. Before spinning, farmers prepared flax via five steps: rippling, retting, breaking, scutching, and hackling.¹¹

In the Netherlands and France, flax was allowed to mature and never pulled before the seed had completely formed, its “capsule brown and hard, so as to be easily disengaged from the stalk.”¹² Left standing in bundles in the fields, the flax could air and dry. Next, *rippling* removed the seed bolls from the flax stems with a rippling comb — “an iron or wooden device with one or more rows of long metal nails or teeth.” Variations of this tool were used in different regions. For example, Italians used wooden mallets to remove the seed bolls, while in Sweden, Flanders, and Scotland, rippling combs were incorporated into benches. The Pennsylvania Germans used heavy, long-handled mallets for the same purpose.¹³ Using a rippling comb, stalks were held from the root ends and drawn through the grid of metal teeth to remove the seed bolls on the tops.

The next step, *retting*, proved the most crucial, and it became a point of contention for manufacturers and consumers as evidenced in more than a dozen debates and studies by the American navy and Congress in the first part of the nineteenth century.¹⁴ The value of the final

¹⁰ *American State Papers*, 6, *Naval Affairs*, 2: 32.

¹¹ Heinrich, *Magic of Linen*, 3, 19.

¹² *American State Papers*, 6, *Naval Affairs*, 2: 33.

¹³ Heinrich, *Magic of Linen*, 19, 20.

¹⁴ See *American State Papers*, 6, *Naval Affairs*.

product depended greatly on the success of this processing step. Retting (also *rotting*, *wretting*) dissolved the pectins or glue that held the fiber bundles together within the woody stalk of the plant. Farmers considered this step “the bane of flax processing because of its unpredictability.”¹⁵ The retting process stopped before actual rotting. The goal was to dissolve the pectins connecting the fiber bundles together without dissolving the pectins between the individual cells within the bundles. Thick stems ret faster than thin because they “contain more wood, proportionately less fiber, and the pectin layers are thinner.” Thus, sorting the flax stems into groups of equal thickness promoted an even ret.¹⁶

Flax producers retted their crop by one of two means: water-retting or dew-retting. Generally, European producers water-retted crops while Americans dew-retted theirs. In water retting, rippled flax was immersed in stagnant or running water. Bacteria and moisture acted together to cause the pectins and woody matter to rot leaving the bast fibers to be separated in the next step of processing. Stagnant water produced discolored, foul-smelling fibers. As a result, flax retted in stagnant water often required a second step of rinsing after the initial submersion and then *grassing* or spreading the flax out across a meadow to finish the ret.¹⁷ Virtually any natural or man-made waterway could be used for water-retting flax. In Holland and Ireland, man-made trenches across the countryside provided ideal means for water retting. Nonetheless, any pond, lake, river, or creek would do. Often, flax producers, particularly the Dutch, would submerge the flax bundles, or *sheaves*, in several layers separated by coatings of mud to exclude light and air. This would render a fiber more uniform in color and quality. The flax remained

¹⁵ Graves and Colby, “Flax and Linen Production,” 119.

¹⁶ Heinrich, *Magic of Linen*, 21.

¹⁷ Wingate, *Fairchild's Dictionary*, 503; Heinrich, *Magic of Linen*, 23.

submerged from six to thirteen days with the cultivators inspecting samples carefully after the fifth day to avoid over-retting.¹⁸

Dew-retted flax was spread in thin layers on the ground, and the pectins dissolved over time through the interaction of molds, warm air, oxygen, and moisture. Though the flax had to be turned and inspected regularly, it was a simple and inexpensive process. Dew retting relied on very heavy dews or rain to attain the desired results. Dry or cold weather brought the ret to a standstill. Its dependence on weather conditions made it an unpredictable process, much greater than in water retting. Generally, it took two or three weeks to accomplish a dew ret.¹⁹ Cultivators determined if the ret was finished by wrapping the stem around their fingers. If complete, the fiber would separate easily from the inner woody core. Under-retted flax could be re-retted, but over-retted flax was ruined. Once the ret was achieved, flax was rinsed and set out to dry in *chapels* (also called *gaits*, *wigwams*, or *pyramids*) in the cut fields for a week or so. “The fanned-out roots provided a base on which the stems [could] stand. After several days, the chapels [were] turned inside out.”²⁰

When the retted flax dried, farmers separated the fiber from the inner woody core, termed a *boon* or *shive*, by *breaking* or crushing it with wooden mallets against heavy flails with ribbed bottoms or, in time, a flax *brake*. The flax brake consisted of a “heavy hinged, movable upper part with one or more blades which [fell] into the grooves in the solid lower part. The grooves [allowed] the broken woody core to fall through to the ground.” A handful of clean fiber coming off the brake was called a *strick*. Fragments of boon stuck to the fiber after breaking were removed in the *scutching* or *swingling* process. If the flax had achieved a proper ret, the boon would have shattered in the breaking process, and scutching would have been unnecessary.

¹⁸ *American State Papers*, 6, *Naval Affairs*, 2: 34.

¹⁹ Wingate, *Fairchild's Dictionary*, 503.

Usually, however, some of the woody core clung to the fiber and needed removal through scutching. This step required two pieces of equipment – a wooden blade and tow board. Eventually, scutching machines were developed that resembled ships' wheels with four to twelve blades sticking out like spokes and operated by foot pedals. "The broken flax was placed over a board close to the wheel, and the revolving blades struck the flax and removed the remaining bits of boon."²¹ Finally, scutched fibers were *hackled* to separate the long line fibers from short tow fibers. The hackle consisted of a bed of nails of varying height, thickness, number, and arrangement. The fibers were drawn through the hackle from the coarse, widely spaced pins to the fine, densely spaced pins. Fiber trapped in the hackle would be saved and spun as tow fiber. The remaining strick would be lustrous, uniform in length and color, and ready for spinning.

"Spinning is the process of drawing out fibers from a mass and twisting them together to form a continuous thread or yarn."²² Thread is composed of many fibers, each shorter than the thread they form, spun into strands, and twisted together to form what appears to be a continual long cord. Spinning can be carried out with the aid of a spindle and distaff or a spinning wheel and, later, via a number of inventions, the most significant being the Arkwright automatic spinning frame developed in 1768. The spindle and distaff were amongst the earliest spinning tools. A quantity of loose fibers was tied to the distaff, a stick measuring approximately one foot long. The spinner would attach the other end of the fibers to the spindle, drop the spindle slowly to the floor, wind the thread around it, and repeat the process until the fiber was used up or the spindle was full. The spinning wheel was the first improvement to the spindle and distaff. It allowed the spinner to "turn the spindle, twist the fibers, and wind the thread mechanically

²⁰ Heinrich, *The Magic of Linen*, 22-26.

²¹ Heinrich, *The Magic of Linen*, 28-30.

²² The Learning Company, Inc., "Spinning and Weaving," *Compton's Encyclopedia Online* (version 3.0, 1999), INTERNET.

instead of manually.” With the distaff fixed to the end of the wheel, the spinner would feed the fiber to the spindle, which rotated with the turn of the wheel. A *flyer* twisted the thread before it was wound on a bobbin. The bobbin turned more slowly than the spindle allowing the spinner to twist and wind the thread simultaneously. The amount of twist given the fibers determined, in part, the strength of the final product. Sir Richard Arkwright developed his famous water-frame machinery by “combining the isolated and imperfect discoveries of earlier patentees into a practical and nearly automatic system for preparing and spinning cotton.”²³ His invention spun threads using rollers powered by water. Threads and yarns coming off Arkwright machinery were strong and hard, suitable for warp threads. Samuel Slater introduced this system to United States manufacturing at Pawtucket, Rhode Island, in 1790, traditionally recognized as the start of the American Industrial Revolution. Slater had been an apprentice under Arkwright in England and immigrated to the United States. American innovations and improvements on this system over the next century, such as throstle spinning, mule spinning, and the ring traveler, promoted the use of cotton suitable for sailcloth.

Weaving interlaces two sets of threads, usually at right angles, to produce a length of cloth. Lengthwise threads are called the *warp*; crosswise threads are called the *weft*, *woof*, *filling*, or *shoot*. Simple weaving can be accomplished by hand, but the aid of a loom produces workable lengths of cloth with relative uniform tension. Simple looms date from antiquity and consisted of a framework of beams holding parallel warp threads. A weft thread was woven across them. A major improvement in the loom was the introduction of the *heddle*, which lifted alternate, warp threads in a set allowing a weft thread to pass through them all at once by means of a block of wood called a *shuttle*. The space between the two sets of warp threads is called the *shed*. The term *selvage* referred to the cloth panel’s finished edge. Thread count and the density

of warp and weft yarns determine the closeness or looseness of the weave. The strength of the cloth depends upon the strength of the individual threads that make up the weave. Linen and canvas are made from the most basic weave consisting of the weft passing over and under each warp thread for the entire length of the cloth. The order of interlacing is alternated with each row resulting in a checkerboard pattern and producing the strongest cloth possible because the threads can be very tightly interlaced.²⁴ Cloth produced on looms is generally much longer than it is wide.

Canvas was identified by number or weight per measured bolt — for the Royal Navy, canvas was 24 inches wide and a bolt 38 yards long. Smaller numbers represented heavier cloth; No. 00 represented the heaviest cloth typically used for Cape Horn passages. Numbers 1 to 6 were termed double, and above No. 6, single canvas.²⁵ The Admiralty laid down specifications that “Nos. 1, 2, and 3 canvases should be composed of at least 560 double threads of yarn, both warp and weft to be of long-staple flax with no admixture of tow whatever. It seems that some of the more unscrupulous sailcloth manufacturers tended to mix tow with some of their cheaper grades of sailcloth.”²⁶

Table 2. Numbers of canvas and corresponding weights

No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
44 lbs.	41 lbs.	38 lbs.	35 lbs.	32 lbs.	29 lbs.	24 lbs.	21 lbs.

Note: Bolts measured 24 inches across by 38 yards long for this designation.

Before the Industrial Revolution, spinning and weaving were home industries. Whole families took part in linen production; many were skilled artisans who brought their knowledge

²³ Clark, *History of Manufactures*, 1: 425.

²⁴ Learning Company, Inc., “Spinning and Weaving.”

²⁵ Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 62.

²⁶ Horsley, *Tools of the Maritime*, 288.

and traditions with them when they migrated to America from Europe. Account books reveal that merchants gave flax, wool, and cotton to rural families to spin and weave for them.²⁷ Nonetheless, flax processing “remained a tedious and time-consuming job.” As an industry, linen production was limited. Labor was expensive, Europe had an abundant supply of raw materials near its factories, and European technology was more advanced. In the early part of the nineteenth century, however, many machines came on the United States market to aid in flax production from seed to spinning, and flax mills became common. In the United States and Europe, private and public interest in machines increased: even Napoleon offered one million francs to the inventor, of any country, who submitted the best machine for spinning flax. In 1810, American businesses for spinning and weaving flax were few in number. On record, an establishment in New York State employed twenty-six workers and annually spun and wove 90,000 pounds of flax into canvas and coarse linen. Two firms outside of Philadelphia manufactured both flax and cotton canvas — one produced annually 72,000 yards of canvas made from a combination of flax and cotton, the other 500,000 yards of cotton bagging, sailcloth, and coarse linen.²⁸ By the 1820s, spinning machines were effective enough to allow factories to take over production. By 1860, steam and acid treatments replaced water and dew retting, leaving only plant cultivation to the family farm.²⁹ In factories, boys chiefly performed the labor. In a ten hour work day, manufacturers expected that a boy could spin almost 300,000 feet of flax or hempen thread or weave fifteen to twenty yards of sailcloth on machinery.³⁰

Towards the end of the nineteenth century, flax and hemp continued to be spun and woven on household looms and in small mills in the mid-west and West for coarse linens and

²⁷ Clark, *History of Manufactures*, 2: 163.

²⁸ Bishop, *History of American Manufactures*, 2: 149.

²⁹ Graves and Colby, “Overview of Flax and Linen Production,” 119, 121.

³⁰ Bishop, *History of American Manufactures*, 2: 71.

bagging. In the Northeast, a few larger mills produced linen and linen thread using imported flax. In New England, hand weaving of linen ceased between 1830 and 1840.³¹ By the early twentieth century, very little flax fiber was prepared in the United States despite the extensive cultivation of its seed. Hemp processing held on much longer than flax processing because of its use in cordage and binding twine.³²

One of the most significant developments in the history of sailmaking was the change from flaxen linen to cotton duck. Duck is a “broad term for a wide range of strong, firm, plain weave fabrics...usually made of cotton, although sometimes linen is used. The terms *canvas* and *duck* are used interchangeably, but canvas often is used to refer to heavier constructions.” The term *duck* originates from pre-nineteenth century when nearly all sailcloth was imported from Europe. European producers stenciled lighter flaxen cloth with the trademark of a raven and the heavier cloth, a duck. Thus, duck took on the designation of the heavier canvas and was transposed to cotton canvas after manufacturers introduced it to the United States market in the nineteenth century.³³ Cotton is one of the few cellulosic fibers — cotton, flax, hemp, jute, and ramie — whose strength increases when wet. Cotton fiber grows in the boll or seed pod of the plant and is cultivated in warm climates. Before Eli Whitney invented the cotton gin in 1793, removing fibers from seed bolls proved too time-consuming for mass production.³⁴ Different species of cotton plants produce fibers of varying lengths from one-half inch to two inches. When cotton sailcloth was first developed, Americans predominantly used two kinds for making sailcloth, southern American and Egyptian.

³¹ Clark, *History of Manufactures*, 1: 430.

³² Clark, *History of Manufactures*. 2: 120, 3: 218, 219.

³³ Wingate, *Fairchild's Dictionary*, 205-206.

³⁴ *Textile Handbook*, 13; Charles G. Davis, *How Sails Are Made and Handled*, 24; Graves and Colby, “An Overview of Flax and Linen Production,” 117.

Cotton fibers are much shorter and finer than flax, but its woolly fibers twist spirally. When spun, the fibers interlock and make a very strong yarn. The spinning jenny was invented around 1767 in England, and an example was exhibited in Philadelphia before the Revolution began. Jennies were the first multiple-spindle machines used in the United States and allowed one person to spin twenty or more strands at a time. By 1790, a South Carolina mill using waterpower for its ginning and carding machinery employed the use of spinning jennies. Hand-jennies were in use in Rhode Island at this time for manufacturing cotton. In the same year, another mill in Haverhill, Massachusetts, operated power driven, multiple-spindle jennies to spin flax for sailcloth. In cotton factories, Arkwright machinery quickly replaced jennies in short order when they became available in the United States. Jennies could not spin cotton fiber into a thread strong enough for warp threads, and until this was accomplished, cotton replaced flax only for lighter fabrics.³⁵ Before 1790, only Great Britain was spinning cotton threads by power using Arkwright machinery.

Inventions in spinning technology led to a surplus of thread and yarn and, thus, naturally, drew attention to looms. The development of the loom enabled weavers to keep the warp threads parallel and maintain a higher degree of tension in the weave. On hand looms, the quality of canvas varied considerably with the skill of the weaver and grade of the yarn. Automatic looms were invented in Europe before spinning machinery, but their use was intermittent until 1785 when the Cartwright loom was introduced. It was not, however, suitable for factory use. In the United States, Francis Lowell invented a loom in 1814 that was used successfully in Waltham, Massachusetts factories. Three years later, mills in Rhode Island were using power looms from Scotland, which were cheaper and simpler than Lowell's loom.³⁶ With the invention of the

³⁵ Clark, *History of Manufacturing*, 1: 424-425.

³⁶ Clark, *History of Manufacturing*, 1: 429.

power loom, weavers could produce cotton cloth with a very tight weave, excellent for sailcloth. This change led to a significant increase in sail efficiency for those shipowners and captains who chose to accept it.³⁷ After the power loom arrived in America, the growth of power-weaving was very rapid, much more than in Great Britain “where industrial conservatism, manufacturing organization, and the large production of fine fabrics, which at first power weaving was not adapted, tended to maintain hand weaving.”³⁸

By the middle of the nineteenth century, manufacturers were mass-producing textiles, and within that category, sailcloth. With the aid of power machinery, both flax and cotton canvas could be made to suit seagoing ships in large quantities. The switch to cotton, however, took quite some time despite enthusiastic reports from ship captains and, most especially, the yachting community, which was won over by the success of cotton sails on the yacht *America* in 1851. For a number of years, however, the advantages of one material over another provided fodder for endless debate amongst mariners. Flax, hemp, and cotton canvas did not equal one another in costs, wear and tear, handling, and behavior under diverse weather conditions and everyone had an opinion about which material was best suited to his needs.

³⁷ Horsley, *Tools of the Maritime Trades*, 287.

³⁸ Clark, *History of Manufacturing*, 1: 429.

CHAPTER 5 DIFFERENCES BETWEEN FLAX, HEMP, AND COTTON FOR SAILCLOTH

For centuries, most of the world's mariners solely relied on flax and hemp for sailcloth. The plants could be cultivated in many geographic regions, though some produced more prolifically than others. Cotton was grown world over, but its suitability for sailcloth did not occur until the advent of the cotton gin, power loom, and the Industrial Revolution. The change from linen to cotton canvas at first was erratic and highly dependent on personal perceptions of the advantages of one material over another. Both government and private interests investigated the option of using domestic cotton as a substitute for sailcloth because suppliers could not guarantee a regular inventory of foreign flax and hemp canvas, especially in wartime. Between 1823 and 1835, Congress conducted several studies comparing cotton to flax and hemp for sailcloth and cordage in an effort to reduce expenses and secure a domestic supply of sailcloth for the Navy.¹ Comparing the three plants and their products revealed many similarities yet demonstrated, also, the reasons for cotton's ultimate dominance as sailcloth. In spite of experiments and test results that elevated some people's opinions of cotton as a suitable alternative for sailcloth, many mariners continued using sails made of linen. Their lives and livelihoods depended on their choice, and linen, despite its limitations, had stood the test of centuries. Most sailors had never seen anything else used in their rigs.

Both flax and hemp could be woven into linen and accounts from the first half of the nineteenth century rarely differentiate between the two. For the most part, however, hemp was made into cordage and twine because it was strong and cheaper to process, plus, its long fibers

¹ *American State Papers*, 6, *Naval Affairs*, Vols. 1-4.

resisted salt water. Both flax and hemp linens were stronger wet than dry.² Flax linen was coarser than cotton and difficult to spin very finely. During the eighteenth century, Southern planters started to turn their attention to cotton as a potential textile crop. At the outbreak of the Revolution, anticipating a shortage in English manufactures, planters began to devote growing numbers of fields to cotton.³ During this period, planters relied on slave labor to remove lint manually from the boll. Sailmakers preferred Egyptian and Sudanese cotton for sails, but American cotton was woven into acceptable cloth as well. Cotton fiber is short and fine, rarely more than an inch long — compared to flax fibers, which average from eighteen to twenty inches long. Nonetheless, cotton's woolly, twisted structure "causes resistance between the fibers when they are spun into thread, and naturally produces a uniform cloth."⁴

New England's first cotton duck sails were manufactured in 1809 by Seth Bemis in Watertown, Massachusetts. Sail duck of flax warp and cotton weft had already been made in Philadelphia and Kentucky. Only recently had mills adopted Arkwright machinery to spin cotton threads. Before then, cotton thread was not strong enough for warp threads in sailcloth. Bemis's factory used a twisting machine of forty-eight spindles and employed several English weavers earning fourteen cents per yard. He sold his first cotton duck at sixty-five cents per yard for No. 1 and fifty-eight cents for No. 2. With the success of this first production run, he expanded his business and employed a ship captain, Winston Lewis, as his selling agent. Captain Lewis helped market the cotton duck by using it on his own ships.⁵

² Jeremy Howard-Williams, *Sails* (Tuckahoe, New York: John de Graff, Inc., 1967), 38; American Home Economics Association, *Textile Handbook*, 3d ed., rev. (Washington D. C.: American Home Economics Association, 1966), 14.

³ Clark, *History of Manufacturing*, 1: 85.

⁴ Howard-Williams, *Sails*, 38, 39.

⁵ Bishop, *History of American Manufactures*, 1: 139.

Because cotton furnished a fine thread, it could be woven more closely than flax after mills adopted the power loom. The more tightly woven cloth provided a considerable improvement in sail efficiency. Nonetheless, decades passed before this fact was realized and accepted. The War of 1812 provided the impetus for many vessels to replace flax with cotton for their ships' canvas, as demand was high and blockades kept imports of foreign flax sailcloth to a minimum. Almost twenty years later, in 1829, records show that Congress still grappled with the problem of inadequate supply and escalating costs for Navy sailcloth and cordage. The House of Representatives ordered experiments to test the "comparative fitness of cotton and hemp and also to compare their costs." Clearly, cotton had not supplanted flax on the American waterfront by then. According to a report from the Commissioners of the Navy submitted to Congress in February 1829, cotton canvas was in use on naval ships for small boat sails, awnings, hammocks, hammock cloths, wind sails, bags, tarpaulins, boat and boom covers. While approved for small boat sails, the Commission held that for larger ships, cotton "would be attended with so many hazards to the safety of the ships, that the Board would not take upon itself the responsibility of substituting it" for linen sailcloth.⁶

The changeover from linen to cotton duck sailcloth took nearly a century to transpire. The Navy appears to have held on to traditional flax longer than the merchant fleet and yachting community. Account books and records from southern New England sail lofts and ship captains in the nineteenth century show a gradual, but not consistent, shift from linen to cotton canvas. The ship *Pilgrim* ordered sails from Connecticut sailmaker John R. Taylor in 1805, and receipts reveal all its sailcloth came from Russia and Britain. By the 1830s, New England ships' and sailmakers' ledgers disclosed a marked shift to cotton duck with Russian and ravens⁷ duck still

⁶ *American State Papers*, 6, *Naval Affairs*, 3: 301.

⁷ Ravens duck referred to lighter duck cloth from Russia, the Netherlands, England and Scotland.

maintaining a strong presence. In 1834, the ship *Commodore Perry* sent 10 bolts of flax duck to its sailmaker, John K. Pimer of Connecticut, along with 334 yards of cotton duck. The next year Pimer made a new suit for the ship *Tuscarora* using all flax canvas but used both flax and cotton canvas for individual sails on the ship *Julius Caesar* the same year. By 1839, nearly all of Pimer's clientele received new sails made solely from domestic cotton duck.⁸ More records from the 1850s and 1860s show a mix of choices between flax, hemp, and cotton. In wartime, some sailmakers resorted to the use of burlap, when any kind of sailcloth was exceedingly difficult to obtain. They saturated the burlap with lime to give it enough body to keep the wind from blowing through it.⁹ After the Civil War, records of flaxen duck in southern New England are rare. Conversely, in England, flaxen canvas maintained a stronger hold as sailcloth material. In the yachting community, the schooner yacht *America* made its famous debut in England using cotton sails in 1851. Its success drew immediate attention to cotton as a material for sailcloth. British yachting enthusiasts analyzed all aspects of the *America's* design to determine what differences led to her great speed and ability to point so close to the wind. Most focused on her cotton sails, eliciting a consensus that led to the Marquis of Anglesea's famous quote, "If she is right, we must all be wrong!"¹⁰ Nevertheless, English shipowners clung to their traditions for decades to come. In 1873, well after cotton duck had been established as sailcloth in the United States, a London publisher printed a new book for yachtsmen spelling out the necessary specifications for flax canvas with no mention of cotton whatsoever.¹¹

⁸ "Duck Book, 1834-1841," John Kingsbury Pimer Papers, G. W. Blunt White Library, Mystic Seaport Museum, Inc. Lists by ship, duck used, and source.

⁹ Charles G. Davis, *How Sails Are Made and Handled* (New York: Rudder Publishing Co., 1931), 22.

¹⁰ Marquis of Anglesea quoted in Vanderdecken, *Yachts and Yachting* (1873; reprint, London: Scholar Press, 1979), 79.

¹¹ Vanderdecken, *Yachts*, 82.

Clearly, perceptions of the advantages and disadvantages of one material over another dictated the choices of sailmakers, shipowners, and sea captains. Priorities of those individuals making comparisons sometimes differed considerably. For instance, seamen and ship captains were more interested in the behavior and handling of the different materials, while sailmakers and shipowners may have been more interested in costs. All parties were interested in a sail's appearance and ability to resist wear. "The principal qualities required from sailcloth [were] durability, tensile strength, low-stretch factor, stability and impermeability."¹² Examining the comparisons between flax, hemp, and cotton sails reveals the hesitations many had regarding the change. Ultimately, however, cotton prevailed as mills produced better grades and ample quantities of duck.

Any glance at maritime art from ancient times to 1800 will provide images of billowing sails on ships making way to leeward. At that time, the notion that a sail could function as an airfoil — and provide, therefore, both greater thrust and allow for a ship to sail closer to the wind — was unknown. The fact that flaxen sails stretched and sagged mattered little. And stretch they did. Not until the nineteenth century, however, did mariners see this as a drawback.

Although reputed fit for hard use in sails, flax canvas inevitably stretched out of shape. Trials with cotton sails demonstrated cotton's ability to lie flatter. In the first half of the 1800s, naval Captains reported them much less porous than flax sails. Lieutenant Bocrum of the United States Ship *Erie* in 1831 remarked that "with regard to our cotton sails, ... they hold better wind, nobody will deny." Naval Captain Wilkinson of the *John Adams* reported in 1827 that his "cotton sails hold more wind" and recommended them for square sails.¹³ By mid-century, the schooner yacht *America* debuted its cotton sails at an international regatta in Britain and

¹² Howard-Williams, *Sails*, 37.

¹³ *American State Papers*, 6, Naval Affairs, 3: 719.

demonstrated the effectiveness of cotton's capacity to maintain a flat shape. Its opponents' flax sails sagged in comparison and could not maintain a course as close to the wind as the *America*.¹⁴

Speed and efficiency were not the only factors a mariner considered — and often they were not even a priority. More important for seamen was how each cloth behaved in the wide range of weather conditions an ocean-going ship would encounter. In wet conditions flax sails were stronger than cotton, stronger than they were dry, in fact. In storms, “a little extra stretch [could] be accepted as the price of easier handling and greater strength.”¹⁵ Linen sails were soft to work with, even when wet, unlike cotton which was exceedingly difficult to handle. The fact that flaxen sails were so porous that sailors would often scoop up seawater and fling it on the sails to swell the threads in dry weather seemed a small price to pay for its wet weather advantages.¹⁶ Officers from the United States Ship *Peacock* in 1831 reported to the Navy Commissioner's Office that their flax cloth sails did “not absorb half the weight of water of the other; while the cotton sails, on the contrary, were stiff and heavy, and the sails difficult to handle, especially in wet weather, which required a much greater force at all times to manage.”¹⁷ Cotton sails, in particular, made of heavy canvas became extremely heavy and hard when wet. When wet and cold, they were almost unmanageable. Flax and hemp sails remained soft enough that, “even in a gale, seamen could manage to get a grip on [them].”¹⁸

Equaling their concerns with behavior and handling was their attention to sailcloth's durability. A sail that wore out quickly resulted in extra labor for the ship's crew and expense for repairs, downtime, and personnel who would have to be pulled from other duties to unbend,

¹⁴ Horsley, *Tools of the Maritime Trade*, 287; Howard-Williams, *Sails*, 16.

¹⁵ Howard-Williams, *Sails*, 39.

¹⁶ Davis, *How Sails are Made and Handled*, 20; Richard Henry Dana, Jr., *Two Years Before the Mast* (1840; reprint, New York: Penguin Books, 1981), 58.

¹⁷ *American State Papers*. 6, *Naval Affairs*, 3: 721.

¹⁸ Davis, *How Sails are Made and Handled*, 21.

repair, send aloft, and re-bend sails. Most importantly, since sails were a ship's only means of propulsion, a weak sail could blow out in a situation that would put the ship and lives on board

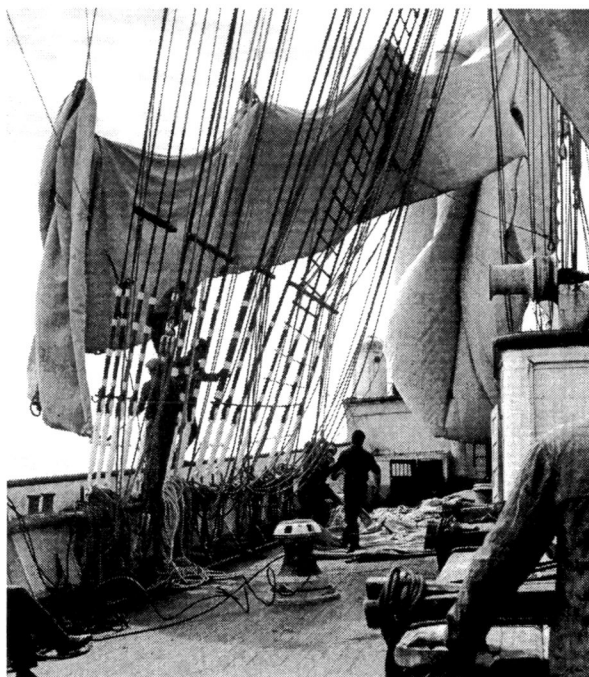


Figure 14. Sending a new foresail aloft on the *Moshulu* after a storm. (Eric Newby, *Learning the Ropes* (New York: Times Books, Random House, 1999), 79.)

in jeopardy. As an organic material, microorganisms – mildew and rot – degraded both linen and cotton canvas. Flax resisted moth damage, however, and from a collection of naval surveys, it appears that flax sails held up better in most climates.¹⁹

In the late 1820s and early 1830s, Congress ordered a series of experiments and surveys amongst naval ships to test and compare cotton sails against flax and hemp sails. Naval ships were sent to sea with experimental cotton sails, and, sometimes full suits of sails made from cotton. When asked to weigh strengths and weaknesses, the reports came back mixed. Some of the earlier trials in 1827 tested a cotton main topsail with an otherwise flaxen-made suit. The

¹⁹ American Home Economics Association, *Textile Handbook*, 14; *American State Papers*, 6, *Naval Affairs*, 3: 718-723.

captains from the *John Adams* and *Constellation* in 1827 reported that, with minor repairs, most likely the normally expected wear, their cotton main topsails were in good condition. They noted that main topsails were set and carried “as long as practicable.” The *Constellation*’s main topsail had lain in storage in Key West for some time before they brought it on board, and it needed some immediate repair but was quickly made serviceable. Afterwards, it “had a fair test in all weathers” and Captain Woolsey reported it in good condition. Captain Woolsey’s final recommendation held that cotton duck was as good as linen for light sails. Captain Wilkinson of the *John Adams* had his cotton sail middle-stitched²⁰ to strengthen the sewing after they had been at sea 240 days and sailed 18,587 miles. He recommended them “highly for square sails.”²¹ Commodore Elliot sent high praise regarding the United States Ship *Peacock*’s trials with a full suit of cotton sails, “the experimental sails, manufactured of cotton, are in the full force of successful operation.” The *Peacock*’s Captain McCall added, “this ship has been in commission twelve months, during which she has been kept almost constantly at sea, and her sails ... [have] stood the test of the north winds on the coast of Mexico during the last winter, which are very severe, and often very violent.... [The sails] are in a trifling manner mildewed, and a little chafed.”²² Only one year later, the *Peacock* lay in drydock in Charlestown, Massachusetts. Charles Morris, Commander of the Charlestown Navy Yard, reported that the *Peacock*’s cotton sails “were found to be so much more defective than their general appearance indicated.” He wrote to his superiors inquiring whether to replace the sails with cotton or flax sails. The officers who conducted the survey added that the sails made from flax canvas were “strong and serviceable.” The final report by the surveying officers regarding the *Peacock*’s suit of cotton

²⁰ A third row of stitching made in the middle of a seam.

²¹ *American State Papers*, 6, *Naval Affairs*, 3: 301.

²² *Ibid.*, 719.

sails explained, “We are of the opinion that they [cotton sails] are far inferior to the flax cloth sails usually worn by our ships-of-war. Such has been the decay of all the cotton sails continued in use, that they may, with ease, be torn between thumb and fingers in any direction. ... With equal numbers or sizes of canvas, it would require double the power to tear the flax cloths. ... To men acquainted with heavy ships-of-war ... it would be jeopardizing a ship of the line, or a frigate, to entrust it to cotton canvas.”²³ This report, combined with others noting cotton’s flammable qualities, resonated the Navy’s objections to substituting flax sailcloth with cotton at that time.

For the merchant fleet, costs could be tallied as part of their overhead. Higher costs towards upkeep reduced profits. The cost for a full suit of sails on a vessel was a considerable part of a ship’s equipage. For the Navy, the dilemma between linen and cotton sailcloth meant a huge savings, or loss thereof, when making policy for the whole fleet. Naval ships also used sailcloth for hammocks, hammock cloths, tarpaulins, and sailor’s sea bags. In 1826, Commodore Warrington provided the following table regarding costs:

Table 3. Flax v. Canvas, Costs per Yard Nos. 1-8, 1826.

No.	1	flax,	47 ½	cents per yard;	cotton	41	cents per yard.
	2		43 ¾			39	
	3		42 ½			37	
	4		41 ¼			**	
	5		40			34	
	6		38 ¾			**	
	7		37 ½			32	
	8		36 ¼			**	

***No prices for these weights of cotton canvas because they were not contracted in 1826. (American State Papers, 6, Naval Affairs, 3: 302.)*

There was yet another consideration, however, that the Navy, in particular, had to take into account: the United States produced a tremendous amount of cotton and not much flax. By 1835, the Navy was still grappling with this issue. In a letter from Mahlon Dickerson, Secretary

²³ Ibid.

of the Navy, 1834-1838, to John Bell, Speaker of the House of Representatives, he stated, “It is very important to the country that cotton should be substituted for hemp and flax in making canvas for our navy, as far as it can be done without injury to the service.” Although flax and hemp could be produced domestically, he noted that Americans continued to import them. “In case of war, our commerce with countries from which we import these articles may be obstructed, and our supplies cut off. ... Should we, after long experience, ascertain that cotton canvas will answer the purposes of our ships, it will diminish, in a considerable degree, the expense of equipping our navy.”²⁴

In 1831 the Federal Government directed the Navy Commissioner’s Office to conduct a series of experiments to test the comparative strength of flax and cotton canvas. They stretched samples of each cloth, dropped shot from various heights on wetted canvas, amongst other tests. Overall, flax seemed to fare better than cotton within the parameters of these specific tests and samples. Without more specifics on these experiments and without the Navy’s response, it is difficult to speculate how they affected policy decisions.

Regardless of the quantitative data, the concept of switching from flax to cotton sailcloth represented also a change in tradition for mariners. Flax and hemp canvas had been the only sailcloth most mariners had ever used. The notion of trusting their livelihood, their defenses, their lives to a cloth untested through time was more than many were willing to risk. Linen sailcloth had its limitations, but these were well known and accepted as part of life at sea. When the schooner yacht *America*, with cotton duck sails, handily defeated its British opponents in a series of races in 1851, she made headlines on both sides of the Atlantic. Since that time,

²⁴ Ibid., 718.

Table 4. Test Results of 1831 Navy Commissioner's Experiments: Cotton v. Flax.

Letter dated October 20, 1831, Navy Yard, Washington. Signed by Isaac Hull.
 "Experiments for ascertaining the comparative strength of flax and cotton canvas."

First.

5 feet square flax, No. 2, bore.....	11,872 lbs.
5 feet square cotton, No. 2, bore	<u>10,948</u>
Difference	1,824

Second.

5 feet square flax, No. 1, wet, 571 32 lb. shot dropped from a height of 12 feet	18,272 lbs.
5 feet square cotton, No. 1, wet, 405 32 lb. shot dropped in same manner	<u>12,960</u>
Difference	5,312

Third. With cable-improving machine,

6 feet cotton, lengthwise, bore.....	22 lbs. 12 ounces stretched 18 inches.
6 feet flax, lengthwise, bore.....	<u>18 lbs. 00 ounces</u> stretched 11 inches.
Difference	4 lbs. 12 ounces

Deduct from cotton for greater width than flax 3/22.....3 lbs. 1 ½ oz. nearly.

Fourth. With cable-proving machine,

6 feet cotton, crosswise	22 lbs. 8 ounces stretched 3 inches.
6 feet flax, crosswise	<u>17 lbs. 12 ounces</u> stretched 6 inches.
Difference	10 lbs. 12 ounces

Fifth. With lever,

1 square foot of flax, No. 2, bore.....	298 lbs. 8 oz.
1 square foot of cotton, No. 2, bore.....	<u>240 lbs. 8 oz.</u>
Difference	58 lbs. 0 oz.

Sixth. Lever,

1 square foot of flax, No. 2, bore.....	271 lbs. 0 oz.
1 square foot of cotton, No. 2, bore.....	<u>234 lbs. 0 oz.</u>
Difference	34 lbs. 0 oz.

2 yards, No. 2 flax canvas, dry rot	2 lbs. 4 oz.
2 yards, No. 2 cotton canvas, reduced to the same width	<u>2 lbs. 0-¾ oz.</u>
Difference	3 ¼ oz.

2 yards, No. 2 flax canvas, net weight	3 lbs. 7 oz.
2 yards, No. 2 cotton canvas, reduced to the same width	<u>3 lbs. 2 ½ oz.</u>
Difference	4 ½ oz.

mariners began to recognize the benefits of flat sails, even though the understanding of airfoil principles was still over fifty years away. Nonetheless, flax sailcloth held on for decades to come. D. Van Nostrand in *The Young Seaman's Manual*, published in 1875, discussed the importance of obtaining good canvas for sails. Specifically, he outlined what characterized good canvas and only mentioned flax. Later, he acquiesced that cotton canvas on ships was used for all other canvas work on board such as: tarpaulins, mess-cloths, awnings, boat covers, hammocks, et cetera. By the twentieth century, rare was the American sailmaker who used flax canvas. In England, however, publishers still sold new books on sailmaking that either focused on flax alone or instructed that “it [mattered little] whether flax or cotton canvas [was] used...”²⁵

Flax, hemp, and cotton duck each made acceptable canvas for sails. Eventually, cotton replaced linen in sailcloth and in many other textile uses. Once new inventions in processing and manufacturing enabled mills to mass-produce cotton, its takeover was inevitable. Power looms provided the means to produce higher quality cotton that could compete and improve on performance by linen cloth. In addition, American ship captains could count on a reliable inventory of quality sailcloth at cheaper rates. The major reason the transformation took so long once improvements in manufacturing produced high quality duck was mariners' cultural resistance to changing traditions.

²⁵ Sadler, *The Art and Science of Sailmaking*, 40.

CHAPTER 6 AMERICAN SAILCLOTH MANUFACTURING TO 1900

When England began colonizing North America, it sought to relieve part of its dependence on the Baltic for naval supplies. The Royal Navy imported masts, pitch, tar, sailcloth, and cordage from that region. War, embargo, or a blockade would put their navy in jeopardy by cutting off naval stores, just when they needed them most. Documents from the first permanent settlement at Jamestown reveal that the colonists built boats of several types including pinnaces, “frigatts,” and shallops, needing sails. Settlers headed for Maryland 1634 were urged to bring “necessaries for a boate ...[including] canvis for a sayle.”¹ At the end of the seventeenth century, Governor Andros of Virginia reported that twenty-four vessels had been built in Virginia, but their rigging and sails were from England.² From the beginning, American colonists used the sea and inland waterways for transportation. Need for sails became apparent immediately. Until the end of the age of sail, Americans struggled to overcome the problem of an inadequate sailcloth supply. Although Americans grew flax and hemp successfully, problems with cultivation and processing techniques kept them from satisfying the maritime community’s demand. American manufacturers eventually produced better and better cotton cloth that, in time, was accepted by mariners as a substitute for linen sailcloth. Nonetheless, United States sailcloth manufacturing, despite technological breakthroughs, endured an arduous course with repeated setbacks from personal prejudices.

Colonists cultivated and produced flax linen from the early stages of settlement. Though used primarily for clothing needs, as ships from Europe laden with manufactured goods were irregular at first, this cloth was used for sailcloth as necessary. Laws in Connecticut and

¹ *Records of the Virginia Company*, quoted in Marion V. Brewington, “Chesapeake Sailmaking,” 138.

² Brewington, “Chesapeake Sailmaking,” 139.

Massachusetts in 1640 and 1655, respectively, required households to plant flax and hemp and spin it to remedy clothing and cordage insufficiencies.³ While colonial ship and boat builders turned out American vessels in increasing numbers, they still relied on sails and rigging imported from England. Unpredictable shipments created limited sailcloth inventories. Initially, England exempted colonists from import tariffs, eliminating the motivation to launch manufacturing enterprises within their shores. It was cheaper, in most circumstances, to import manufactured goods than to make them. As the population grew, however, unreliable shipments of clothing turned the attention of the colonists towards home manufacturing of linen and woolen cloth. It became customary in rural areas for people to manufacture parts of their own wardrobe and, in some cases, all household linens, with homegrown flax, cotton, or woolen cloth.⁴

By the second half of the seventeenth century, England reversed its taxation strategy and enacted trade restrictions affecting its North American colonies. While the Navigation Acts promoted shipbuilding, and thus increased the demand for sailcloth, they also hampered access to traditional sources of that cloth. The Navigation Act of 1663 required that all European goods headed for the colonies be carried first to England, then transported in English ships to North America. “This added to the price of freight and gave a third profit to the English middlemen, thereby increasing the cost of European manufactures to the colonials and to that extent encouraging local manufactures.”⁵ By the end of the seventeenth century, colonial governments encouraged local textile manufacturing with financial assistance and public awareness. In Pennsylvania, for example, colonial leadership organized fairs starting in 1686 to provide a market for linen and other home manufactures. The growth of trade within colonial borders

³ Bishop, *History of American Manufactures*, 1: 300; Clark, *History of Manufactures*, 1: 31.

⁴ Bishop, *History of American Manufactures*, 1: 298, 299.

⁵ Clark, *History of Manufactures*, 1: 17.

increased demand for specialized trades such as professional spinning and weaving. In 1720, Bostonians “of all classes ... flocked to the common, where spinning wheels were set out in the open-air; prizes were offered for the best work, and homespun fabrics were for a time the fashion of society.”⁶

In the eighteenth century, colonial leadership tried to balance the agenda of the English government against local interests, resorting occasionally to subterfuge. Reports by governors to the Board of Trade regarding local manufacturing were skewed to avoid drawing attention to themselves if their manufactures competed with those from England. Though in conflict with England’s mercantilist philosophy, eighteenth century colonial legislation promoted local manufacturing with bounties, premiums, and subsidies. Bounties were the most common and applied to particular articles and their specifications. Bounties were expected to promote a large production. Premiums were designed to raise standards of production by being awarded to a few examples of exceptional quality. Subsidies were offered to individuals for completing highly specific products – not to be confused “with such forms of aid to specific individuals or companies as loans, land grants, lotteries, monopolies, and other assistance not based on the amount and quality of the articles manufactured.”⁷

In the early eighteenth century, Massachusetts subsidized farmers to water-ret hemp. A Massachusetts statute in 1700 instructed officials to “encourage the sewing and well manufacturing of hemp.” Rhode Island granted a bounty in 1721 on water-retted hemp and the next year extended it to include manufacturing hemp into cloth. In 1722, it subsidized William Borden of Newport with twenty shillings for every bolt of duck he manufactured from local hemp “equal to good Holland duck.” By mid-century, Rhode Island promoted flax “cured and dressed

⁶ Clark, *History of Manufactures*, 1: 200.

⁷ *Ibid.*, 33.

within its boundaries” through bounties.⁸ Private societies and individuals used premiums to promote higher standards when taxpayers complained about bearing the financial burden of these efforts. Bounties on raw materials were meant to encourage manufacturing rather than agriculture. Colonists were encouraged to produce and export naval stores — flax and hemp specifically — to England as a means “of making returns for large purchases of English manufactures” and to supply the Royal Navy with naval stores. Local markets, however, absorbed most of these products. Despite the government’s inducements to export, their goals were never realized.⁹

The combination of a need for better access to raw materials, growing markets, and colonial merchants with capital led the colonists to push for new laws encouraging development of local industries. Examples of these kinds of statutes were bounties, exemptions from taxes, easier access to raw materials, standards of quality, and enticements for skilled artisans to settle in specific areas. These proposals were generally opposed by the Board of Trade. A 1705 report from the Board of Trade stated that “it cannot be expected that the encouragement should be given to the making of any manufactures [also] made in England..., it is being against the advantage of England.” New York passed a law in 1706 to develop the sailcloth industry. The Board of Trade disallowed it because it would be “more advantageous to England that all hemp and flax of the growth of the plantations should be imported hither, in order to [manufacture] it here.”¹⁰ Regulations were intermittently enforced depending on the local governor’s authority.

A mass immigration of Scotch Irish to America in 1719 introduced better knowledge and skills regarding flax cultivation, its manufacture into linen, and the spinning wheel. Most hailed

⁸ *Rhode Island, Acts and Laws*, April, 1751, quoted in Victor Clark, *History of Manufactures*, 1: 39, 34.

⁹ Bishop, *History of American Manufactures*, 1: 328; Clark, *History of Manufactures*, 1: 37, 38.

¹⁰ Hacker, “The First American Revolution,” 283.

from Londonderry and settled in New Hampshire, Massachusetts, and Rhode Island. The flax spinning wheel “became an appendage to almost every farmhouse and cottage” in New England. Most linen was still used to make clothing. English manufacturers exported most sailcloth used by colonial vessels, although home manufactured cloth supplied a small part of the demand.¹¹ In addition, English law delineated specifications for sailcloth that prevented variations in production. Home produced cloth had to conform to these specifications to be marketable. Legislation outlined highly specific processing techniques of flax and hemp for sailcloth, dimensions of the finished product, weight, finishing, et cetera.¹²

While local efforts were made to encourage growth of the textile industry overall, the same enticements were used to promote manufacturing of linen sailcloth specifically. After 1720, a determined effort was made in New England to establish linen sailcloth manufacturing. Both public and private parties cooperated to offer bounties, premiums, subsidies, grants, and loans to individuals and partnerships. In 1721, Rhode Island offered a bounty on flax and hemp for use in sailcloth and ordered the treasurer to accept both fibers for taxes at ten pence and eight pence per pound respectively.¹³ During this period Massachusetts and Rhode Island regularly used incentives and continued to support sailcloth manufacturers, sometimes over many years. Some loans stipulated an output of 100 to 500 bolts of canvas per year; no evidence shows the manufactories were able to fulfill that condition.¹⁴ In 1726, John Powell of Boston presented a petition to the General Court claiming that domestic flax and hemp were equal to Great Britain’s or Ireland’s. He applied for funds to establish a sailcloth manufactory of twenty looms. In his proposal he planned to send for workmen and equipment from England and declared he could

¹¹ Bishop, *History of American Manufactures*, 1: 331-332; Clark, *History of Manufactures*, 1: 112.

¹² Hacker, “The First American Revolution,” 265.

¹³ Clark, *History of Manufactures*, 1: 35, 45.

¹⁴ Massachusetts, *Acts and Resolves*, XI, appendix VI, 241 in Clark, *History of Manufactures*, 1: 42.

produce fifty pieces of sail duck from each loom per year. The committee that reviewed his petition agreed to grant him a bounty of twenty shillings for each piece of duck “thirty-six yards long and thirty inches wide, of good even thread, well drawn, and of a good bright color, being wrought wholly of good strong water-rotted hemp or flax, of the growth of New England [each weighing] between forty and fifty pounds ... for fourteen years.” They also provided him with £2000 in bills of credit for start-up costs and another £1000 after he produced five hundred pieces of cloth that could pass inspection.¹⁵

Rhode Island counted on a bounty to William Borden in 1722 to develop a sailcloth manufactory. By the terms of his bounty, Rhode Island granted him exclusive rights for five years, which was extended to ten at his request. In 1725 and 1728 he applied for additional assistance and the General Court loaned him £3000 in bills of credit without interest for ten years providing he successfully manufactured 150 bolts of quality sail duck per year. Three years later, he was still unable to maintain his business without assistance and the General Court relieved him “of his obligation to produce the stipulated quantity, while it continued the bounty upon such quantities as he might make.”¹⁶ Legislative assistance for linen manufactories appears throughout the colonies repeatedly during the seventeenth century. Efforts to advance the sailcloth industry, however, were confined to New England where shipbuilding, overseas trade, and fishing created a demand for sails.¹⁷

In the 1730s, the British Board of Trade became increasingly concerned with colonial linen manufacturing. Despite reports that the high price of labor in the colonies maintained imports of manufactured goods, they had fears that colonial linen manufactures could grow to the

¹⁵ Bishop, *History of American Manufactures*, 1: 334.

¹⁶ Ibid.

¹⁷ Clark, *History of Manufactures*, 1: 35.

point where they would compete with Britain's monopoly supplying the colonies with linen cloth "unless an early stop be put to their progress."¹⁸ The British Government granted bounties on colonial flax and hemp as raw materials in an attempt to keep the colonists from manufacturing it themselves. Linen manufacturers in England obtained a bounty for exporting their sailcloth. A 1746 British statute required that all sailcloth be stamped with the manufacturer's name and location. It also stated that "every ship or vessel built in Great Britain and every ship or vessel built in any one of his Majesty's plantations in America, shall upon her first setting out to sea have or be furnished with one full and complete set of sails made up of sailcloth manufactured in Great Britain. No sailmaker or other person, in this kingdom, shall make up into sails or tarpaulins any foreign-made sailcloth or canvas, not stamped according to the directions of the act." Violations were punishable by a fine of fifty pounds or six months in prison. It also stipulated that no one could repair or alter foreign-made sailcloth not stamped according to the act. British sailmakers were required to mark new sails with a stamp, eight inches in diameter, stating his name and location. The law included fines to ship captains for possessing foreign sailcloth for which appropriate duties had not been paid.¹⁹ Ship owners and captains shouldered the burden of these laws by paying increasing amounts for sailcloth, as a sufficient domestic supply was still a century away.

Sailcloth manufactories expanded at a pace corresponding to inventions in linen and cotton processing and weaving. Among the most important were the flying shuttle patented in 1733 by John Kay, which sped up the process of weaving by placing the shuttle on wheels and allowing it to send the weft across warp threads at an accelerated pace; James Wyatt's innovation

¹⁸ A Report to the British Board of Trade, 1731 reprinted in Bishop, *History of American Manufactures*, 1: 339.

¹⁹ Elton W. Hall, "Sailcloth for American Vessels," *The American Neptune* 31, no. 2 (April 1971): 132; Bishop, *History of American Manufactures*, 1: 337.

of roller spinning in 1737; and Louis Paul's development of the first cylinder carder in 1738. Carding placed cotton fibers parallel to each other before spinning and previously had to be done by hand using wire brushes. The spinning jenny, credited to James Hargreaves in 1764, allowed spinning several threads at once; Sir Richard Arkwright's water-powered spinning frame for cotton and his use of divisions of labor lent well to the factory system. Arkwright combined the use of roller spinning and the flier in one machine, which enabled the machine operator to produce a finished yarn from fiber in one procedure.²⁰ Samuel Crompton's spinning mule in 1779 combined features of existing machines with a spindle carriage that could draw, twist, and wind cotton thread while decreasing the danger of breaking threads – a constant problem with earlier spinning machines. The first power loom which could be improved upon for further refinements was invented in 1785 by Edmund Cartwright.

Until this time, mechanized textile mills used waterpower and, thus, had to be located near a rapidly-flowing watercourse – not always near a labor supply and means of transport for receiving raw materials and sending out finished products. In 1785, a cotton mill first used a steam engine for power, which eventually eased geographic restrictions on factory locations. In 1790 Samuel Slater introduced Arkwright machinery to American manufacturing in his Pawtucket, Rhode Island mill. Three years later, Eli Whitney invented the cotton gin that allowed mechanical removal of seeds from fibers. This invention made cotton economically viable as a fiber for use in large-scale mills and factories. By 1814, all the steps for cotton textile manufacturing, from fiber to finished cloth, were joined under one roof at Francis Cabot Lowell's factory in Waltham, Massachusetts.

²⁰ John G. Glover and Rudolph Lagai, eds., *The Development of American Industries: Their Economic Significance*, 4th ed. (New York: Simmons-Boardman Published Corp., 1959), 92-93.

Another means colonial leaders used to encourage the founding and growth of factories was to establish spinning and weaving schools. The growth of poverty was becoming a major problem in cities. In New England, colonial government sought to relieve their dependence on imports of linen cloth and employ the poor by establishing spinning schools for training of the indigent, especially children and women. In the seventeenth century, every colony enacted public legislation concerning the teaching of flax spinning. At that stage, manufactory workers were still artisans. Establishing and maintaining a successful manufactory depended upon training a knowledgeable labor force. Consequently, industrial education became a subject of public concern. A public committee in Boston in 1720 recommended that the city rent a building and provide instructors and twenty spinning wheels to teach children flax spinning. The next year, a wealthy merchant constructed a building for that purpose.²¹ In the 1730s, Bostonians again collected funds to build and organize a spinning school for children and the poor for the dual purpose of teaching them marketable skills and providing a trained labor force. In 1749, the Boston Assembly continued the policy by purchasing a factory to be used to train and employ the poor in manufacturing flax into linen to reduce some of their dependence on imports.²² Assembling a group of laborers in one building for training inevitably led to the factory system. Boston's Manufactory House, built in the early eighteenth century for educating poor children in textile manufacturing, developed into a regular factory. "After the middle of the eighteenth century, we hear less of the educational purpose of these enterprises, and more of their economic service. It would be difficult ... to differentiate between philanthropic and commercial motives in the public promotion of textile manufactures; but the idea was well fixed in the popular mind that the employment of children

²¹ Clark, *History of Manufactures*, 1: 67, 188.

²² Bishop, *History of American Manufactures*, 1: 333, 345.

in such arts served the general welfare, and that the profit of their labor ... properly belonged to the person who undertook the burden of their instruction.”²³ With more trained spinners in the labor force came shortages in raw materials for spinning. In the 1760s in Rhode Island, there was scarcely enough flax to supply the spinners.²⁴

Public and private groups offered bounties and premiums on raw materials in the northeastern colonies to increase supply for fledgling manufactories. These included special awards going to farmers who produced the most flax and hemp grown on a single acre or for the largest amount of meadow cleared for hemp and flax cultivation. Merchants and public committees tried to excite interest in manufactures in the years preceding the American Revolution. Non-importation agreements in Massachusetts were renewed in 1768. When the sloop *Liberty* was seized in August of that year for violating revenue laws, Boston merchants agreed to boycott British goods from January 1769 to January 1770. Nonetheless, they exempted from this agreement items they could not supply themselves including sail duck.²⁵ In the 1770s, American households still provided most of the domestic supply of linen cloth, especially in light of non-importation agreements. Connecticut sold a large amount of flax seed in addition to manufacturing it into cloth. Trained artisans from Great Britain arrived on American shores, some enticed by American entrepreneurs and others on their own searching for employment.

The British government was clearly nettled by the threat to its home industry. In 1719, Parliament passed a law that made the transport and luring of artisans abroad a crime punishable by fine and imprisonment. A 1750 British Act extended that law by forbidding the transport of tools and utensils of the silk and woolen trades abroad. Neither, however, covered the American

²³ Clark, *History of Manufactures*, 1: 189.

²⁴ Bishop, *History of American Manufactures*, 1: 373.

²⁵ *Ibid.*, 367.

colonies until 1774 when Great Britain mandated that any person who shipped “any machine, engine, tool, press, paper, utensil, or implement, or any part thereof” used in the cotton or linen industry would be punishable by a fine of £200, forfeiture of the contraband, and be imprisoned for twelve months.²⁶ Thus, just when the factory system in England was expanding and enjoying the fruits of new inventions in cloth manufacturing, “in the colonies methods of production remained at a hopelessly backward level because of the impossibility of setting up large workshops without running foul of the law.”²⁷

The Revolutionary War changed the landscape dramatically. The war shut down the supply of sails from England while simultaneously creating a huge demand. Sailcloth was a strategic item. While it could now be imported from other European countries without paying import duties, conflict on the sea lanes interrupted shipments. Demand for domestically produced sailcloth skyrocketed. Within American borders, the Navy competed with the army, which needed canvas for tents. Merchant shipping and privateering competed with the navy for supplies as well, creating widespread shortages. Despite the impetus from non-importation agreements and wartime shortages, domestic sailcloth manufacturing could not supply the demand even after the Treaty of Paris. At the end of the war, accurate information on British textile inventions was well-known in America. Massachusetts granted public aid in 1786 and 1787 to acquire these inventions, but the British government fought hard to keep information and machinery within its shores. British agents would buy tools and machinery in the United States and send them back to England. They bought and burned cottonseed to prevent its use in American mills. Nonetheless, within a few years, American manufacturers managed to obtain all the information on textile

²⁶ Bishop, *History of American Manufactures*, 1: 378, 396.

²⁷ Hacker, “The First American Revolution,” 268.

inventions and manufacturing used abroad.²⁸ Samuel Slater immigrated to the United States and set up the first manufactory using Arkwright machinery in Rhode Island in 1790.

Before 1800 several attempts at establishing cotton manufactories were made in New England — most with public assistance in the form of bounties, premiums, subsidies, or loans. Fewer than a third of them survived once the terms of their assistance expired. Of the sailcloth manufactories started in Haverhill, Salem, Beverly and Nantucket in Massachusetts, one in Exeter, New Hampshire, and another in Newport, Rhode Island towards the end of the eighteenth century, only the two in Newport and Salem succeeded. A sailcloth factory set up in Boston in 1789 with the aid of a bounty operated in a large facility nearly two hundred feet long and two stories high. The duck produced there was reported to be of the highest quality then ever produced in the United States and sold at a price lower than imported sailcloth. In 1790, the eight hundred ton ship *Massachusetts* went to sea with sails wholly of Boston manufacture. In 1792, the factory was still going strong, producing nearly two thousand yards of duck weekly and employing four hundred workers, mostly young women and children. In 1820, a linen factory run by John Colt in Paterson, New Jersey, established a sailcloth manufactory run by water power. The navy awarded it large sailcloth contracts to ensure a domestic supply in case of war, a hard lesson learned from the War of 1812. Colt introduced the power loom to his factory in 1824. By 1827, his Paterson factory was the largest duck factory in the country; yet, it depended on imported raw materials. Within a few years, Colt's manufactory produced nearly one million yards of duck annually and it enjoyed an excellent reputation for its quality. This sailcloth was made of linen because the Navy feared the combustibility of cotton for warships. The Paterson

²⁸ Clark, *History of Manufactures*, 1: 533; Donald Graves and Michael Colby, "Overview of Flax and Linen Production in Pennsylvania," 115.

mill also produced cotton duck for civilian markets.²⁹ Other sailcloth manufactories in New Jersey and Baltimore shared the success of this market. Mechanized mills at that time either used jennies or Arkwright machinery. Jenny mills were operated by hand or horse power and produced cotton only for weft while flax was still used for warp threads.³⁰ Arkwright machines produced the first cotton yarns suitable for warp threads. Arkwright machinery displaced the use of spinning jennies for cotton, though jennies continued to be used for wool and flax spinning.³¹

Most American vessels, however, still used linen sailcloth from Europe. After the close of the Revolution, American ships ventured to foreign ports, previously not open to them for trade because of British law. The transition was not necessarily a smooth one; for example, in 1783 after the Treaty of Paris, Denmark restricted new trade liaisons with American ship agents until a trade agreement was reached with the United States.³² Most European countries, however, enjoyed open access to American ports. In 1790, twenty-two ships arrived from Russia laden with iron, cordage, sail duck, and processed flax and hemp.³³ Between 1783 and 1807, over one thousand American ships cleared into the Baltic for cargoes of sailcloth, iron, and cordage.³⁴ In 1798, the United States government purchased sailcloth from Holland, Russia, and France for use on naval frigates. Within two years, however, it also contracted with Levi Shepherd and Sons of Massachusetts for bolts of flaxen sailcloth with specifications that matched Royal Naval specifications almost exactly.³⁵ The number of cotton mills in southern New England more than doubled between 1800 and 1804. Until 1810, flax manufacturing “was the best established and

²⁹ Clark, *History of Manufactures*, 1: 530; Bishop, *History of American Manufactures*, 2: 272.

³⁰ Clark, *History of Manufactures*, 1: 533, 534.

³¹ Ibid., 192.

³² A. A. Rasch, “American Trade in the Baltic, 1783-1807,” *Scandinavian Economic History Review* 4, no. 2 (1956): 58.

³³ Bishop, *History of American Manufactures* 1: 411.

³⁴ Rasch, “American Trade in the Baltic, 1783-1807,” 39, 41.

³⁵ Brewington, “Chesapeake Sailmaking,” 142, 143.

most widely distributed textile industry in the country, ... though it was confined mainly to the household.”³⁶ Only two percent of domestic American cloth was made in factories. Seth Bemis made his all-cotton sailcloth using Sea Island cotton, sold at twenty-five cents per pound. During the War of 1812, he installed a power loom, which reduced production costs during a time of great demand. Transporting sailcloth to seaports overland by wagon, he sold it at almost one dollar per yard.³⁷ By the middle of the nineteenth century, nearly all flax and hemp fiber manufacturing was replaced by cotton. Flax and hemp processing required manual labor while cotton machinery developed to the point where machines produced nearly all cotton cloth. The transfer of manufacturing from the home to the factory produced widespread social implications with the loss of traditional employment in the home and shift of labor to the cities for factory work. Cotton developed into a staple crop harvested by slave labor and processed by machine. In addition, domestic linen could not compete with the quality of Russian and Dutch sailcloth.³⁸ In the 1820s, the United States imported more linen than it manufactured. A Congressional report from 1825 on the feasibility of using domestic flax and hemp for naval sailcloth included conflicting reports from manufacturers. Some reported that “the high price of American flax, its unequal quality, and the uncertainty of supply” kept them looking to Europe. Others testified that they had not used imported flax or hemp since 1821 and were able to maintain a sufficient supply of American grown raw materials.³⁹ An 1828 Protective Tariff covering flax and hemp imports resulted in

³⁶ Clark, *History of Manufactures*, 1: 325, 535.

³⁷ Bishop, *History of American Manufactures*, 2: 232.

³⁸ Melvin Herndon, “A War-Inspired Industry: The Manufacture of Hemp in Virginia During the Revolution,” *The Virginia Magazine of History and Biography* 74, no.3 (July 1966): 311.

³⁹ *American State Papers*, 6 *Naval Affairs*, 2: 28.

making cotton cheaper per pound than flax. The handful of flax mills in the country, using imported flax, shut down operations after that year.⁴⁰

The gradual acceptance of cotton as a material for sailcloth paralleled the rate of mill expansion in New England. Once manufacturers installed power looms, sailcloth could be produced at a much greater rate and at a higher quality. At the same time, ships grew in tonnage and sail area thus requiring more canvas in their rigs. Before the advent of steam power in 1845, mills relied on waterpower. A drought could drop water levels and bring production to a standstill. Expansion continued, nonetheless, with an increase in the number of southern New England mills from 41 to 169 between 1809 and 1815.⁴¹ During the War of 1812, British ships blockaded American ports interrupting imports from overseas and coastal trade. Individual sailcloth manufacturers like Seth Bemis in Boston and Almy and Brown of Providence seized the opportunity for high returns by transporting their product by land and inland waterways for considerable distances up and down the eastern seaboard.⁴² After the War of 1812, English cotton woven on power looms inundated the market and Rhode Island manufacturers could not compete. Rhode Islanders pushed for a high tariff on imported cotton cloth because they did not yet have the power loom. Francis Lowell lobbied Washington for a more moderate tariff and succeeded in obtaining a rate of 6 ¼ cents per yard of cotton cloth.⁴³ In 1817, Rhode Island mills finally acquired power looms from Scotland that could weave flax as well as cotton. The Waltham looms wove cotton only.

Sailmakers used both materials for sailcloth in the nineteenth century, but they oftentimes

⁴⁰ Clark, *History of Manufactures*, 1: 531; Graves and Colby, "Overview of Flax and Linen Production in Pennsylvania," 124.

⁴¹ Clark, *History of Manufactures*, 1: 538.

⁴² Ibid., 336.

⁴³ Glover and Lagai, *Development of American Industries*, 97.

received cloth from the vessels. Thus, the customer usually dictated the preference for one over the other. Evidence from the Duck Books of Connecticut sailmaker John Kingsbury Pimer, 1834 to 1841, shows the transition from flax to cotton. His records from 1834 – 1835 show a mix of linen and cotton sailcloth received for work on the ship *Commodore Perry* with linen dominating

Table 5. New Sails Made for the Barque *Acors Barns* by John Kingsbury Pimer, 1866

1	topsail	Linen	No. 1	271 yards
1	foresail	Linen	No. 1	235 yards
1	topgallant sail		3	115
1	jib		3	106
1	fore topmast staysail		0	56
1	lower steering sail		6	106
2	topmast steering sail		6	200
1	main spencer		1	93
1	flying jib	Cotton	No. 6	109 yards
1	jib with bonnet	Cotton	No. 5	130 yards
1	main topmast staysail		5	142
1	Mizzen topmast staysail		7	100
1	Spanker topmast staysail		4	174
1	Gaff Topsail		7	92
1	Fore Sail		2	247
1	Mainsail		5	315
2	Topsails		2	566
2	Topgallant Sails		5	260
2	Royals		7	120

Linen duck received:

Nos. 0, 1, 3, 6, 8 >> 1193 ½ yds

Cotton duck received:

Nos. 2, 4, 5, 6, 7 >> 2275 yds⁴⁴

the inventory. During the same time, however, he built sails for more than twenty fishing smacks using cotton duck with one exception. Between 1835 and 1836, three ships under contract still used a mix of linen and cotton for individual sails with linen designated for all repairs. By 1841,

⁴⁴ "Papers re: Sails for the Barks *Acors Barns*, J. D. Thompson, George and Mary, and Perry, and schooners *Ezra* and *Quickstep*, 1863-1872," Box 3 / Folder 23. John Kingsbury Pimer Papers.

Pimer's account books recorded that he bought only cotton duck for new work; linen appears to be used only when supplied by the vessels.⁴⁵

The Civil War affected United States manufacturing dramatically and textile manufacturing was no exception. By 1860, flax processing became easier with the adoption of steam and acid treatments instead of retting.⁴⁶ By that time, however, cotton sailcloth orders surpassed linen canvas. New England sailcloth manufacturers depended on cotton from southern states. In the first year of the war, the sale of southern cotton to northern mills dropped to half of what it had been the preceding year. Sails were in huge demand for the military, privateering, and commercial uses. Some sailmakers resorted to the use of burlap soaked in lime for lack of cotton or linen cloth. Others imported hemp from Canada but were dissatisfied with its quality. The price of white cotton canvas, when it could be obtained, rose from forty cents to two dollars per yard, putting some sailmakers out of business. By the second half of the war, Union occupation of southern territories provided increased movement of cotton to northern mills.⁴⁷

At the war's end, linen held on as sailcloth for use in larger sails as shown in the records of the barque *Acors Barns*'s orders to John Kingsbury Pimer's sail loft. Of its twenty-three sails made new in 1866, nine were linen, fourteen were cotton. Several sails were made from old spares, one with linen, and the other cotton.⁴⁸ Whether or not these selections were based on the availability of certain cloth or because they were a ship owner's preference is difficult to say. The flax and hemp industry was barely hanging on with centers of manufacturing now in the mid-west

⁴⁵ "Sailmaking Accounts with N. and W. W. Billings, 1835-1841," Box 4 / Vol. 20; "Duck Book, 1834-1841, Record of Materials," Box 3 / Folder 13, John Kingsbury Pimer Papers, G. W. Blunt White Library, Mystic Seaport Museum.

⁴⁶ Graves and Colby, "Overview of Flax and Linen Production," 124.

⁴⁷ Mead, *Bent Sails*, 9; Davis, *How Sails Are Made and Handled*, 22; Clark, *History of Manufactures*, 2: 8.

⁴⁸ "Papers re: Sails for the Barks *Acors Barns*, *J. D. Thompson*, *George and Mary*, and *Perry*, and schooners *Ezra* and *Quickstep*, 1863-1872," John Kingsbury Pimer Papers, Box 3 / Folder 23.

and a few major mills left in Passaic and Paterson, New Jersey, and Philadelphia and Allentown, Pennsylvania. Several larger mills were branches of successful mills in Great Britain and continued to rely on imported raw materials from Russia, Ireland, Belgium, and Canada.⁴⁹

Between 1873 and 1893, the cotton industry expanded significantly with New England producing eighty percent of the nation's cotton fabrics. Steady improvements in the power loom, including replacement of wooden parts with metal, led to increased efficiency. By 1894, New England textile mills operated with electric power. Among cotton cloth manufacturers, only one permanent consolidation was formed by the early twentieth century. Twenty duck mills, most making sailcloth, combined to form The United States Cotton Duck Corporation in 1901. In 1907, it was reorganized as the Consolidated Cotton Duck Company and completely absorbed the Mount Vernon–Woodberry Cotton Duck Company, one of the largest duck manufactories in the country.⁵⁰

By the twentieth century, American cotton manufacturers supplied most vessels with their necessary canvas. The navy had launched its last all-sail powered warship in 1854, the USS *Constellation*, and by the twentieth century relied on engines to power its fleet. The Industrial Revolution was well under way; the age of the sailing vessel as a commercial or military vessel was over. A handful of vessels in the New England fisheries still operated under sail power along with smaller sail vessels in the coastal trade. Australian grain, South American guano, and coal maintained the markets for a number of very large ocean-going sailing ships, and the yachting community was growing. Overall, the need for sail to drive ships was waning. American

⁴⁹ Clark, *History of Manufactures*, 2: 120, 384, 182, 458, 459.

⁵⁰ Glover and Lagai, *Development of American Industries*, 107; Clark, *History of Manufactures*, 3: 3, 182.

manufacturers finally succeeded in gaining acceptance of their product by the sailing community.

By then, the age of commercial sail was ending.

CHAPTER 7 CLOTH: DOMESTIC VERSUS FOREIGN

Once American manufactories began producing canvas, shipmasters only slowly switched their sailcloth preference from imported to domestic sailcloth because of concerns over quality. For most of the nineteenth century, ships and boats relied on sails alone for propulsion. Sails for a larger vessel were a considerable investment and at sea could mean a ship and crew's life or death. Malcolm Cowan expressed it well in his *Essay on the Construction of the Sails of Ships in Vessels* written in the early nineteenth century. His essay proposed a new technique of sailmaking that would reduce the risk of the cloth splitting. He remarked that "ships are driven onshore every winter by hundreds, that might, with proper sails have escaped every danger."¹ Those responsible for acquiring sails for a vessel demanded the highest quality cloth that could be obtained. Most felt Russian and Dutch sailcloth was superior to American cloth and were willing to pay tariffs and deal with the difficulties of importing it instead of purchasing locally made sailcloth. Robert Kipping explained that the cost of making a sail out of poor quality cloth was the same as high quality, making "the best [canvas] ... by far the cheapest in the end."²

While the hull of a ship could be maintained to last for decades, sails needed constant maintenance and repair and would still have to be completely replaced several times in the life of a vessel. Linen and cotton canvas were organic materials subject to rot and mildew. In addition, the combination of physical strains and exposure to a wide range of environmental stresses led to injury to the cloth, sometimes with catastrophic results. Cowan's *Essay* explained that he was motivated to seek improvements in sail design and construction from an experience on board a vessel on a lee shore "exposed ... to the danger of being totally lost, with all her crew, by the

¹ Cowan, *Essay on the Construction of the Sails*, 3.

² Kipping, *Sails and Sailmaking*, 38.

splitting of the sails, and the utter impossibility of reefing them. No human means then known, were left untried to save the ship.”³ Shipmasters and ship owners understood the importance of well-made sails constructed of the highest quality cloth available. For commercial and military vessels, budget constraints had to be considered as well. Many depended on their sailmakers to test and choose the best cloth for their vessels. Kipping explained how an experienced sailmaker tested his canvas in *Sails and Sailmaking*. In one test, he described a sailmaker testing two sections of canvas from different manufacturers, “[making] a slit in each, and [knotting] them together; he then [hanged] weights to the loose parts” to determine which could bear the most weight. Sailmakers also bored holes through the canvas with fids to see how easily the threads broke. Finally, he noted that, at the very least, a sailmaker would draw a few threads from the cloth panel to examine the general quality of the fibers and determine whether they were composed of long flax, as opposed to tow mixtures.⁴

Aside from running rigging, sails underwent the toughest treatment on a vessel. They were constantly set and struck in all kinds of weather. Stresses on corners, diagonals, and reefs affected their longevity. Canvas sails were elastic and had to be stretched as tightly as possible to get the optimum performance from them. But stretching ultimately destroyed their shape and structure. Injury to sails by chafing or mishandling cut a sail’s life dramatically. In the days of sail power as the only means of propulsion, sails were carried as long as practicable. Sometimes, the mere strength of the wind was enough to split and destroy even the best sails. Accounts from ocean-going ships describe constant attention to sails a crew maintained. Newer, heavy sails were bent for going around Cape Horn and the North Atlantic while a crew would swap out an entire suit of new to old when they reached the doldrums to avoid unnecessary chafing on their

³ Cowan, *Essay on the Construction of the Sails*, 5.

⁴ Kipping, *Sails and Sailmaking*, 39.

best sails. When ships started using cotton canvas, sailors loathed handling the heavier cotton sails, especially when wet. Seawater and rain rendered it incredibly stiff and heavy. Furling heavy cotton sails was likened to handling wooden boards, and seamen would have to beat the cloth with their fists to get the tightest furl possible. In adverse conditions, the quality of sails would be obvious. Sorry indeed was the ship and crew stuck at sea with substandard sails. Sails made from inferior material, but well-woven, would stretch and bag in erratic places. In time, they would not fit the rig and spars or would not set well. Sails made of good fibers but poorly woven were more likely to split.⁵

Mildew and rot deteriorated sails and a ship's crew protected them as if their lives depended on them — which, indeed, they did. Wet sails were never furled tightly and were loosened for drying as soon as conditions permitted. Even by 1937, Calahan noted that no



Figure 15. Square sails loosened for drying, Massachusetts clipper *Syren*, built in 1851. (MacGregor, *British and American Clippers*, 84.)

⁵ Vanderdecken, *Yachts*, 84.

process had yet been developed to “mildew-proof” white sails, though tanned sails “survive pretty well.”⁶ In 1814, the Royal Navy published instructions for manufacturing canvas for the navy and delineated treatments to sailcloth to prevent mildew including boiling cloth to destroy the mucilage within the fibers, but not using alkaline or lime. It also warned manufacturers that ignoring those instructions would be enough to strike them from the list of suppliers. Previously in 1808, Browell & Co. of England applied for a patent for their chemical treatment to prevent mildew in canvas manufactured from “vegetable substances.” After the Royal Navy issued their instructions, Browell & Co. published a pamphlet titled “Narrative and Documents Relative to the Preservation of Mildew in Sailcloth” trying to market their chemical treatments. They explained that, besides the great expense attributed to premature deterioration of a suit of sails on a ship, rotting sails had “in many instances frustrated well-planned naval operations, and sometimes caused the loss of valuable lives, together with ships and their cargoes.” They described existing treatments that destroyed the mucilage of the fibers within the cloth. Mucilage, they explained, was “the chief food of mildew” and alkaline preparations were used to remove it. The alkaline process, however, weakened the cloth. For a navy, these decisions carried enormous financial and practical ramifications as they related to the policy for an entire fleet. Browell & Co. conducted experiments on hempen, flaxen, and “ordinary scotch” canvas and determined that the scotch canvas, after treatment, was more durable than untreated hempen or flaxen canvas. Their experiments consisted of soaking cloth panels in river water, rubbing them occasionally to assure that the water penetrated the threads, and rolling them up wet, packing them in boxes and letting them sit for a month. They claimed that ordinary scotch canvas sold for 1s. 4d. per yard while the government-approved canvas sold for 2s. to 2s. 6d. per

⁶ Harold Augustin Calahan, *The Ship's Husband: A Guide to Yachtsmen in the Care of Their Craft* (New York: The MacMillan Co., 1937), 157.

yard. With their treatments, the Royal Navy could save on costs considerably because they could offer their treatments at three half pence per yard if done on a large scale. Several ship captains provided testimonials on improvements they noticed in sails treated with the Browell & Co. chemical process.

These examples included sails made from treated and untreated cloth within a given sail as untreated sail panels were found unfit for use much more quickly than treated. Browell & Co. pointed out that the mildew on scotch canvas appeared to result from the “great quantity of paste that it [contained]” because mildew attacked the paste first. Their process removed the soluble matter of the canvas. Other than that, however, none of their chemical processing techniques, nor what substances they used were explained in the pamphlet.⁷ Curiously, in 1784 William Falconer claimed that sailcloth from North America was more durable than British-made cloth because of a practice followed there where the weavers moistened the warp in the loom with a “gelatinous substance, prepared from the refuse of neat’s feet (after the oil [was] extracted), which [was] boiled in water until it converted into a kind of glue.” He compared this to the British practice of using a paste of flour and water, which rendered the cloth brittle.⁸ An 1826 company catalogue from the Phenix Manufacturing Company in Paterson, New Jersey confirms that paste or starch was commonly used in manufacturing British cloth. They advertised that, unlike foreign cloth, which was woven using starch, they treated their cloth by “steeping in alkaline [lye] without any preparation that can injure the fiber of the yarns or texture of the cloth.”⁹ Like Browell & Co., their catalogue included testimonials comparing their “Russian

⁷ Browell & Co., *Narrative and Documents Relative to the Preservation of Mildew in Sailcloth* (London: Nichols, Son, and Bentley, 1817), 1-15.

⁸ Falconer, *A New Universal Dictionary of the Marine*, 424.

⁹ Phenix Mill Catalogue, quoted in Hall, *Sailmaking In Connecticut*, 106-109.

Imitations Duck” favorably to Russian and Holland sailcloth, but claimed it to be twice as durable.

Fishing vessels, at the end of the eighteenth century often carried tanned sails. Canvas fibers readily absorbed tannic acid and were claimed to produce an insoluble compound within them.¹⁰ Some tanning practices used a composition of horse grease and tar and red or yellow ochre for color, heated, and then spread over sails. David Steel described another “much approved” process as follows: “the sail being spread on the grass, is made thoroughly wet with sea-water, and then payed over, on both sides, with brown or red ochre mixed with seawater to the consistence of cream, it is then well rubbed over, on both sides, with linseed oil. The sail may be used within twenty-four hours after being oiled.” The Royal Navy, he claimed, tried these methods but had not approved them for widespread use in their fleet. Tanning rendered sails various shades of brown to red to mustard color.¹¹ The United States Navy and Royal Navy never adopted tanning or treatments to sailcloth that resulted in darkened colored sails, though they experimented with a variety of treatments to sailcloth throughout the age of sail. For the merchant and fishing fleets, tanned sails were a matter of personal preference, though; the practice appears to have been popular only within the fishing community. Yachts held true to the beauty of white sails over the utility of tanned sails.

Sailcloth quality and mariners’ general preference for foreign over domestic stemmed more from just cloth treatments. Cultivation and processing techniques combined with individual preference and prejudice to cause some sources of cloth and fibers to succeed over others. The quality of fibers varied from farmer to farmer and depended upon his experience, local climate and agricultural traditions. A debate among manufacturers and consumers raged

¹⁰ Wingate, *Fairchild’s Dictionary*, 603.

¹¹ Steel, *Steel’s Elements of Mastmaking, Sailmaking, and Rigging*, 61.

for years during the early colonial period over the source of cloth and cultivation techniques. The debate focused on water versus dew retting. Nineteenth century seafarers generally agreed that the basic difference between American and foreign sailcloth emanated from the differences in cultivation and processing techniques.

At the end of the eighteenth century, American farmers produced flax for household use in significant quantities. For commercial use, however, American linen was as not well suited for heavy duty as European cloth because Americans dew-retted hemp and flax. American hemp and flax were relegated to use in bagging, bale covering, and cheap cordage on farms. Ships' cordage and sailcloth were imported on a large scale despite import duties. The rate on hemp importation was \$20 per ton in 1792, twice that during the War of 1812, and raised to \$60 a ton in 1828. Four years later it was lowered to \$40. Shortly after the Revolution, several manufactories for making canvas were founded in New England. Flax and hemp were grown extensively in the Merrimac and Connecticut Valleys, but most factories used water-retted imported flax and hemp from Ireland and Russia. John Colt's duck factory in Paterson, New Jersey, used nearly 400,000 pounds of imported flax in 1827, increased to 600,000 pounds in 1832. Use of American fibers was limited to cheaper grades of cloth for bagging.¹²

In the first half of the nineteenth century, the Federal Government teamed up with the manufacturing community to determine the state of American manufactures of sailcloth, especially as it related to supplying the navy. In a report to the Senate regarding this effort, an American manufacturer of sailcloth claimed that the quality of American hemp "as compared to Russian hemp was demonstrably inferior" and that "the principle cause of this defect [was] in the manner of rotting it, and why the mode of dew-retting [was] practiced, [he could] not say." In

¹² Clark, *History of Manufactures*, 1: 289, 325, 530-531.

the same letter, the manufacturer commented that “seafaring people give Russia hemp a decided preference; they say it looks much better, wears better.” A manufacturer, he added, depended on the reputation of his product. Thus, “it is absolutely necessary the raw material should be of the best quality; and it is a fact that neither the flax nor hemp of this country are of such a quality as to justify their general use for manufacturing purposes.” The report concluded that American manufacturers objected to dew retting and preferred to import Dutch, Irish, and Russian flax despite costing them more than sixty percent more to use than American flax. The manufacturers surveyed, overall, agreed that American hemp, in its natural state, was of equal quality to Russian hemp, and if farmers could be persuaded to adopt water-retting, they would be willing to use it. The report did include a number of manufacturers that, in 1825, reported they had not used imported flax in four years. Nonetheless, these individuals comprised the minority.¹³

European cultivation and processing techniques appeared to result in a higher quality fiber and cloth. Each country’s traditions rendered sailcloth distinguishable by country of origin. A study, conducted as part of the same report to Congress in 1822, examined conclusions written up by Peter Besnard, Esq., sent by the British Linen Board to the Netherlands to determine differences between their cultivation techniques and those of Ireland. He reported that the Dutch placed equal importance on the cultivation of flax seed as well as fiber. During the water-ret, the Dutch covered fibers with mud and slime, which resulted in a more uniform color and quality. He concluded that this custom, “as practiced in the Netherlands and France, [formed] the most important points in the treatment of that plant.” France, he noted, prohibited the export of flax in any form.¹⁴ Russia maintained its lead by water-retting flax and hemp and using great care in every other step of processing. Russian serfs provided labor, which kept overhead low. An 1810

¹³ *American State Papers*, 6, *Naval Affairs*, 2: 39.

¹⁴ *Ibid.*

letter from John Quincy Adams, then the Minister at St. Petersburg, reported that the Russians submerged hemp in a stream or pond and kept it totally immersed by putting it under wooden frames with stones on top and covered the frames with planks. When stones were not available, they used earth instead.¹⁵ Russian laborers manufactured sailcloth in huge factories which, unfortunately, fell victim to the plague in the 1770s. In 1771, the admiralty's sailcloth factory in Moscow lost 614 of 704 workers to the plague and shut down operations but was revived later and moved to Novgorod. A request for workers from other factories and the move to private enterprise was denied because the Russian admiralty decided private plants could not produce sailcloth to their specifications. Nonetheless, this calamity led to the growth of smaller industrial manufactories and even a temporary resurgence in home production of sailcloth.¹⁶ By 1800, however, Russia appeared to have recovered from its loss and, once again, foreign vessels headed there in significant numbers to purchase sailcloth and cordage.

Americans were forbidden from trading in the Baltic for naval stores by British Navigation Acts, which were not repealed until 1849. Before independence, few American vessels voyaged to Russia — or, at least, records of this illicit trade are scarce. Trade with Russia during and immediately after the American Revolution was complicated by Russian politics. In 1780, Stephen Sayre, an American claiming to be British, tried to negotiate a deal in the Russian court to ship sailcloth to an island off Surinam as a way of circumventing the British blockade of the North American coastline. He was unsuccessful and in the same year Catherine II declared neutrality regarding shipping on the seas along the coasts of warring nations. The Continental Congress misinterpreted this as an invitation to engage in trade. For a time, Catherine II denied

¹⁵ Ibid., 29.

commercial relations between Russia and the American states to avoid jeopardizing her government's relationship with Great Britain. Another failed attempt at establishing a trade agreement was tried in 1781 by Francis Dana. Russia was waiting for the outcome of the war before making deals with the United States — then not yet an independent nation. Some Russian merchants shipped naval stores, including sailcloth, to the American colonies through French ports and this trade proved quite lucrative.¹⁷

After the war, however, American ships ventured to the Baltic for iron, hemp, and sailcloth in increasing numbers. In 1788, only ten ships cleared St. Petersburg, increasing to seventeen in 1789, and jumping to eighty-four by 1803. Of Russian sailcloth exports to the United States, 87 percent came from St. Petersburg.¹⁸ The voyage required a substantial amount of capital, which could be offset, however, by “refitting the ships inexpensively with superior tackle and sails while in the Russian port.” This became a common practice and large profits could be realized by selling the ships themselves upon their return. For example, the ship *President Adams*, purchased for \$18,000 just before her departure in 1810, was refitted in St. Petersburg with rigging and sails and sold for \$25,000 at auction upon her return.¹⁹ The American maritime community maintained their preference for European sailcloth well into the second half of the nineteenth century. In 1869, the Mallory sail loft in Mystic, Connecticut, received the largest contract for sailcloth ever made at the time and it specified use of “the best imported scotch linen duck” for a total of \$30,000.²⁰ At this time, however, most sail lofts in

¹⁶ James T. Alexander, “Catherine II, Bubonic Plague, and the Problem of Industry in Moscow,” *The American Historical Review* 79, no. 3 (June 1974): 663-666.

¹⁷ David M. Griffiths, “American Commercial Diplomacy in Russia, 1780-1783,” *William and Mary Quarterly*, 3d ser., 27, no. 3. (July 1978): 382-396.

¹⁸ Rasch, “American Trade in the Baltic,” 55, 62, 63.

¹⁹ Norman Saul, “The Beginnings of American-Russian Trade, 1763-1766,” *William and Mary Quarterly*, 3d ser., 26, no. 4 (October 1969): 599.

²⁰ Peterson, *Mystic Built*, 106.

southern New England worked only in cotton sail duck. The Mallory contract was for auxiliary sails for thirty Spanish gunboats being built in Mystic and New York.

In America, the British Navigation Acts that forbade use of foreign sailcloth without penalties proved difficult to enforce. In the years leading up to the Revolutionary War, customs laws were “involved and forever changing,” making “strict observance of the laws ... almost impossible.”²¹ American sailcloth manufacturers struggled to compete with European suppliers, especially at the close of the eighteenth century when British industrialism advanced dramatically. Americans hoped British inventions in textile manufacturing would make their way to American shores despite laws against it. The Federal government recognized the uneasy dependence the navy maintained on foreign shipments of sailcloth and other naval supplies. Tench Coxe, Assistant Secretary of the Treasury under Alexander Hamilton, drafted a proposal to Congress in 1790 to promote domestic manufacturing to free the United States from its dependence on Europe for military supplies. He noted the need for “machines and secrets in the Useful Arts.” Coxe sent agent Andrew Mitchell to England to make models of textile machinery in secret. This attempt at industrial espionage failed, but soon afterwards, Coxe successfully acquired textile machinery through George Parkinson. Parkinson was British and had made an agreement with Coxe claiming he knew the details of Sir Richard Arkwright’s Patent Machine and could build it in the United States. The Federal government paid him a salary, granted him a patent for his improvements to the machine, and transported his wife and children from Liverpool to Philadelphia in return for his services.²² That same year, Samuel Slater began his factory in Pawtucket using Arkwright machinery. Enterprising British textile workers, looking

²¹ Alfred Martin, “The King’s Customs: Philadelphia, 1763-1774,” *William and Mary Quarterly*, 3d ser., 5, no. 2 (April 1948): 203.

²² James E. Cooke, “Tench Coxe, Alexander Hamilton, and the Encouragement of American Manufactures,” *William and Mary Quarterly* 3d ser., 32, no. 3 (July 1975): 370-372, 380-381.

towards the United States to seek their fortunes, circumvented British law by shipping actual machinery piece by piece to avoid detection.²³

With the development of the power loom in the late eighteenth century, American manufacturers were able to produce linen and cotton sailcloth tighter, harder, more durable, and more uniform in texture. With the arrival of Arkwright machinery in American factories during the 1790s, cotton sailcloth approached the quality of flax sailcloth and began to gain the acceptance of the merchant marine. Advances in technology also led to decreased manufacturing costs, which were passed on to consumers. During the War of 1812, privateers and blockade-runners using cotton canvas were considered to sail closer to the wind than those carrying flax sails. Nonetheless, both the British and American navies continued to use flax canvas sailcloth throughout the war.²⁴ The war provided a huge demand for sails just when blockades denied traditional supply routes. A handful of new sailcloth manufacturers within the United States realized large profits by producing and transporting domestic sailcloth to American ports via inland roads and waterways. Seth Bemis of Massachusetts, for instance, sold cotton sailcloth during the War of 1812 at nearly one dollar per yard. He transported his sailcloth to Baltimore, Alexandria, and Richmond, overland by wagon teams when coastal shipping proved too risky or impossible because of the British blockade.²⁵ Sailmaker Alexander Cutler witnessed skyrocketing costs of sailcloth during the Civil War when prices for white cotton canvas soared to two dollars per yard. Some sailmakers used a substitute hemp canvas manufactured in Canada selling for forty cents per yard. The hemp cloth had a “shade of tan,” and Cutler reported that sailmakers and ship owners disliked how it looked. The scarcity of cloth in wartime caused some

²³ Bishop, *History of American Manufactures*, 1: 377.

²⁴ Chapelle, *The Search for Speed Under Sail*, 211.

²⁵ Bishop, *History of American Manufactures*, 1: 232.

sailmakers to close their lofts. Cutler closed his business during the war and moved to New York to make tents for the Union Army.²⁶

From the navy's experience in the War of 1812 when they often found ships unable to put to sea for lack of sails, the government made efforts to overcome this problem by investigating local sailcloth sources. They examined every step in the sailcloth manufacturing process, from seed to final product to remedy the situation. In an 1824 letter from the navy Commissioner's office to Samuel Southard, Secretary of the Navy, John Rodgers explained that American canvas was made from flax, but with some adjustments in cultivation, hemp might be a preferable substitute regarding strength. Rodgers's report concurred with several other surveys in that sailcloth manufacturing authorities believed that "there [could] be no doubt that the American plant, if water-rotted and properly dressed, [would] make a cloth which may be used in the equipment of our national vessels with equal advantage as if of foreign fabric or materials." He concluded his letter by noting that the navy had purchased a considerable quantity of water-rotted linen sailcloth from Fairfield, Connecticut, and commended its quality. The navy also experimented with sails made from a mixture of foreign and domestic flax, but that it was lacking in quality.²⁷

The demands of the maritime community for the highest quality sails and an adequate supply soared in the nineteenth century. By mid-century, the clipper ship era ushered in the greatest need for strong, durable sails. John Colt's mill in New Jersey, and Seth Bemis's factory in Massachusetts, led American sailcloth manufacturing efforts in producing a sufficient inventory of sailcloth; they also led the way in raising the quality standards. Bemis's cotton duck production began in 1809 with handlooms and he introduced the power loom in 1816. Colt

²⁶ Mead, *Bent Sails*, 9, 17.

²⁷ Rodgers to Southard. 17 November 1824. *American State Papers*, 6 Naval Affairs, 2: 28.

opened his mill in 1814, manufacturing yarns and twine from American flax. In 1817, he added linen canvas to his production runs and switched to cotton products in 1822. He added power looms in 1824 and by the next year his canvas and twines surpassed most other domestic manufacturers of cotton sailcloth. Southern New England sailmakers, including Charles Mallory and John Kingsbury Pimer, relied on Colt's cloth in increasing numbers after the 1820s. His cotton sailcloth was reputed to perform well because it was made without starch, which produced stiff cloth with a greater vulnerability to mildew.²⁸ Colt, Bemis, and other American manufacturers secured greater acceptance of their products and steadily increased production. Nonetheless, this did not mean that American vessels were suddenly rigged with domestic sailcloth as European cloth maintained its popularity with many mariners.

Records from sailmakers and ships indicate that, by the end of the nineteenth century, just about all canvas made into sails in the United States came from domestic sources. Conversely, the navy continued to rely on Europe to fulfill most sailcloth requirements. During the Revolution, sails for navy ships had been in such great demand that personnel were instructed to take great pains to salvage sails and cloth from vessels that had been destroyed. The navy juggled sails between ships and seized sails from private vessels for use on naval ships. In a letter from Lieutenant Colonel Tench Tilghman to Major Benjamin Eyre in 1777, he instructed the Major to arrange and send wagons immediately to Trenton and Bordentown "for the removal of the sails and rigging and military stores ... on board any of the ships or vessels either public or private property laying in the river Delaware above the city of Philadelphia." In the same letter he instructed Eyre to move a "quantity of sail duck [near] Bordentown ... to a place of security

²⁸ Baughman, *The Mallorys of Mystic*, 15; "Duck Books," John Kingsbury Pimer Papers.

[and not to] lose a moments notice.”²⁹ Captain Deshon of the *Defence* reported his inability to put to sea for want of duck for sails in December 1777. He negotiated to borrow cloth from the Navy Board until the cloth designated for his ship arrived.³⁰ One month earlier, Isaac Sears in Boston complained that he had not been able to obtain a single piece of duck in New England but was waiting hopefully, anxiously, for the arrival of a ship from France reported to be carrying a large quantity of sailcloth.³¹ In Connecticut, merchants sympathetic to the war effort were disinclined to part with their own supplies knowing they might not be able to replace them. When they did offer them, it was at greatly inflated prices.³² For perspective on numbers, the Royal Navy was estimated to use three to four million yards of canvas annually in wartime.³³

Lessons from those experiences did not necessarily endure after the war. When Congress ordered construction of the six original United States frigates in 1794, Secretary of the Treasury Alexander Hamilton was negotiating the passage of Jay’s Treaty and tried to encourage American manufacturing through bounties and protective tariffs. Instead of aiding fledgling sailcloth manufacturers with large naval contracts, he looked to European suppliers based on their reputation for quality. Curiously, in a draft of Hamilton’s *Report on Manufactures*, he wrote that Boston sailcloth “is asserted to be of a quality superior to any import.”³⁴ Tench Coxe contracted with the Boston Company for sailcloth for the frigates in 1791 at thirteen to fifteen dollars per bolt of thirty-nine yards each. In an 1795 letter by Timothy Pickering, Secretary of War, to the Senate regarding the gathering of materials for building the frigates, he explained that

²⁹ Michael Crawford, ed., *Naval Documents of the American Revolution* (Washington D. C.: Naval Historical Division, 1986), 10: 168.

³⁰ *Ibid.*, 812.

³¹ *Ibid.*, 402.

³² Hall, “Sailcloth for American Vessels,” 134.

³³ Browell & Co., *Narrative and Documents Relative to the Preservation of Mildew in Sailcloth*, 5.

³⁴ Alexander Hamilton, quoted in John R. Nelson Jr. “Alexander Hamilton and American Manufacturing: A Reexamination,” *The Journal of American History* 65, no. 4 (March 1979): 979.

it had been proposed to fit the ships with one full suit each of sails made from American cloth and a second full suit of foreign cloth.³⁵ Thirty years later, the House of Representatives continued to struggle with this problem. Throughout the 1820s and 1830s they studied the feasibility of connecting establishments for water-rotting hemp and flax near navy yards, testing domestic cloth against foreign cloth in experiments ashore and at sea, and attempted to encourage higher standards and output from American manufacturers.³⁶ The War of 1812 and the Civil War continued to frustrate private and military mariners in their abilities to supply their ships with sailcloth. With the launching of the last all-sail naval vessel in the 1850s, the solution to their problems came in the form steam propulsion.

³⁵ *American State Papers*, 6, *Naval Affairs*, 1: 17, 18.

³⁶ *Ibid.*, 3: 241.

CHAPTER 8 THE SAILMAKERS

Shipboard Sailmakers

It was blowing great guns from the north-west. ... One reef after another, we took in the top-sails, and before we could get them hoisted up, we heard a sound like a short, quick rattling of thunder, and the jib was blown to atoms out of the bolt-rope. We got the top-sails set, and the fragments of the jib stowed away, and the fore top-mast stay-sail set in its place, when the great main-sail gaped open, and the sail ripped from head to foot. "Lay up on that main-yard and furl the sail, before it blows to tatters!" shouted the captain; and in a moment, we were up, gathering the remains of it upon the yard. We got it wrapped round the yard, and passed gaskets over it as snugly as possible and were just on deck again, when, with another loud rent, which was heard throughout the ship, the fore top-sail, which had been double-reefed, split in two athwartships, just below the reef-band, from earing to earing.

Richard Henry Dana, Jr. *Two Years Before the Mast*¹

On voyages that lasted several years the sailmaker was indispensable. As Richard Henry Dana described, a ship caught in a storm could lose many sails in one blow. Nineteenth century merchant vessels, however, did not always ship a sailmaker and his duties fell to the crew. To

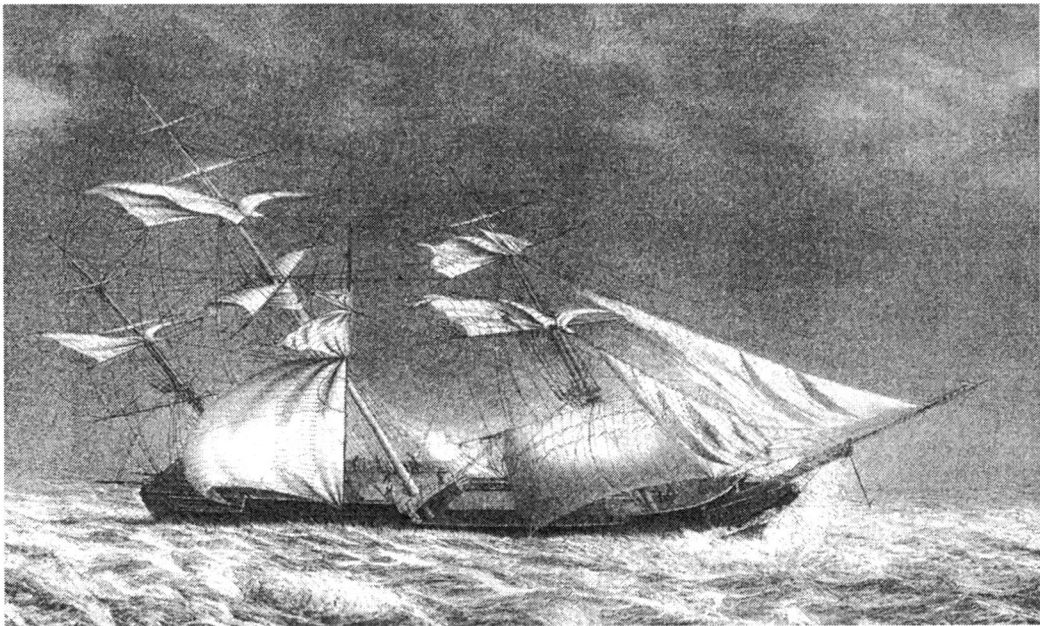


Figure 16. Losing sails in a blow. (MacGregor, *British and American Clippers*, 20.)

¹ Dana, *Two Years Before the Mast*, 289-290.

stay competitive, nineteenth century ship owners often reduced crew size. Sailmaking on such vessels, “like carpentry, ... [was] tacitly considered to be a part of the education of a thorough seaman and it would be a rare thing to find one of them without an expert amateur among the

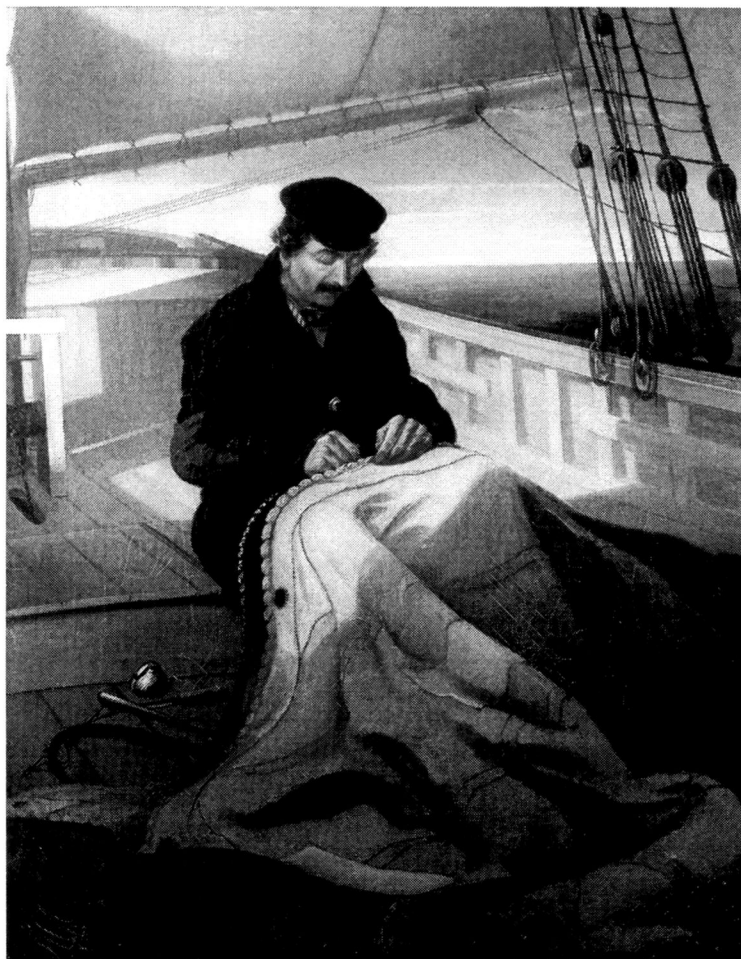


Figure 17. Ship's sailmaker. (J. Welles Henderson and Rodney P. Carlisle, *Jack Tar: A Sailor's Life, 1750-1910* (Suffolk, England: Antique Collector's Club, 1999), 46.)

officers.”² Most seaman were competent at stitching, they made many of their own clothes after all. If an officer could design and cut out sails, the crew could construct them. Coastal vessels generally relied on sailmakers in port. Between 1863 and 1880, Maine schooner *Stephen G.*

² Frank T. Bullen, *The Men of the Merchant Service: Being a Polity of the Mercantile Marine for Longshore Readers* (New York, Frederick A. Stokes, Co., 1900), 170, 176.

Pinkham maintained regular correspondence with its Portland sailmaker and also hired local sailmakers in ports away from home. Even on voyages as far as Manila and Cape Town, no sailmakers were shipped as part of the *Pinkham*'s crew.³

Dana described a new ship coming into port as admirably "complete" with a crew of three mates, a carpenter, and a sailmaker. None of the other vessels he came into contact with between 1834 and 1836 carried a designated sailmaker.⁴ The merchant service's shipboard sailmaker was a privileged crewmember, though usually paid only slightly more than able seamen. Traditionally, he apprenticed under a master sailmaker either ashore or at sea. In the nineteenth century, however, a good discharge from his last ship, having served as sailmaker or sailmaker's mate there, was generally enough to satisfy a captain looking to fill the sailmaker's berth on a new vessel. An able seaman who proved himself skillful in sail work was sometimes promoted on a subsequent voyage, but at a salary below that of a formally trained sailmaker. While such a seaman-turned-sailmaker may have been proficient in sail repair, cutting and fitting a new sail required training.⁵

The sailmaker, nicknamed "Sails," traditionally lived in steerage with the carpenter. On a ship with a full crew, he worked as a "day man" or "idler," stood no watch and worked at his trade all day. He slept at night unless all hands were called. If he shipped as seaman as well as sailmaker, he was required to perform able seaman's duty when called, but focused on sail work when maintenance duties were assigned. If he signed on solely as sailmaker, he contributed to all hands work such as setting or striking sails, coming about, and standing a watch in bad

³ Alfred H. Pinkham Papers, G. W. Blunt White Library, Mystic Seaport Museum, Inc.

⁴ Dana, *Two Years Before the Mast*, 227.

⁵ Bullen, *Men of the Merchant Service*, 174-176.

weather. He was “not expected to handle the light sails, nor to go above the topsail yards. Nor would the inferior duties of the crew, such as tarring, slushing, and sweeping decks be put upon him. ... He [had] no command, and when on deck,” belonged up forward with the forecastle

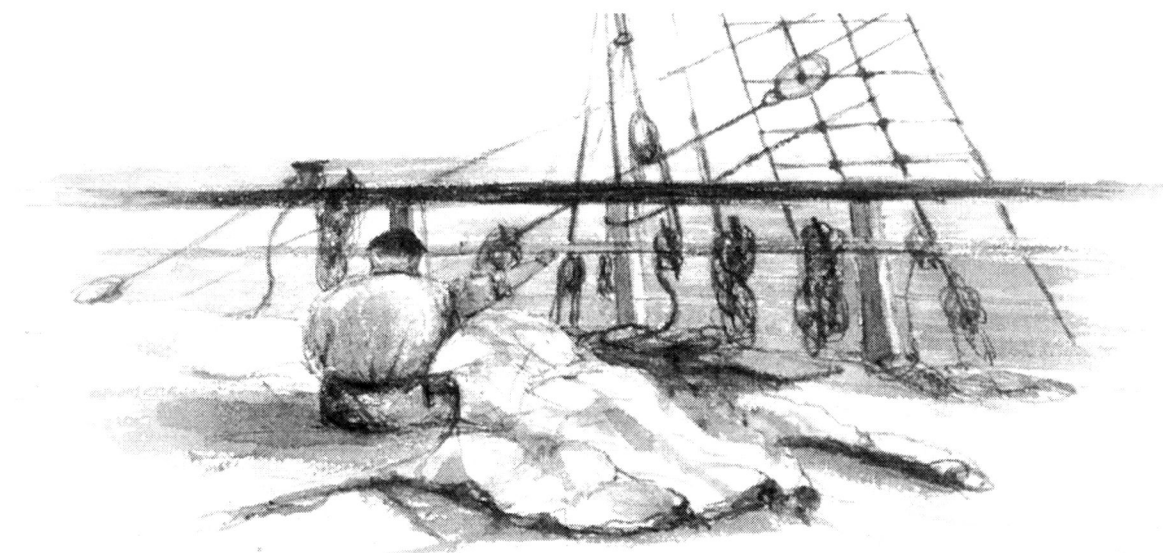


Figure 18. The sailmaker at sea. (Henderson and Carlisle, *Jack Tar*, 47.)

crew. For sail work, he answered to the master; but in ship's work he was under the command of the mates. He could not give orders but was still considered a privileged person on board.⁶

Dana described a typical 1835 workday on the ship *Alert*: “the sailmaker and carpenter worked between decks, and the crew had their work to do upon the rigging. ... The [*Alert's*] sailmaker was the head man of the watch, and was generally considered the most experienced seaman on board.”⁷ At sea, if a ship suffered considerable damage to her sails, everyone on board who could be spared from other functions was sent to the sailmaker. During the clipper ship *Sea Serpent's* circumnavigation, 1854 through 1855, seaman Hugh McCulloch Gregory recorded that the crew routinely unbent a sail, repaired it as a group, and sent it back aloft during

⁶ Richard Henry Dana Jr., *The Seaman's Friend: A Treatise on Practical Seamanship* (1879; reprint, New York: Dover Publications, Inc., 1997), 153, 155.

⁷ Dana, *Two Years Before the Mast*, 250.

a single watch. He made no mention of a sailmaker in the crew. When a mizzen topgallant sail needed a refit, “all those who could use the palm were occupied in altering it so as to make it fit better.” He described sailing in a gale and dealing with sails splitting from head to foot. When the main topgallant sail ripped in a blow, the mate sent three seamen aloft to repair it in place.⁸

The civilian sailmaker was responsible for every aspect of maintenance and storage of his ship’s sails. He supervised storage of spare sails in the sail locker and made certain that sails



Figure 19. Gloucester fishing schooner drying her sails. (Garland, *Down to the Sea*, 159.)

were hoisted for drying in port. Ships leaving on a long voyage would get underway with enough sails and spare cloth to get them home. At least two and sometimes three full suits were carried. Crews regularly swapped suits of sails when reaching the doldrums or stormy regions. The best suit was designated for heavy weather; older suits used in calmer waters. It “would be a great waste of money to allow good canvas to bang itself all to pieces against the masts as the vessel rolls idly upon the sleepy swell.”⁹ Newly launched ships occasionally went to sea with their

⁸ Robert H. Burgess, ed., *The Sea Serpent Journal: Hugh McCulloch Gregory's Voyage Around the World in a Clipper Ship, 1854-1855* (Charlottesville: University of Virginia Press, 1975), 48, 56, 57, 67.

⁹ Bullen, *Men of the Merchant Service*, 174.

main suit pre-made, but had the crew construct smaller sails, such as studdingsails, during the maiden voyage.¹⁰

US Navy ships carried sailmakers until the end of the nineteenth century. The Sailmaker's Mate rating was established in the 1775 Continental Navy and extended in the 1797 United States Navy to petty officers aboard the country's newly launched frigates. These first United States Navy sailmakers and sailmaker's mates on the frigates *United States* and *Constitution* were paid fourteen and thirteen dollars per month, respectively, as compared to fourteen dollars paid to the boatswain and eleven to an able seaman. Each frigate had a sailmaker and sailmaker's mate on board.¹¹ They were designated as warrant officers in 1799. Warrant officers "provided the technical expertise in their fields" and were usually permanent members of the ship's company. Between cruises, when seaman and marines might move to different vessels, the warrant officers often stayed with their ships as caretakers while they supervised repairs and refits.¹²

The sailmaker maintained the ship's sails; he also made all canvas work such as windscreens, awnings, hammocks, and wind funnels. According to the 1814 Naval Regulations, the Master Sailmaker was responsible for examining all sails brought on board and was required to "attend all surveys and conversations of sails." He was expected to repair and keep all the sails ready for service. Regulations dictated that the sailmaker inspect stored sails and see to it that they were kept dry and free from "vermin" as much as possible.¹³ By 1826, the sailmaker

¹⁰ Mead, *Bent Sails*, 62.

¹¹ *American State Papers* 1: 400.

¹² Lester B. Tucker, "Classification of Jobs," *Pull Together: Newsletter of the Naval Historical Foundation and the Naval Historical Center* 32, no. 1 (spring-summer 1993); <http://www.history.navy.mil/nhc11.html>.

¹³ Naval Historical Center, "Naval Regulations Issued by Command of the President of the United States of America" (Washington, D.C.: Printed for the Navy Office, 1814); <http://www.history.navy.mil>.

earned twenty dollars per month, again, the same as the boatswain, gunner, and carpenter.¹⁴

Ashore, the navy replaced civilian sailmakers with naval personnel in 1831.¹⁵ When naval ships no longer carried sails, the sailmaker's position was maintained to take care of hammocks, hatch covers, wind funnels, and any other canvas work they might need. "Sailmaker's Mate" changed to Sailmaker's Mate First Class, Second Class, and Third Class in 1921, and was absorbed into the Boatswain's Mate's duties in 1939.¹⁶

In moments of depressions, I can still brighten with the thought that I shall never set eyes on the dear old sailmaker again, stitching away in the hold by the light of a swinging lantern. Perhaps I have been unlucky, but all the sailmakers I have known were illiterate poison-pens who, every time they pricked their fingers, hissed like snakes and stabbed somebody's reputation. I remember clearly the dear old soul who sewed the Christian sails of a hospital-church-ship on which I sailed as a boy. He sang solos during the Divine Service in a high falsetto, screwing up his eyes, and while the ship's parson, swallowing, wrung out his sermon, fighting a losing battle with seasickness, the sailmaker encouraged him with nods. Perhaps I have been allergic to sailmakers ever since the stormy night when a bosun's mate lay dying in his bunk, surrounded by a cowed little group of sailors. The sailmaker came to see him, commiserating like a nurse, but while bending over the dying man he secretly measured him for the death-sack. ... Yet, in retrospect, it must have been a poor life to sit locked up in a dungeon in the stench of the bilge water sloshing under the planks, trying to sew a seam or stitch an eyelet with the world rolling and pitching about one, and an oil-lamp going berserk on the ceiling. The windjammers of my youth were about to be laid up forever, so new canvas was rare. My most vivid picture of human rage, in all its vindictive futility, was the sailmaker of that hospital-church-ship who had just finished mending a tear in the jib under impossible conditions when, from above, there came the loud tearing noise of another sail rending, followed by the thin cheering of sailors. He jumped to his feet, shook his fists at the ceiling, and prayed to his tribal god with a scream to do something to them that was staggeringly obscene, before the swinging lamp knocked him cold. Perhaps it was small wonder that sailmakers were unsentimental about sewing a death-sack, after all.

—Jan de Hartog, *The Call of the Sea*¹⁷

¹⁴ American State Papers, 627.

¹⁵ Sprague, "Charles Ware, Sailmaker," 267.

¹⁶ Tucker, "Classification of Jobs."

¹⁷ Jan de Hartog, *The Call of the Sea* (New York: Atheneum, 1966), 378-379.

Shoreside Sailmakers

The shoreside marine artisan in the American colonial period, on the other hand, was a respected member of the community. While his counterpart at sea may have earned the enmity of his shipmates, the shoreside artisan was recognized, at least, as possessing valuable skills necessary in a port town. At the end of the eighteenth century, most marine artisans enjoyed steady employment and middling wages for the time. With skilled labor in demand in southern New England ports, these men could expect a higher standard of living than their counterparts in English towns “where unemployment and acute poverty were major problems.”¹⁸ In a study of tax and rate books from 1790 Boston listing occupations according to wealth, sailmakers ranked 25th. Coopers and founders were marginally better off at numbers 23 and 24 respectively, while carpenters followed at 27. Shipwrights ranked only 31, ropemakers 35. Merchants topped the list and laborers were last.¹⁹



Figure 20. 1931 Ratsey sail loft. (Collier, *Classic Sails*, 109.)

¹⁸ Nash, *Urban Crucible*, 11.

¹⁹ Kulikoff, “Progress of Inequality in Revolutionary Boston,” 386.

Any experienced mariner would have known how to stitch a sail, and many wandered ashore finding short-term employment at the local sail loft or on an individual basis for a given vessel. Jobs needing more than basic stitching and repair, however, required substantial training and skill. Understanding plans and measurements, advanced marlinspike seamanship, and some business savvy were essential to the shoreside sailmaker's success. Even with the later adoption of sewing machines, a lot of handwork remained. Roping, grommets, cringles, splicing, and the like still had to be done by hand. Individuality was not encouraged; several men might work together to complete a large sail. Sailmakers seamed from right to left, "each man joining his work to his neighbor's."²⁰ Some sails contained dozens of sailcloth panels – oftentimes too large to lay out on the floor. Sail construction required one form of skill, design another. In his treatise on sailmaking, Samuel Sadler explained that:

"The 'science' of the trade is in getting out a geometrical plan of the sail required; finding therefrom the center of effort, where the force of the wind is supposed to be collected, and obtaining the angles of the strain; and finally, squaring the sail from the after leeches, thus finding the position of strain in relation to the threads of the canvas, and thereby being able to calculate the allowances needed for the stretching of the gores upon such parts as are affected by the wind, etc. The 'art' of the trade is in dealing with the knowledge thus gained, and in the general work of manufacture."²¹

With the life of the crew and the safety of the cargo dependant on the quality of a ship's sails, a sailmaker's livelihood was only as good as his reputation. A sailmaker usually guaranteed his work, which included selections of materials as well as craftsmanship. In a letter to Captain Alfred Pinkham in 1875, sailmaker E. A. Sawyer defended his choice of manila as roping for an awning, stating that "we always use manila on them." He continued to explain that he would accept responsibility for altering it if the size were wrong, "but you will remember that

²⁰ Mikelson, "Sailmakers Tools," 32.

²¹ Sadler, *The Art and Science of Sailmaking*, 141.

nothing was said about that [the manila].” This sailmaker was also a shareholder in Pinkham’s schooner. He closed the letter by stating that if Pinkham and the other shareholders were dissatisfied with his work that he would like to sell his interest — effectively giving up the job. From subsequent records and correspondence, it is clear the dispute passed. Sawyer did not sell and he continued to make Pinkham’s sails.²² The sailmaker was expected to select the appropriate type and weight sailcloth and appurtenances for conditions the sail would be expected to withstand unless the shipowner specified otherwise. In this case, Sawyer’s defensiveness is surprising if the owners were dissatisfied. Other sailmakers, less secure in their reputation and their abilities to maintain their clientele, would have been more accommodating.

To determine the typical southern New England sailmaker of the nineteenth century, this study examined every sailmaker listed in the federal censuses of 1850 and 1880 in eleven seaports: Newbury, Newburyport, Gloucester, Rockport, Salem, Boston, Chelsea, and New Bedford, Massachusetts; Newport, Rhode Island; New London and Groton, Connecticut.²³ In this data, the ordinary sailmaker came to life, not just those whose business records or journals survived. A number of changes in the demographics of the southern New England sailmaker occurred in the thirty years between 1850 and 1880.²⁴ In 1850, the average sailmaker was 35 years old; by 1880, that average had increased to 42 — a significant demographic shift in just thirty years.²⁵ No other statistical factors could explain why this shift occurred, other than that, by the late nineteenth century, sailmaking was a dying profession. By 1880, only 22 percent of

²² E. A. Sawyer to Alfred Pinkham, 12 June 1875, Alfred H. Pinkham Papers, Manuscript Collection 74, G. W. Blunt White Library, Mystic Seaport Museum, Inc.

²³ 1850 was the first year that U. S. Federal Census takers recorded an individual’s occupation.

²⁴ Statistics run on SPSS Version 7.0. with 308 cases in 1850 and 267 in 1880.

²⁵ “Significance” here is validated by statistical analysis. SPSS significance tests comparing means between “age” and “year” revealed a significance test of 0.000 within the ANOVA table.

sailmakers' grown sons took up their father's trade.²⁶ At mid-century, nearly half the sailmakers in southern New England were in their teens and twenties, while fewer than a quarter of 1880 sailmakers were that young. In 1850, all southern New England sailmakers were white men, more than half married with children. In 1880, they maintained similar characteristics, though statistically slightly higher numbers that likely correspond to the increased age with some exceptions: two sailmakers were listed as "mulatto" and two others were single women.

Marine occupations provided employment for blacks and even slaves during the colonial period and throughout the nineteenth century. Frederick Douglass made his way to freedom by using borrowed papers documenting that he was a freed seaman. As a slave in Baltimore, he worked as a ship's caulker, lived on his own, and paid a percentage of his wages to his owner. Under this system, slaves developed skills to pursue maritime artisan trades. In Virginia and Maryland in the mid-eighteenth century, most sailmakers were "either slaves or indentured servants working for shipbuilders." The *Virginia Gazette* advertised slave auctions noting slaves who were "tradesmen," specifically sailmakers and seamen.²⁷ In colonial Philadelphia, indentured servants were recruited into the British Army to serve in the French and Indian War, forcing masters to turn to slaves.²⁸ According to historian Gary Nash, in the late eighteenth century, a large majority of blacks in the North had made the transition from bondage to freedom. For many, maritime skills they had acquired as slaves provided them a good living as free men. For a newly free black man with a maritime skill, a seaport was the only sensible destination. As

²⁶ "Grown sons" determined by those listed in the same household as the sailmaker.

²⁷ Brewington, "Chesapeake Sailmaking," 139-140.

²⁸ Gary B. Nash, "Slaves and Slaveowners in Colonial Philadelphia," *William and Mary Quarterly*, 3d ser., 30, no. 2 (April 1973), 230.

a result, the black population of Philadelphia, New York, and Boston boomed between 1770 and 1800.²⁹

In Philadelphia, the famous black sailmaker, James Forten,³⁰ owned a prosperous sail loft employing forty men, half of whom were black. Forten had been the foreman at a large loft and purchased the business when the owner retired. Interestingly, Forten borrowed the money to buy the business from Thomas Willing, one of Philadelphia's largest slave owners.³¹ Willing owned the building that housed the sail loft and rented it to Forten. Despite the popularity of maritime trades amongst blacks, this trend was not in effect in southern New England by the early nineteenth century. The 1839 Boston City Directory had no sailmakers listed under "People of Color," and every sailmaker listed in the ten seaports surveyed in 1850 was white.³²

New England's sailmakers were a fairly homogeneous group. Eighty-six percent of the 1850 sailmakers were born New Englanders, three-quarters of them native to their state. Of the remainder, half were American-born, half foreign. Within a seaport, sailmakers usually lived in neighborhoods segregated more by wealth than by trade. Although in Boston, marine artisans, seamen, coopers, and sea captains lived close by the docks in the North End. It was considered one of the poorer sections of town at turn of the eighteenth century.³³ Sailmakers in this sample congregated in Boston throughout the nineteenth century – 39 percent in 1850 – with outlying seaports evenly spread with numbers in accord with their total populations. By 1880, over 52

²⁹ Gary B. Nash, "Forging Freedom: The Emancipation Experience in the Northern Seaports, 1775 – 1820," in Gary Nash, *Race, Class, and Politics: Essays on American Colonial and Revolutionary Society* (Urbana and Chicago: University of Illinois Press, 1986), 283-321.

³⁰ Forten was active in the Underground Railroad and promoting blacks' rights and political reform.

³¹ Nash, "Slaves and Slaveowners in Colonial Philadelphia," 248; Esther M. Douty, *Forten the Sailmaker: Pioneer Champion of Negro Rights* (New York: Rand McNally & Company, 1968), 78-81.

³² Charles Stimpson Jr., *Stimpson's Boston Directory, 1839* (Boston: n. p., 1839).

³³ Kulikoff, "Progress of Inequality in Revolutionary Boston," 398.

percent of the sailmakers in southern New England lived in Boston proper with the other seaports all paring down their numbers excepting Gloucester, Massachusetts, which enjoyed increasing success in the cod fisheries.

As a group, sailmakers in southern New England did fairly well, financially. Some, of course, struggled to get by and others operated large sail lofts with dozens of employees. But throughout the century, unemployment was practically non-existent for established sailmakers. In the colonial period, the journeyman sailmaker certainly scrambled to earn a living. Without an established loft, he would have had to find work on a ship-to-ship basis or in another loft if he could secure work. The journals of Ashley Bowen, sailmaker and rigger in Marblehead, Massachusetts, in the 1760s to early 1800s, revealed his efforts to secure work. When he repaired sails through an established loft, he had to give half his earnings to the owner. As a rigger, he suffered equal toils as riggers were closely allied with local sail lofts. After nine years in the trade, Bowen built up a regular clientele for rigging work and some sail work. His wife assisted him by making flags for ships.³⁴

In the nineteenth century, the proprietors of sail lofts often grew wealthy and rose to be prominent citizens. Charles Mallory of Mystic, John Kingsbury Pimer of New London, New Bedford's Simpson Hart, the sail loft of Rhoades and Matthews in Boston, and the Ratsey family of England and New York represented very successful sailmaking firms throughout the century. Skilled as they might have been, however, these people were more businessmen than working artisans. Although they paid their workmen real wages, they often took shares in a vessel in lieu of cash. The investments often realized impressive returns. The typical sailmaker in 1850, however, was neither an investor nor a property owner. Of the 26 percent who did own real

³⁴ Philip Chadwick Foster Smith, ed., *The Journals of Ashley Bowen (1728-1813) of Marblehead*, (Portland, Maine: Anthoensen Press in association with the Colonial Society of Massachusetts, 1973), 142.

estate, the average value of their property was upwards of \$2500. Those property owners were nearly all established in their communities: married, with children, and over twenty-five years old (average age of property holders was forty-five).³⁵

While journeyman sailmakers may have done piecework, established sail lofts often had more work than they could handle. Many hired those same journeymen, took on apprentices and employed up to forty or fifty sailmakers. From June to December of 1854, the Boston sailmaking firm of Rhoades and Matthews sent between seven and twenty loads of sails per month to and from ships in Boston harbor. During the first years of the Civil War, Matthews contracted to make tents for the Army. That, in addition to their sail work, garnered tremendous profits.³⁶ In Mystic, Charles Mallory regularly hired journeyman sailmakers during times of heavy work, providing them with room and board as part of their pay. In 1856, when New Bedford whaling was going strong, the city's fifty-nine sailmakers were employed at over a dozen sail lofts, with six firms dominating the market.³⁷

Shoreside sailmakers and their shipboard counterparts shared the same responsibilities in the construction and repair of working sails and other canvas work. Many sail loft workers had left the sea and settled ashore. Ashley Bowen left the sea after many years, came ashore, married, and made his livelihood from the rigging and sailmaking skills he had acquired at sea. Simpson Hart, Jr. sailed on China and Liverpool merchant ships before moving ashore and opening his sail loft in New Bedford.³⁸

³⁵ Of those who owned real estate in 1850: 95.8% were married; 80.3% had children; 98.6% were over age 25. Mean age of all sailmakers who owned property was 44.89.

³⁶ William F. King Jr., "The Sailmakers and Ship Chandlers of 79 Commercial Street, Boston," *American Neptune* 15 (1955): 222-223.

³⁷ Almy and Bumpass, Simpson Hart, Chapman and Bonney, Charles Hitch, Hunt and Chapman, and Charles Haffords were New Bedford's main lofts employing most of the city's sailmakers.

³⁸ Briggs, "Sails and Sailmakers," 4.

Some divided their time between sea and shore. In Maine, nineteenth century sailmaker Alexander Munro Cutler explained that most of his business came from small, cargo-carrying vessels that laid up in the winter and sent their sails in for maintenance and repair. During the summer, when business was slow, Cutler would go to sea.³⁹ In southern New England, most loft workers were permanent members of their communities. In 1880 Boston, only 21 percent of sailmakers lived in boardinghouses, most were either heads of household or living with immediate family. In the outlying towns and cities, only a handful of sailmakers boarded. Nonetheless, records from John Kingsbury Pimer and Charles Mallory indicate a regular labor pool supplied by itinerant sailmakers. Between 1836 and 1844, Pimer employed ten men, six of whom appeared on his payroll accounts for only one year. By 1857, none of these earlier employees appeared on his payroll. In Newport, however, ten out of twelve sailmakers in the 1858 directory were also listed as sailmakers in later years. In 1880, seven of nine Newport sailmakers had been listed in earlier directories as well, indicating stability in Newport's sailmaking workforce.

Historian Gary Nash noted that the factors affecting a sailmaker's success were no different from any other trade — as were the reasons a sailmaker chose his trade in the first place. An artisan's prosperity, he wrote, "included craft scale, business acumen, health, luck, and choice of marriage partner. Nonetheless, young men tended to base their choice of career far more on those of their fathers — or uncles, older brothers, or cousins — than on a rational calculation of future material rewards."⁴⁰ An examination of the community, however, paints a slightly different picture. In 1850, half the sailmakers in southern New England lived in neighborhoods with other sailmakers in them, while only one in ten had family in those same

³⁹ Mead, *Bent Sails*, 25.

⁴⁰ Nash, *Urban Crucible*, 8.

areas.⁴¹ These are not a particularly surprising statistics given that many sailmakers at the time were men who had learned their trade at sea and that the demand for sailmakers was considerably higher than it had been the generation before. Still, once a sailmaker settled down on shore, he tended to put down roots. Thirty-six of the sailmakers on the 1850 federal census were still in the profession in the same port thirty years later. With demand high, their relatives did tend to join them in the trade — even if they practiced it in different ports. In 1850 and 1880, thirty percent of sailmakers had relatives who were also sailmakers in southern New England.

The end of the century witnessed more newcomers than earlier as less than seven percent of the 1880 sailmakers had relatives in the business in 1850, while 21 percent in 1850 had relatives making sails thirty years later.⁴² Charles Mallory of Mystic learned the trade from his brother-in-law in the early 1800s and opened his own business in 1816. He and his sons carried on the business for the next thirty-five years. They diversified their financial interests in shipbuilding, shipping and whaling, and commercial banking.

While the above-named sailmakers each fit into the statistical model, some exceptions are worth noting. Forten breaks from the mold by being black and highly successful financially. He owned both a business and a large home in Philadelphia and made enough profits from his business to buy several men, women, and children out of slavery. His employees were evenly split between black and white. Sailmaker William Steele of Gloucester, Massachusetts, fit the stereotype: he was white, married with children, forty-five years of age. He had family living

⁴¹ “Neighborhood” is defined, for this study, as households within 5 dwelling #s as listed on the federal censuses; “family” is defined as sharing the same surname.

⁴² 38.6 % of 1850 sailmakers had relatives who were sailmakers in 1880. 31.8 % of 1880 sailmakers had had relatives making sails in 1850. These percentages may be even higher, as “family” included only those with the same surname. Other relatives may have existed in the profession with different last names.



Figure 21. James Forten. (Douty, *Forten the Sailmaker*, 124.)

close by and shared the sailmaking business in Gloucester with several relatives that carried on the trade. He stands apart, however, in that he owned real estate valued at over \$12,000. Most sailmakers did not own property, and only one other in all of southern New England owned property over \$10,000. Excepting these two property owners, all other property owners' real estate averaged \$2,400.

New Bedford and Boston were home to the only non-white and the only female sailmakers in 1880. In New Bedford, 72-year-old Charles Anthony had been making sails for Simpson Hart for more than ten years. He hailed from Pennsylvania and was listed as "mulatto." In 1880, Anthony was unemployed for half the year.⁴³ Anthony was married with a grown stepson, who was not a sailmaker. He had no extended family in southern New England. The other "mulatto" listed was Thomas E. Crute in Boston. Crute emigrated from Canada and, like Anthony, had no other family in the survey. At age 35, he was married and found steady employment in Boston's sail lofts. The two women sailmakers also lived in Boston and New Bedford. Both were single, white women with relatives who were sailmakers within southern

⁴³ Statistically, there was no relationship between a sailmaker's age and the number of months he may have been unemployed. Thus, Anthony's age did not dictate the fact that he was unemployed part of the year.

New England at the time. Kate Higgins emigrated from Ireland and found year round work in Boston. In 1880, she was thirty years old and living with extended family. Emma F. Palmer worked in her native New Bedford. At age 20, she still lived with her parents.

Sailmakers in southern New England enjoyed high employment rates, but setting one's self up in business was another matter. As we have seen, seafarers did not make changes if they did not have to — there being enough risk and uncertainty in their lives already. Thus, if a locality already had an established sail loft, starting up a new one required more patience and capital than most possessed by most craftsmen. Colonial sailmaker and rigger Ashley Bowen lamented in his journal that with no loft, he was “forced to fix sails at the halves and take goods for my pay, but [he did not] know how to do the better.”⁴⁴

In Connecticut, the Mallory family “seems to have had a virtual monopoly on the sailmaking needs at Mystic through most of the nineteenth century.”⁴⁵ But when the demand was high an enterprising sailmaker could establish himself in business. In the bustling seaport of Boston in 1789, the twelve sailmakers listed in the city directory worked in five separate lofts. By 1858, Boston employed 220 sailmakers working in dozens of independent sail lofts. As New Bedford's demands for sailmaking increased mid-century, the total number of sailmakers increased. The dispersal of independent sailmakers became more consolidated as the years passed, however. For example, New Bedford in 1845 had forty-seven sailmakers working at fourteen different firms, averaging just over three men per loft. By 1870, the city's fifty-five sailmakers were concentrated in only seven sail lofts, averaging almost eight men per loft.

A sail loft employee typically worked a nine or ten hour day with one day off per week. The bosses, like many small business owners, put in extra hours. Ledgers from John K. Pimer

⁴⁴ Smith, *The Journals of Ashley Bowen*, 142.

⁴⁵ Peterson, *Mystic Built*, 104.

and James Morris reveal that their employees were paid for nine to eleven hour days in 1831, but Pimer and Morris, themselves, routinely worked twelve and thirteen hour days. Wages were paid either on an hourly or daily basis. Charles Mallory paid short-term sailmakers to stitch canvas and paid them by the yard sewn. For journeymen sailmakers, Mallory arranged for their room and board. His accounts show debits in cash and supplies, bills and notes paid for them, and days lost per worker. Their labor was credited at 92 cents per day for a ten-hour day. Separate allowances were made for night work.⁴⁶ In 1832, some of John Pimer's employees exchanged labor for board at \$1.00 per day during a time that most were paid only \$1.15 to \$1.33 per day for their work. By 1840 Pimer paid his regular employees \$10 per week, double their wages of 1831.

Like Mallory, Pimer regularly paid his sailmakers, partially, with supplies, particularly yardage of duck. Some men were paid by the amount of duck sewn rather than by time worked.⁴⁷ Journeyman sailmakers provided extra labor when work was busy, as they were often willing to work overtime without a commitment from the sail loft to maintain employment for them when times grew slack. In the 1850s in New Bedford, if a large group of whaling vessels made port all at once, sailmakers were in heavy demand. At such times, a master sailmaker in need of workers customarily would "wait at the foot of their rival's stairs toward sundown. As the journeymen came down from their day's work, they were asked to come work at another loft until nine o'clock, which they often did." Night wages were sometimes double the regular working day rate.⁴⁸

⁴⁶ Baughman, *The Mallory's of Mystic*, 17-18.

⁴⁷ John Kingsbury Pimer Papers, "Miscellaneous Sailmaking Accounts, Bills and Receipts, 1836-1840," Box 3 / Folder 11.

⁴⁸ Briggs, *Sails and Sailmakers*, 6.

New sails and sail repair, naturally enough, were generally the mainstays of a sail loft's income. Other canvas work, especially awnings, supplemented many a firm's income. Contracts were won mostly by reputation, supplemented by business drawn in by newspaper and directory advertisements. Those who could afford it, accepted shares in a vessel in lieu of cash and locked in that vessel's sail business. However he landed the contract in the first place, a sailmaker's relationship with his clients tended to be long lasting. John K. Pimer worked most of his career for three different managing owners or agents of New London whaling vessels. Papers from Lawrence and Company, managing owners of whaling and sealing ships out of New London, show that they sought the services of one local sailmaker almost exclusively.⁴⁹

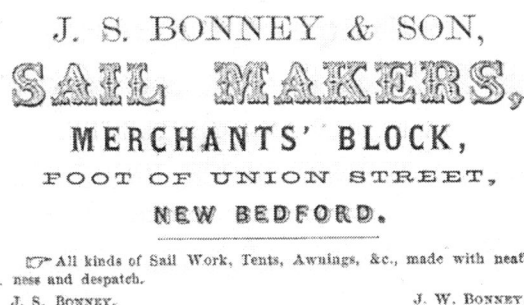


Figure 22. *J. S. Bonney and Son* advertisement in the 1865 New Bedford city directory. (Abraham Taber and Brother, *The New Bedford Directory, 1865* (New Bedford: Abraham Taber, 1865), 218.)

Captains and shipowners, of course, preferred their favorite sailmakers and would often send for new sails even in different ports. Correspondence between Captain Alfred Pinkham and E. A. Sawyer, his sailmaker/partner in Portland, Maine, indicate regular work ordered from ports up and down the eastern seaboard, often sails delivered via another coasting schooner. Pinkham routinely bought small amounts of canvas from chandlers and sail lofts in other ports — but it was Sawyer who did the vast majority of the work.⁵⁰ While some sailmakers may have

⁴⁹ John Kingsbury Pimer Papers, "Description of the Collection: Biographical Resume."

⁵⁰ Alfred H. Pinkham Papers.

The sails would be snaked in casks and compressed by stamping feet to reduce their volume.⁵² Merchant vessels often kept just enough supplies on board for repairs but counted on the services of sailmakers in port to take care of bigger jobs. Though Pinkham retained the services of his sailmaker outside of his home port, his accounts from a stop in New York City include a receipt from a local sailmaker who worked on board his schooner *Stephen G. Pinkham* for a single day in 1874.

If a sailmaker did not learn his trade at sea, he most likely started as an apprentice working for an established sailmaker — often a relative or family acquaintance. The apprentice system was in existence from colonial times to the twentieth century. In colonial Massachusetts, “it seems to have required a special act to free an apprentice from his obligations, even after his master had absconded and deserted him.”⁵³ Charles Mallory apprenticed to his brother-in-law, Nathan Beebe, in New London at age fourteen. Four years later, he had advanced to loft foreman and soon moved to Mystic in 1816, finding sailmaking work for fishing vessels. Newport native Henry B. Almy moved to New Bedford at fourteen to apprentice to his brother Job Almy who ran a loft at 11 Parker’s Block.

In New Bedford, it was customary for master sailmakers to take on one or more young men for a three-year apprenticeship. Apprentices received room and board, but little or no cash for working. They often lived in the master’s house. One contemporary account recalled that a sailmaking apprentice he knew was not allowed at the table with the family.⁵⁴ Family members, naturally, would have maintained a less formal living arrangement. Alexander Cutler explained that at his loft, “helpers” learned the trade for three years after which they were given a

⁵² Briggs, “Sails and Sailmakers,” 9.

⁵³ Clark, *History of Manufactures*, 1: 67; Brewington, “Chesapeake Sailmaking,” 145.

⁵⁴ Briggs, “Sails and Sailmakers,” 5.

certificate and pronounced “first-class” sailmakers. The master sailmaker would determine after the fourth month whether the apprentice was going to work out. If not, he was let go. In comparing seamanship learned at sea to apprenticeship, Cutler claimed that a voyage around Cape Horn with experienced fellow seamen would equate to a year’s work at a loft ashore.⁵⁵ Boys and men could either apprentice to an individual sailmaker or to a larger loft where his training would come from more experienced workers, but not necessarily the owner.

The business savvy sailmaker knew that many of his clients had more potential than cash and that the relatively modest amount of money advanced to a shipowner in the form of sails at the beginning of a voyage could prove extremely valuable at its end. For those who could wait for the reward — and accept the risk that a ship might not make a profit (or return at all) — investing in shipping could be a nineteenth century sail loft owner’s ticket to wealth. Outfitting a ship with sails usually bought $1/64^{\text{th}}$ or $1/32^{\text{nd}}$ of the ship’s profit. In addition, becoming an investing partner would also guarantee supplying that particular vessel with sails.

Owning part of the ship turned some sailmakers into brokers. Alexander Cutler explained that “the man who made the sails always took a good-sized piece of the vessel but was permitted to resell any portion he wished. In order to continue to hold the sailmaking work on the schooner, he would have to retain a sizable portion” with the minimum generally $1/32^{\text{nd}}$.⁵⁶ In 1856, Boston sailmakers Rhoades and Matthews acquired $1/32^{\text{nd}}$ interest in the barque *Belle*, for which they provided a suit of sails valued at \$1,018.93 as payment. The shares were worth \$997.26 — cash covered the balance.⁵⁷

Such an arrangement, of course, served the needs of the ship’s other investors quite

⁵⁵ Mead, *Bent Sails*, 36.

⁵⁶ Mead, *Bent Sails*, 46.

⁵⁷ King, “Sailmakers and Ship Chandlers,” 221.

neatly by dramatically reducing the amount of cash it took to put a vessel to sea. Much of the capital required to outfit a vessel was “merely bookkeeping transfers within a circle of investors, agents... and suppliers.”⁵⁸ Within that circle, chandlers and sailcloth manufacturers discounted cloth and supplies to sailmakers. The Boston sail loft of J. L. and R. H. McLaughlin bought cotton and ravens duck from Fearing, Thacher & Co. and Wright and Whitman and consistently received discounts of 4 and 5 percent.⁵⁹ John Pimer enjoyed the same discount for “raw materials” from N. and W. W. Billings for the duration his account with them between 1835 and 1841. Loft owner Charles Mallory ended up owning pieces of sealers, whalers, and both coastal and transoceanic merchant vessels. He eventually expanded into shipbuilding, brokerage, and salvage. By 1850, his profits from these shares allowed him to pass management of his loft to his foreman and employee sailmakers.⁶⁰ John K. Pimer, working in the latter half of the nineteenth century, also accepted shares in vessels as payment for sail work, but he did not keep them for long. As a man who had had trained his whole life to determine which way the wind was blowing, he chose to make his long-term investments in railroads and real estate. Pimer personally ran his loft until he retired, a wealthy man, in 1882.⁶¹

Most people who worked in the lofts, of course, were skilled workers, not investors. The skills involved were considerable and took years to learn. For merchants and mariners, those skills were prized above all but, perhaps, those of the shipwrights themselves. Sails were a vessel’s sole means of propulsion and mariners relied on them for their livelihood and their lives. Sailmakers were responsible for delivering a product that could withstand extremes of weather and stresses yet still work efficiently. Each step in the sailmaking process required an

⁵⁸ Baughman, *The Mallory’s of Mystic*, 23.

⁵⁹ J. L. and R. H. McLaughlin. “Bills, 1858-1860, and 1878,” Manuscript Collection, G. W. Blunt White Library, Mystic Seaport Museum, Inc.

⁶⁰ Baughman, *The Mallory’s of Mystic*, 24

understanding of design and manual skill. Not until the introduction of the sewing machine did the demands on the sailmaker change. Although the sewing machine was first patented in 1842, it was not adapted for general purposes until several years later. In the first nineteen years after its introduction, there were six hundred new patents on improvements. Isaac Singer and Orson Phelps advertised their Belay-Stitch Sewing Machine in Boston in 1850 and specifically promoted that it could be “adapted to perform any kind of work from the stitching of a fine shirt-bosom to a ship’s sail.”⁶²

Nonetheless, it was a few decades later that sail lofts acquired machines to do even part of their work. Mallory’s loft was using them by 1890; most Boston sailmakers did not use them until the twentieth century. In Maine, Alexander Cutler recalled that “foot machines had been used for the braiding of awnings and often for stitching light work,” but that power machines for stitching seams were not used until 1898.⁶³ The sewing machine improved productivity levels for a loft but was not always welcomed by sailmakers. With mechanization, some sailmakers became more like “other urban industrial operatives.”⁶⁴ In the early years of the twentieth century, Gloucester and Boston sailmakers organized into unions and went on strike several times.

Machines, in any event, could not do much of the work and were only useful for basic stitching of seams, reef bands, and tablings. Roping, grommets, cringles, and splicing still had to be done by hand. Cutler asked for police protection when he first introduced sewing machines to

⁶¹ “Description of the Collection: Biographical Resume,” John Kingsbury Pimer Papers.

⁶² Bishop, *History of American Manufactures*, 2: 491; Ruth Brandon, *A Capitalist Romance: Singer and the Sewing Machine*, (Philadelphia: J. B. Lippincott Co., 1977), 50.

⁶³ Mead, *Bent Sails*, 41.

⁶⁴ Andrew W. German, *Down on T Wharf: the Boston Fisheries As Seen Through the Photographs of Henry D. Fisher* (Mystic, CT: Mystic Seaport Museum, Inc., 1982), 43.

his loft because he knew of “near-riots” in other places where sailmakers from competing lofts vandalized the new machinery. Other manufactories witnessed violence at the introduction of machinery where people rioted, destroyed machines, and burned buildings in which they were found. At his own loft, however, he claimed that his sailmakers accepted sewing machines as devices that both saved time and eased the strain on their hands.⁶⁵

Small lofts represented the typical sailmaking business in the nineteenth century. Boston’s 180 sailmakers of 1858 worked in forty different sail lofts, averaging four or five men per loft. Larger lofts, especially those with financial shares in local shipping, could monopolize sailmaking work in their area, particularly in the smaller outports. Rigger-sailmaker Ashley Bowen commented that, although he was the chief rigger in Marblehead, he “darst not engage a suit of rigging without asking who makes their sails,” because sailmakers often kept the rigging business for themselves — or, at least, kept control of the job. If not direct employees of the loft, riggers often had to rent loft space from sailmakers and pay half their wages in rent, and Bowen complained about having to haul his gear from one sail loft to another with each job.⁶⁶

Established lofts often stayed in business from one generation to the next. New Bedford’s Simpson Hart opened his loft on I. & G. Howland’s Wharf in 1834 and made sails until he died in 1876. The Simpson Hart sail loft survived him and stayed in business into the twentieth century under the direction of Thomas Hart, his son. New Bedford Directories reveal a consistent representation of the same few family names — even if business relationships amongst them were considerably more fluid. Men partnered with other sailmakers and some regularly jumped from one business relationship to the next. In 1836, (John H.) Chapman and (Josiah S.) Bonney, Charles Hitch, and Hunt and (Alfred M.) Chapman dominated New Bedford sailmaking.

⁶⁵ Mead, *Bent Sails*, 41. Riots described in Bishop, *History of American Manufactures*, 1: 377.

⁶⁶ Smith, *Journals of Ashley Bowen*, 139, 142, 149.

In 1856, Job Almy and Shipley Bumpus maintained an active loft, Almy and Bumpus. By then, Charles Hitch was joined by his son and was now doing business as Charles Hitch & Son. Simpson Hart carried the most employees while the one Chapman partnered with Josiah S. Bonney, the other with William Hunt. By 1865, Alfred, John, and Edward Chapman each maintained their own sail lofts, independent of each other. Josiah Bonney, freed of his alliance with Chapman, now ran Josiah Bonney & Son. Four years later, Alfred Chapman teamed up with John Shurtleff, formerly of Charles Haffords's loft at Wareham's Slip. In that same year, Hardy Hitch, having just returned from California's gold fields empty-handed, opened a sail loft on Taber's Wharf independent his brother's established loft, Charles Hitch & Son.⁶⁷ Alexander Cutler inherited his business from his father. His father had employed three other men; the younger Cutler's loft eventually had up to forty employees.⁶⁸

The Ratseys of Ratsey and Lapthorn also remained a family tradition across three centuries. The Mallorys continued to run a sail loft from one generation into the next, but the sons were more involved in other aspects of their family's maritime businesses. Charles and Hardy Hitch followed their father's trade, as did their sons and nephews, Otis, Charles Henry, Obed, and Hardy III. John K. Pimer had no record of relatives having worked for him, and he closed his shop when he retired. As the nineteenth century drew to a close, fewer and fewer members of the younger generations took up the sailmaking trade. The number of sailmakers in these seaports fell by 13.3 percent from 1850 to 1880, despite an overall population increase.⁶⁹ Of the sailmakers in 1880 who had sons carrying on the profession, 77 percent had relatives who

⁶⁷ New Bedford City Directories 1836, 1856, 1865, 1869-70.

⁶⁸ Mead, *Bent Sails*, 3, 34.

⁶⁹ 308 sailmakers in 1850, 267 in 1880 as counted in federal census records.

were also sailmakers in southern New England.⁷⁰ Sailmakers with extended family in the industry, naturally enough, were much more likely to have younger relatives following their example than those who did not.⁷¹ In New Bedford, family members often worked for competing sail lofts, and just as often, switched from one firm to another from year to year. Three members of the Church family made sails in 1856, two worked for Simpson Hart and another for Hunt and Chapman. William Congdon worked for Almy and Bumpus in 1856 but had moved over to Simpson Hart by 1870.⁷² Moses Taber made sails in New Bedford for over thirty-five years for Charles Hitch. John B. Taber, however, worked for Simpson Hart for more than ten years.

In New Bedford, Simpson Hart's loft dominated the sailmaking business for several decades spanning the middle of the nineteenth century; his busiest year was 1856 when he had nineteen employees. Hart was the city's largest employer of sailmakers in 1870 with ten. In addition, he made profits supplying neighboring sailmakers with cordage, duck, and sail hardware, as recorded in his accounting books from the 1860s to 1890.⁷³ If a rivalry existed, it is not apparent from these records. Alexander Cutler recalled that for rushed jobs, they would bring in sailmakers from other lofts in Boothbay and likewise lent theirs out. He explained that this practice was good for lightening the payroll at slack times and augmenting their work force when busy.⁷⁴

Most sail lofts did not specialize in the types of sails they made or the ships for which they made them. An exception was the Ratseys in England (and later New York), who early on

⁷⁰ Statistics based on sailmakers with sons listed as household members only. "Relatives" counted as those with the same surname within the sample.

⁷¹ Of those with sailmaking in the family, 40% had grown sons who were sailmakers compared to 4.9% of the total sailmaking population.

⁷² New Bedford Directories. 1836, 1856, 1865, 1869-70.

⁷³ Simpson Hart, Simpson Hart Papers, Business Records Collection, New Bedford Whaling Museum.

⁷⁴ Mead, *Bent Sails*, 35.

became experts in yacht and racing sails. The typical loft, however, took the work as it came. They provided sails for large ocean-going ships, which included sails for the ships' boats, plus smaller coastal vessels and the fishing fleet. Schooners filled the docket more than other vessels, as there were more of them. Naturally, a sailmaker in a seaport that specialized in one type of shipping would have had more work for that type than any other. Gloucester sailmakers, for example, worked mostly on schooners and smacks; New Bedford sailmakers worked on whalers. John Pimer, in New London, split his workload between ships, barques, and schooners for big jobs, but smacks appeared in his duck books more than any other vessel. Rhoades and Matthews, in Boston at the height of the clipper ship era, provided sails for Donald McKay's *Stag Hound* which carried 8,000 yards of canvas in its rig. As mentioned earlier, Charles Mallory's loft made sails for vessels of every kind as did Charles Hannum of Cape Cod whose 1851 account book shows work evenly distributed between schooners and barques.⁷⁵

Sail lofts won business contracts through reputation, by owning shares in a vessel, and sometimes simply by location and market demands. Marion Brewington explained that Chesapeake sailmakers obtained their business "by close contact and friends of the skipper's, ship brokers, and owners." There is no reason to think it was any different in New England. In Connecticut, John Pimer and Charles Mallory secured most of their work by investing in the vessels themselves. In Boston, Rhoades and Matthews bartered sailmaking work for vessel shares in the barque *Belle* in 1856.⁷⁶ E. A. Sawyer of Portland, Maine provided sails for Captain Alfred Pinkham despite conflicts between them, as he was a shareholder in Pinkham's schooners. Most guaranteed their work, and in that capacity, would often insist on bending on the new sails

⁷⁵ Charles Hannum, "Account Book," Manuscripts Collection, G. W. Blunt White Library, Mystic Seaport Museum, Inc.

⁷⁶ Brewington, "Chesapeake Sailmaking," 145; King, "Sailmakers and Ship Chandlers," 225.

themselves. These sailmakers gave strict instructions on how the sails should be set and handled. Otherwise, they would not accept responsibility for how they stretched.⁷⁷ J. L. and R. H. McLaughlin's Boston loft must not have made this demand as their records show that they had a regular contract with Norcross & Co. for "trucking" sails from the loft to the docks.⁷⁸ Often sailmakers depended on the ship's rigger to bend on newly delivered sails.

While some lofts maintained haphazard records, many meticulously recorded their business transactions in Duck Books, Accounting Ledgers, Payroll Ledgers, Waste Books, Spar Dimension books, and Day Books — a practice in keeping with the exacting nature of their craft. Simpson Hart, for one, kept separate notebooks for each vessel, recording rig and spar dimensions, sketches of the vessel, measurements, work ordered and work done. Sail plans

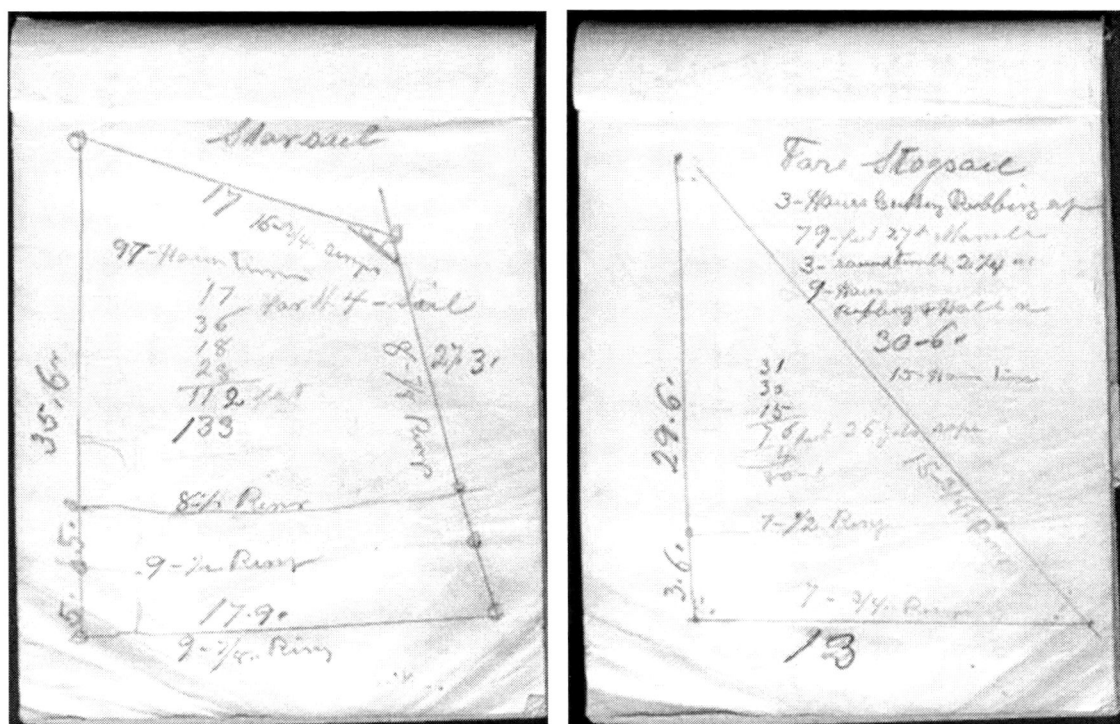


Figure 24. Sailmaker Barney Borrensen's notebooks, nineteenth century. (left) Gaff mainsail and (right) fore staysail. (Notebook No. 2, courtesy of G. W. Blunt White Library, Mystic Seaport Museum, Inc.)

⁷⁷ Horsley, *Tools of the Maritime Trades*, 180.

⁷⁸ J. L. and R. H. McLaughlin. "Bills, 1858-1860, and 1878," Manuscript Collection, G. W. Blunt White Library, Mystic Seaport Museum, Inc.

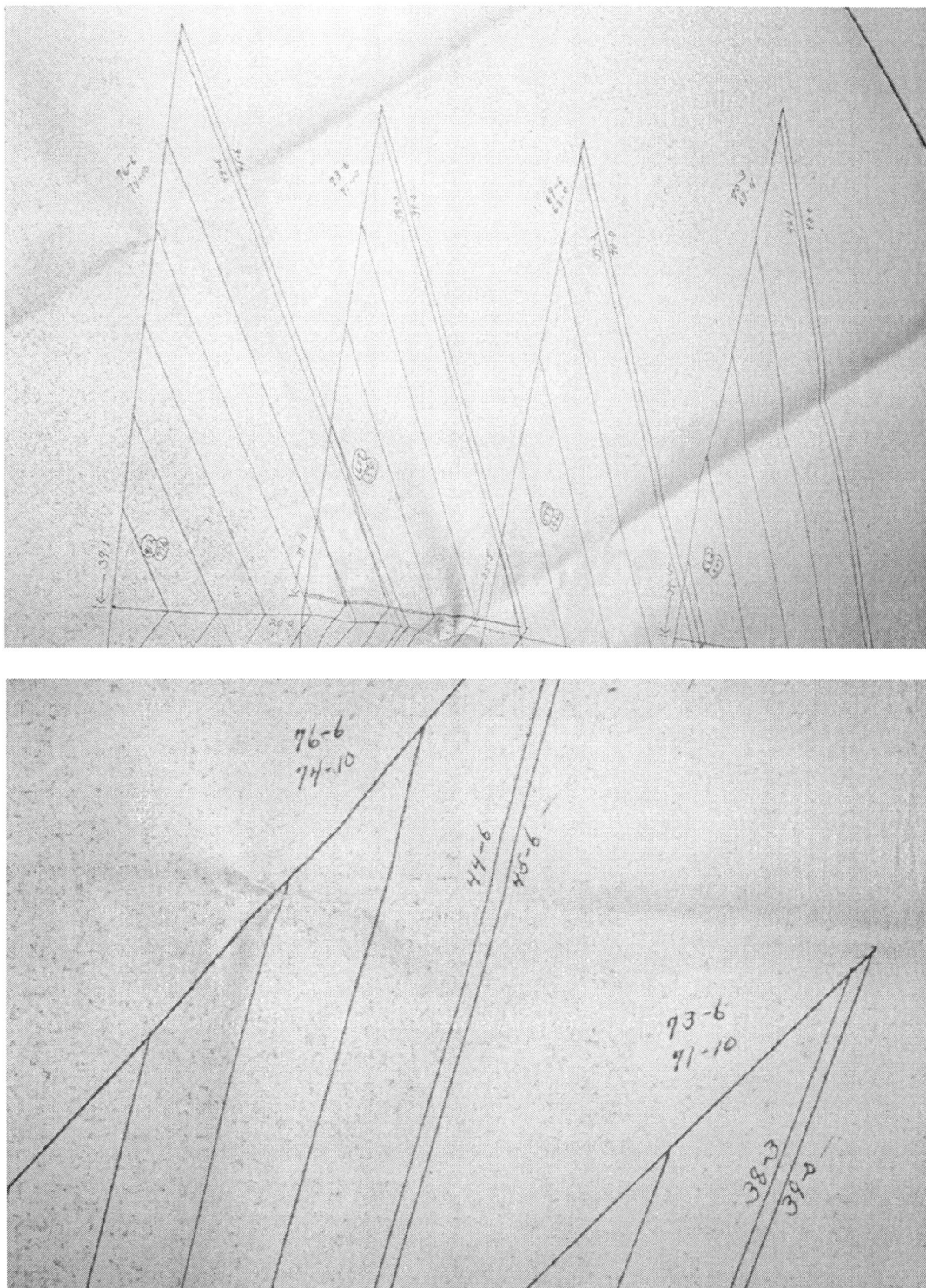


Figure 25. Note the two sets of measurements. The smaller dimensions delineate the cut dimensions. The larger dimensions represent the broken in sail's measurements. (Courtesy of Nathaniel S. Wilson, Sailmaker.)

documented rig and sail dimensions and detailed the changes and reconfigurations made in the life of a vessel. Cut sheets differed from sail plans in delineating the dimensions into which the cloth was cut – not necessarily the dimensions of the finished, broken in sails. The sail plans, themselves, were sometimes provided by the owner — especially for a newly built vessel. Usually, though, the sails were both designed and constructed by the sailmaker himself. A sail plan was usually a simple drawing of the sail's perimeter with measurements and diagonals marked. Other measurements like spar length and angle, rake of the masts, placement of blocks and other hardware were used to refine the basic design. Sails made straight from the original plans did not guarantee a perfect fit as a vessel itself might differ in many small ways from its

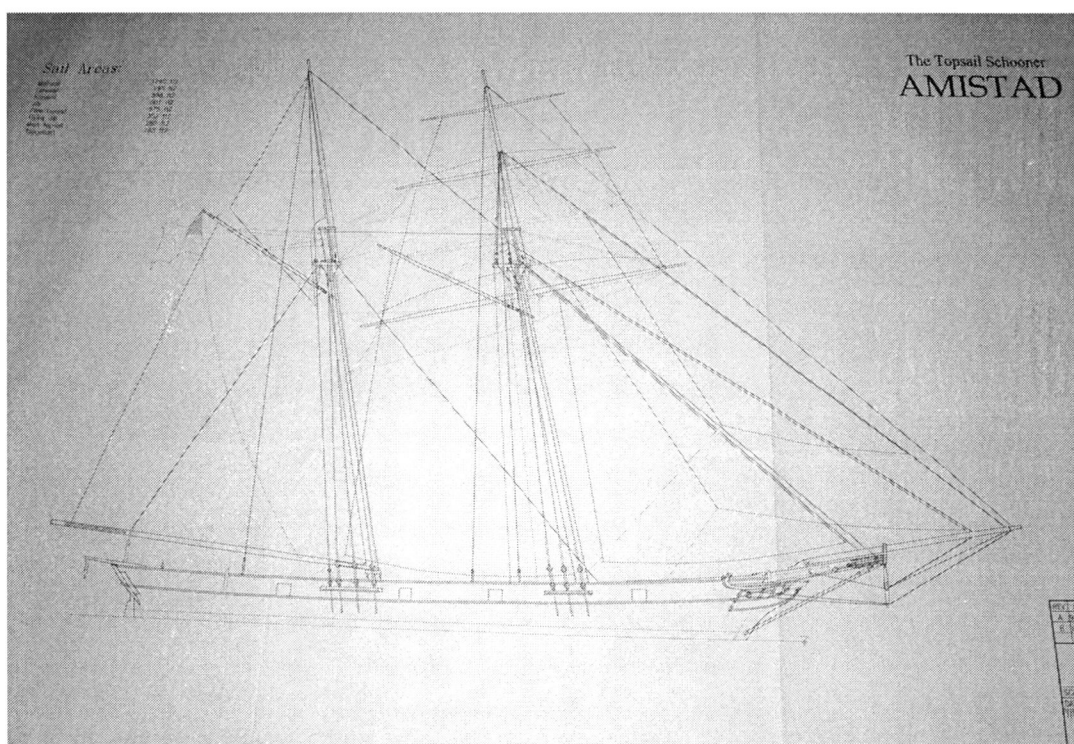


Figure 26. *Amistad* sail plan: drawn to scale, but few details. (Courtesy of N. S. Wilson.)

design on paper. If the sailmaker could, he would usually re-measure after the ship was launched and the rig in place. With so much expensive material — and a reputation at stake — sailmakers, who had turned over the daily operation of their lofts to foremen, preferred to draw the plans

themselves long after they had removed the palm and needle from their hands.⁷⁹ In his treatise on sailmaking, Samuel Sadler warned that it was preferable to measure for sails only after a vessel was afloat so that the sheer could be taken into account. He added that the “exact stand of the masts [must] be known, as a slight difference one way or the other from the perpendicular will throw the whole of the sails out of proper angle.”⁸⁰ Rhoades and Matthews sent their sailmakers out to vessels to measure for sails, hatch covers, awnings, etc.⁸¹ Several letters from E. A. Sawyer to Captain Alfred Pinkham asked for more specifics on measurements before he would start work on the sails. In mid-September, 1874, he reminded Pinkham that he needed the position of blocks on the gaffs before he could make sail covers. Less than two weeks later, he was again writing to Pinkham to clarify if the jib would be furled on the bowsprit or come inside the knightheads. He also noted a discrepancy on the main gaff measurements and asked for confirmation of those measurements.⁸² After he was confident that his plans and measurements were accurate, it was the sailmakers responsibility to build characteristics into the sail so it would set properly and perform efficiently. The plan outlined a sail in two dimensions; the final product would be three. His manipulation of seam width and rounding or hollowing of the sails’ edges would produce the desired camber, or belly, to the sail when set. Only years of experience and natural ability enabled the master sailmaker to understand these principles. The sailmakers under his supervision could construct the sail under his direction without necessarily understanding how and why it all worked. Once a sail was designed, finding people with the skills to actually make it was not particularly difficult. Every sailmaker, and most seamen aboard

⁷⁹ Baughman, *The Mallory’s of Mystic*, 24

⁸⁰ Sadler, *Art and Science of Sailmaking*, 12.

⁸¹ King, “Sailmakers and Ship Chandlers,” 225.

⁸² E. A. Sawyer to Alfred Pinkham, 14 September and 26 September 1874, Alfred H. Pinkham Papers.

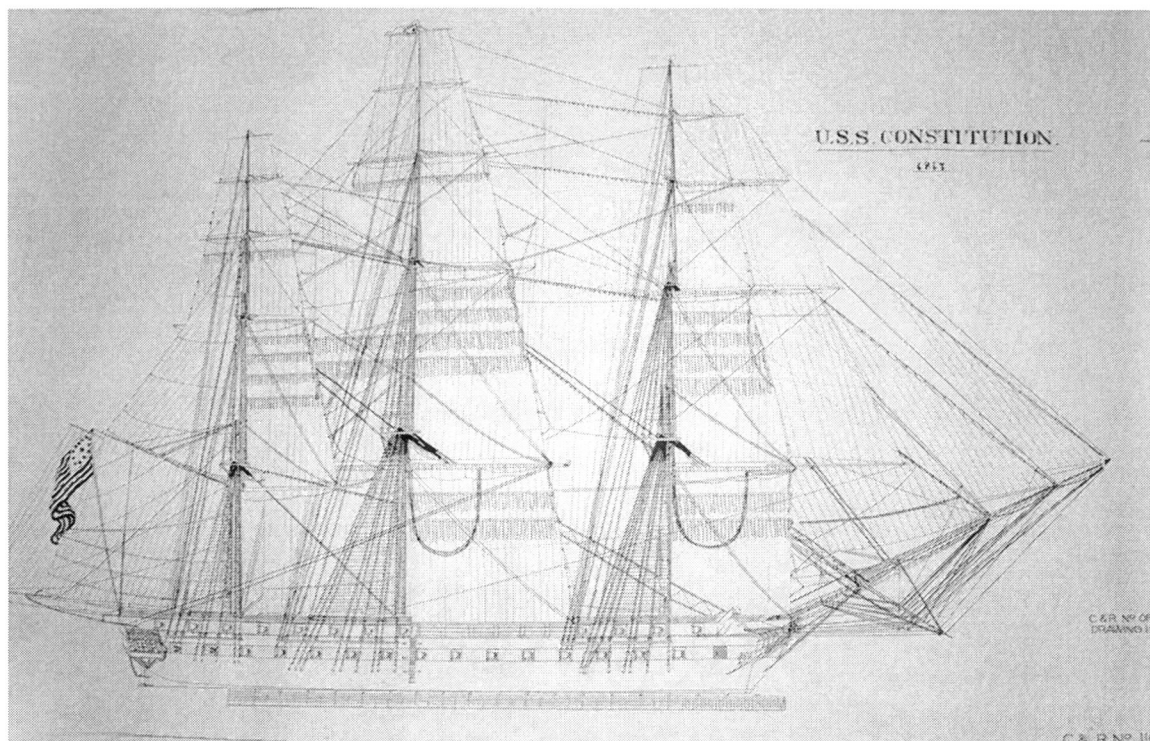


Figure 27. More detailed 1817 sail plan, USS *Constitution*. (Courtesy of N. S. Wilson.)

ships, knew how to stitch. An experienced sailmaker could flat stitch approximately one hundred yards of canvas per working day, for a single seam.⁸³ Journeyman sailmakers were sometimes hired to “middle stitch”⁸⁴ and “work duck,” paid by the yardage sewn. Ships often bought bolts of canvas duck and sent them to their sailmaker to have it middle stitched. John Pimer charged them by the bolt; the standard bolt measuring thirty-eight yards. In the 1830s, Pimer’s fee for middle stitching was 75 cents per bolt. In 1854, it was up to one dollar per bolt.⁸⁵ Although a sailmaker’s skill in designing sails was what brought in the customers, it was often this sort of side job that kept the business going. Another was by selling the cloth itself at a profit and

⁸³ D. Van Nostrand, *The Young Seaman's Manual. Compiled from Various Authorities, and Illustrated with Numerous Original and Select Designs. For the Use of the U.S. Training Ships and the Marine Schools*, (New York: D. Van Nostrand, Publisher, 1875), 193.

⁸⁴ Middle stitches were a third row of baste stitches between the flat stitched seams.

⁸⁵ John K. Pimer Papers.

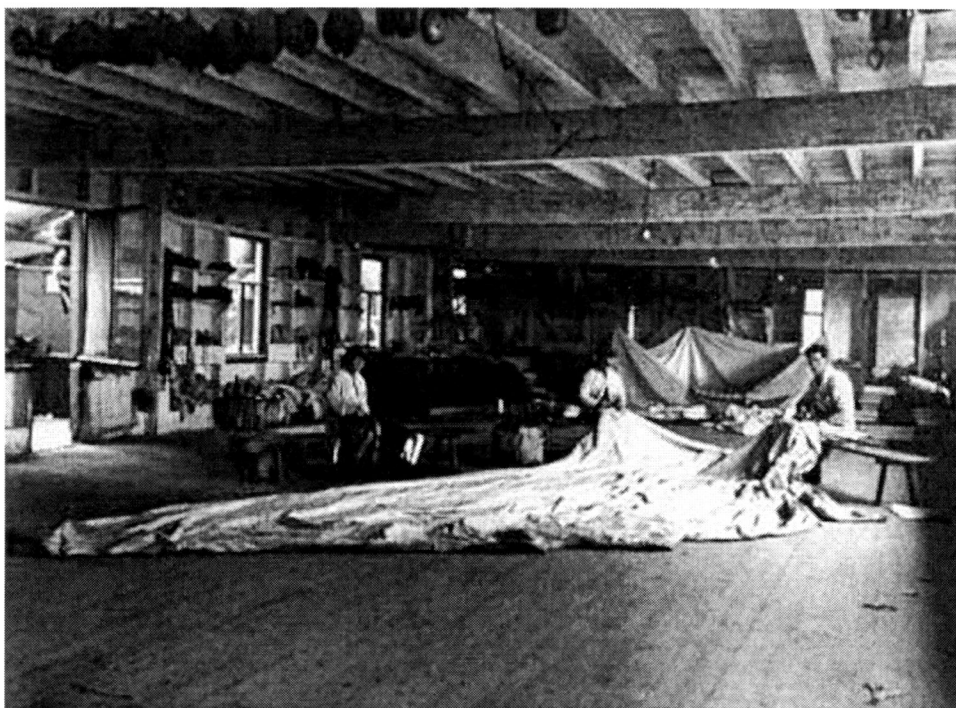


Figure 28. Laphorn loft in Gourock. (Collier, *Classic Sails*, 38.)

making replacement panels and parts that a well-equipped ship needed when out of port.

Sailmakers received discounts of five percent from cloth suppliers with another five percent off if they paid in cash.⁸⁶ As a result, they could make a ten percent profit when they sold it at the retail price. The McLaughlins stocked large quantities of cloth. Rhoades and Matthews inventoried moderate quantities of duck from No. 0 to No. 8. They stocked more No. 0 than any other weight cloth, with No. 6 and No. 4 following.⁸⁷ Charles Mallory stocked large quantities of sailcloth and twine on consignment from manufacturer John Colt and Company of Paterson, New Jersey. Mallory earned a five percent commission on gross sales of duck and twine, plus another five percent for cash sales. In addition, he made twenty-five cents per bolt of duck sold.⁸⁸

⁸⁶ As shown on bills and accounts from J. L. and R. H. McLaughlin Sailmakers, 1858-60, and 1878. John K. Pimer also received a five percent discount for being a sailmaker.

⁸⁷ King, "Sailmakers and Ship Chandlers," 225.

⁸⁸ Baughman, *The Mallory's of Mystic*, 15.

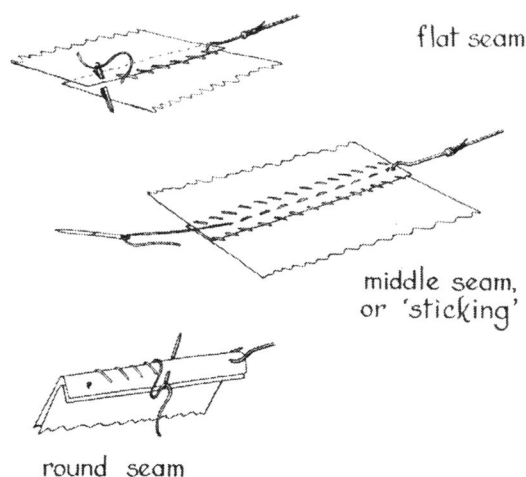


Figure 29. Stitch diagram. (Horsley, *Tools of the Maritime Trades*, 166.)

A frugal shipowner, of course, would often buy his own cloth at the wholesale price to avoid the sailmaker's markup. For sailmakers without the capital or desire to stock large amounts of sailcloth that arrangement worked fine. John Pimer, for one, usually made sails with cloth provided by the customer. Other sailmakers accepted jobs with or without customer-supplied cloth and their duck books and invoices recorded how much cloth the ships supplied and how much the loft supplemented. Although selling second-hand sails was generally a business sailmakers avoided, several regularly sold used cloth by the yard. In 1860, J. L. and R. H. McLaughlin bought second hand sail cloth from Southward & Co., Sail Makers and Dealers in Second-hand Sails and Parceling for ten cents a yard. That same year, they bought new No. 6 duck at twenty-eight cents a yard.⁸⁹

Worn out sails still had many uses, and, in most communities, it was the sailmaker who had the skills to work with them. If nothing else, an old, retired sail might be recycled as a winter boat cover. Towards the end of the century, the second-hand canvas business became

⁸⁹ J. L. and R. H. McLaughlin Papers.

quite profitable. It was in demand as a covering material for trucks and other uses such as tents, cots, hammocks, and awnings. Occasionally, new sails were made from old cloth. Cutler held that using second-hand cloth for new sails was commonplace in Maine, where many vessel owners could not afford the expense of new ones.⁹⁰ When John Kingsbury Pimer made sails for the Brig *Perry* in 1867, one transaction noted that he repaired some old sails but made several new out of cloth from other old sails supplied by the ship. The linen spanker turned into a new fore topgallant and the fore spencer became the mizzen topgallant sail.⁹¹ The *Perry's* owners also supplied Pimer with hardware, cordage, new duck, and even beeswax. Sails going to larger ships with full crews were sometimes delivered with a portion of the finish work, such as robands, reef points, earrings, and cringles, to be completed by the crew on board.⁹² Other vessels did just the opposite, purchasing pre-made grommets and other supplies from their sailmakers to carry on board.

Ships also depended on their sailmakers to provide them with sundry sailmaking and rigging supplies, not unlike those they could purchase from a chandlery. Most sailmakers' records surveyed included invoices for sailcloth sold by the yard or by the bolt to their clients. Sailmakers provided thimbles, cordage, ring clews, twine, wax, strops, grommets (both brass and marline), and needles. In addition to pure sail work, sailmakers provided ships with custom-made sail covers, hatch covers, awnings, hammocks, mast boots, boat covers, tarpaulins, and flags. Ashley Bowen's wife Dorothy made ships' colors to supplement his work in sails and rigging. Simpson Hart's business records include notebooks filled with color sketches of flags

⁹⁰ Mead, *Bent Sails*, 23.

⁹¹ John Kingsbury Pimer Papers, "General Notes," 10.

⁹² D. Van Nostrand, *The Young Seaman's Manual*, 193.

for ships and boats, yacht clubs, inns, and restaurants. Alexander Cutler noted that his loft made the flags for their clients, as well as any canvas and leatherwork they might need.⁹³

Sail Needles.
James Smith & Sons or William Smith & Sons.



Fig. 1730

LONG SQUARE.

Number.	Regular, Per 100.	Reduced Edge, Per 100.	Number.	Regular, Per 100.
17	\$1.30	\$1.70	13	\$2.75
17½	1.30	1.70	12	3.00
16	1.30	1.70	11	5.50
16½	1.30	1.70	10	6.50
15	1.30	1.70	9	7.50
15½	1.30	1.70	8	8.50
14	1.50	1.85	7	9.75
14½	1.75	2.10	6	11.00

James Smith & Son's Reduced Edge Needle changed on Regular List.
25 in a Package.

SHORT SQUARE.

Per Hundred.		Per Hundred.	
Flat Seam,	\$1.35	Small Bolt Rope,	\$2.75
Tabline,	1.35	Middle Bolt Rope,	3.00
Old Work,	1.45	Large Bolt Rope,	3.75
Store,	1.60	Small Marline,	5.00
Head Rope,	2.10	Large Marline,	6.00

25 in a Package.

Packing or Sack Needles.



Fig. 1731

Number.	Length, Inches.	Per Gross.	Number.	Length, Inches.	Per Gross.
14	3	\$2.00	9	6	\$4.00
13	3½	2.00	8	6½	4.33
12	4	2.25	7	7	5.33
11	4½	2.67	6	8½	8.00
10	5	3.00			

3 dozen in a Package.

605

Figure 30. Needles for sale via catalog. (Neptune Hardware Manufacturing Company, *Marine Hardware, Sailmakers' Hardware, and Hardware Specialties*. Catalog No. 61, 1919, 605. Courtesy of G. W. Blunt White Library, Mystic Seaport Museum.)

⁹³ Mead, *Bent Sails*, 44.

With the onset of the Civil War, canvas for sails was in short supply because the army needed it for tents. Some sailmakers abandoned their sail work for the duration and switched to making tents. For some, it was not so much a choice as necessity. Shipping, in general, was interrupted by the war and many sailmakers found themselves out of work. Cutler's father closed his business during those years and went to New York City to make tents. Rhoades and Matthews seized the opportunity by accepting lucrative contracts to make Army tents. In 1861 and 1862, they purchased over 160,000 yards of army duck. In 1862, the firm did \$129,443 worth of business — \$43,101 of that as profit.⁹⁴

A sail loft had special requirements, mainly an indoor, wide-open space in which sails could be laid out in their entirety. Although any barn could be adapted to accommodate sailmaking needs on an upper story, most loft owners preferred a convenient location accessible to the waterfront. In towns where this type of real estate was not available for purchase, even the most successful sailmakers rented their spaces. James Forten of Philadelphia ran one of the more profitable businesses around, yet he rented his loft throughout his long career. Rhoades and Matthews rented space over a butcher shop on City Wharf for \$325 per year in 1854. Two years later, they moved to Commercial Street, renting space over a ship chandlery. John Pimer never owned the building that housed his loft for fifty-six years. During the 1830s, his rent ranged from \$25 a month to \$37.50 by the end of the decade.⁹⁵

Individual sailmakers, trying to get established in the trade, could expect a rough start, unless they were in a location where sailmakers were in great demand. In Boston, forty individual sailmaking businesses were listed in the 1858 city directory, more than half on

⁹⁴ Mead, *Bent Sails*, 17. King, "Sailmakers and Ship Chandlers," 223.

⁹⁵ King, "Sailmakers and Ship Chandlers," 220; John Kingsbury Pimer Papers, "Miscellaneous Sailmaking Accounts, Bills and Receipts, 1836-1840," Box 3/Folder 11.

Commercial Street and Commercial Wharf demonstrating the proliferation of work in downtown Boston for a great number of sailmakers. In smaller towns, one existing loft might have a monopoly on sailmaking work. Alexander Cutler's father started his loft over a grocery store in Maine in a space measuring 25 feet by 45. Although it was a rather small space for a sail loft, most of his business came from small lumber-carrying vessels. Cutler explained that, since there was already a loft established at the local shipyard, his father would oftentimes leave the loft to repair sails on board vessels and travel to neighboring towns to find work.⁹⁶ Ashley Bowen, struggling to earn a livelihood in Marblehead, Massachusetts, fixed sails cheap rates because he had no loft of his own. When he found work through an existing sail loft, he paid half his wages to the loft owner as rent. Bowen eventually obtained his own loft, even hiring assistants, but most of his work then came from pure rigging jobs, with few entries for sails. Even then, it took Bowen years to establish himself.

One obstacle Bowen had to contend with was a provincial law, designed to reduce fire risks, that restricted anyone from improving or occupying a building for the use of a sailmaker's or rigger's loft without permission from the selectmen. Because the selectmen were mostly merchants, they could use their positions to benefit those with whom they were already in business.⁹⁷ Just as journeyman and individual sailmakers might struggle against an established competitor, loft owners sometimes felt the pinch from those in from sea with no loft, and thus, no overhead, who could work cheaply. Some loft owners responded by hiring journeymen as part of their regular work force. A handful of John Pimer's staff appeared on his payroll accounts for more than one year. Most appeared only once.

⁹⁶ Mead, *Bent Sails*, 21.

⁹⁷ Smith, *Journals of Ashley Bowen*, 1: 139, 142, 293.

A large part of income to Charles Mallory's loft came from labor charges. Tasks and their charges were fairly standardized within his loft and in the area. By hiring journeymen, he both reduced his competition and made a profit from their labor.⁹⁸ The loft furnished all large tools, winches, derricks, benches, and materials. Men brought their own personal tools: seaming and roping palms, fids, needles, marlinspikes, etc.⁹⁹

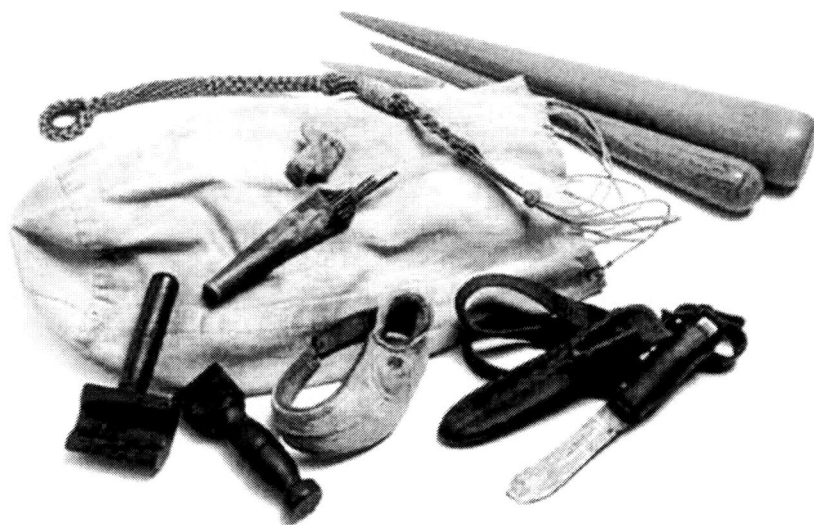


Figure 31. Nineteenth century ditty bag with sailmaker's personal tools: fids, needles, wax, sheath knife, palm, seam rubber, and serving board. (Henderson and Carlisle, *Jack Tar*, 47.)

Individual sailmakers sometimes supplemented their income with other types of work. Some eventually gave up sailmaking entirely for their second occupation. Henry Bull Almy, originally of Newport, worked for his brother Job Almy in New Bedford after 1834. Throughout the 1850s, he split his time between working at the sail loft and shipping off on a merchant vessel on voyages between New York and the West Indies. During the Civil War, he joined the Hitches and other sailmakers in New York and Philadelphia making army tents. After the war, he returned to New Bedford and opened a sail loft and awning business in partnership with Obed

⁹⁸ Baughman, *The Mallory's of Mystic*, 17; John Kingsbury Pimer Papers, Box 4. "Once" refers to one reference in an annual payroll ledger.

⁹⁹ Mead, *Bent Sails*, p.3.

Hitch. Henry Gladding, a sailmaker in Newport, Rhode Island, for his entire adult life first learned the sailmaking trade under the tutelage of Benjamin Freeborn. He later was in business for himself after Freeborn retired in 1865. Towards the end of his career, Gladding also ran a boat rental business in Newport Harbor and served as Newport Harbor Master and Health Officer. His neighbor Overton Langley started his working career as a sailmaker, following in his father's footsteps. He stayed with the profession throughout the Civil War, with brief service in Company F of the First Rhode Island Regiment. Immediately after the war, he abandoned sailmaking, first working as a clerk, and eventually opening a stove and tin parts store in Newport. He had one son who did not become a sailmaker. Fellow Newporter William J. Roberts made sails until 1852 until he became the Sheriff of Newport County. He later spent eight years as the Inspector at the Newport Customs House.¹⁰⁰ Otis Hitch and brother Hardy Hitch III abandoned sailmaking after the Civil War and opened a carpet, window shade, and upholstery business.¹⁰¹

Southern New England sailmakers in the nineteenth century earned twice the wages of common laborers.¹⁰² Some, through work and effective business practices, became quite wealthy. Most enjoyed a stable work environment and were able to maintain a good standard of living for themselves and their families. Certainly, there were men like Ashley Bowen, who struggled to compete against more established firms, but even he eventually ran his own rigging loft. A handful of sailmakers were able to attract work and earn profits from inventions and

¹⁰⁰ Henry Gladding Obituary, *Newport Mercury*, Mercury Publishing Co., 5 December 1908; Overton G. Langley Obituary, *Newport Daily News*, T. T. Pitman Publisher, 23 September 1911; William J. Roberts Obituary, *Newport Mercury*, 16 February 1878. Other information came from Newport City Directories of 1858, 1863, 1865, 1867, 1880, and 1900.

¹⁰¹ Hitch Family Genealogy web site. <http://www.geocities.com/~mikehitch/hitchgen.html>.

¹⁰² Baughman, *The Mallory's of Mystic*, 20

innovations in sail design they patented.¹⁰³ Most attracted jobs by their personal connections and by the quality of their products.

As the demand for sails decreased towards the close of the century, sailmaking witnessed a corresponding drop in numbers. Despite a growing population, the number of sailmakers dropped by over thirteen percent. The sailmaking population was growing older, with fewer young men choosing to learn the trade. As the sailing ship era drew to a close, there was still a moderate demand for sailing vessels plying the seas. Most ocean-going steam vessels carried auxiliary sails at that stage, and all types of vessels needed other canvas work including hatch covers and awnings. The yachting population was growing after mid-century and this community continues to employ sailmakers today, though in smaller numbers.

¹⁰³ The Ratseys patented “Improved Diagonal Sails” with three different patents between 1845 and 1889. James Forten patented a device that made managing large sails easier.

CHAPTER 9 MAKING SAILS

Sailmakers worked off sail plans, blueprints, to determine dimensions, shaping, and appurtenances. When plans were not available, rig and spar measurements were enough to design a particular sail, although several other factors would have to be considered before completing the sail. The common practice of maintaining files of sail plans and “duck books” served as references for future replacements, repairs, and adaptations and reminded sailmakers of special characteristics of a rig, weight, and choice of cloth. The sailmaker needed a solid understanding of different sailcloths’ material, weight, and handling characteristics. If possible, a sail was made from a single bolt of cloth because inevitable variations in the weave from bolt to bolt – even if it came from the same loom — could cause flaws that could ruin a sail. He also needed to take into account the type of service for which the sail would be used.¹ Sails were supplied ready for bending, sometimes requiring reef points, robands, and select hardware for use in a particular rig. A single, large square-rigged vessel could carry more than sixty sails. With some square sails containing forty-five separate panels; a contract for one ship could employ a sail loft for a considerable time.

A sailmaker designed sails for vessels that did not furnish sail plans. Even with plans, for a new vessel, experience taught him not to trust measurements on paper, and he would measure the rig again after masts were stepped and spars rigged. He needed to know the rake of the masts, plus measurements for spars, halyards, blocks, and hardware, to design a sail that fit precisely. The rake, in particular, could throw a whole suit of sails off its designed angles.² The sail plan depicted a sail’s dimensions in the rig after stretching from use. New sailcloth and rope

¹ Ratsey and de Fontaine, *Yacht Sails*, 161.

² Sadler, *The Art and Science of Sailmaking*, 12.

stretched significantly when set, and the sailmaker would cut and construct a sail with dimensions that sometimes differed considerably from the worn sail to allow for stretch. Only experience and knowledge of his materials could guide him to properly anticipate stretches and strains a sail would undergo in handling and weathering. The more stable and consistent the materials, the better chance he had of constructing a sail to fit properly after use.

One problem was that cotton sailcloth shrank substantially. When ships converted to cotton sails, sailmakers exposed new bolts of cotton duck to the weather for a week or more before cutting.³ Bolts of sailcloth were rolled on the loft floor, and sailmakers paid close attention to determine if the selvage laid flat. A tight edge was often unavoidable in weaving, but it could result in hard spots in a sail and errors in measurements. If the bolt of cloth rolled off on a pronounced curve, a sailmaker would reject it entirely if supplies were plentiful. When he had to make do, he reversed the bolt with every panel to bring two tight edges or two loose edges together — effectively reducing hard spots. Where selvages had different lengths, sailmakers measured cloth along the centerline.⁴ Individual panels were lofted on the wooden floor and struck, or marked, with charcoal or colored chalk. Allowances for bonnets, drablers, tablings, and reefs were added as the sailcloth was laid out; these were cut after seaming.⁵ For the sail loft with ample floor space, sails were lofted full size. For smaller lofts, constructing larger sails, and for the shipboard sailmaker, extra calculations were made for seam allowances and gores. If all sails were perfect squares or rectangles, lofting would be unnecessary. One could simply determine the number of panels needed to make up the width, including overlap at seams, cut them for the appropriate hoist, and sew them together. By the nineteenth century, few sails were cut perfectly square. Obviously, fore and aft sails were not square, but even “square” sails were

³ Davis, *How Sails are Made and Handled*, 48.

⁴ Calahan, *The Ship's Husband*, 171; Butts, *The Merchant's and Mechanic's Assistant*, 33.

designed with angled corners and edges. For the sailmaker, these angles, or *gores*, introduced complications. Leeches were often *hollowed* or *roached*. A curve, or roach, was cut in the foot of a square sail to clear boats on deck, superstructures, stays, or anything else that might be in the

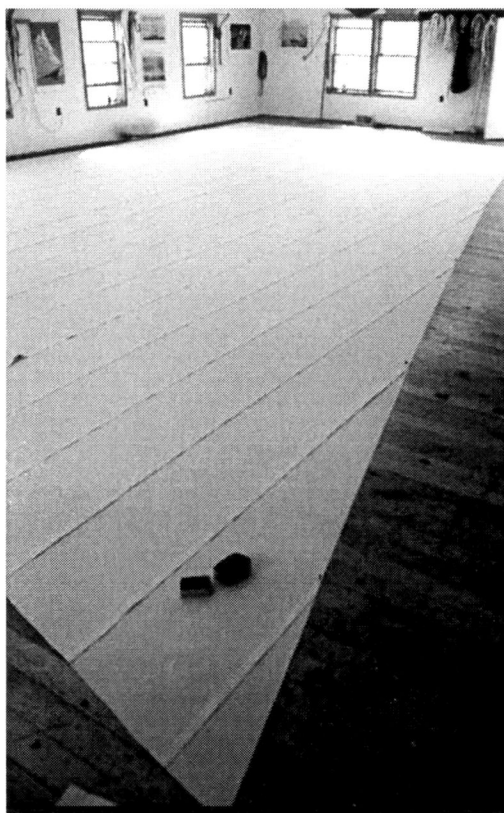


Figure 32. Lofted panels, 1997 USS *Constitution* topsail. (Photograph by N. S. Wilson.)

way. Sailcloth cut in any direction other than straight across is *gored*, and these cuts were treated very carefully to avoid excessive stretching. “Science proves that all strains work upon direct lines, the nearest or shortest from where strain is applied to a fixed point, and as the gores of sails stretch when pressed by the wind on account of their position, allowances are necessary.”⁶ Some sailmakers “broadseamed,” increased the width of the seam toward the foot, in lieu of goring leeches. Varying the width of seams gave sails three-dimensional shaping.

⁵ Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 68; Vanderdecken, *Yachts*, 193.

Broadseaming was a common practice in the merchant fleet, but disallowed in the Royal Navy for courses.⁷

On a ship, or in a loft with insufficient space to lay out a full size sail, the sailmaker calculated the length of cloth and exact angles, or gores, to cut. The true square section of a square sail was cut simply according to dimensions on the sail plan; each panel was cut with a gore longer than the previous one producing the roach, or curve, in the sail's foot. The aim of the early treatises written on sailmaking was to provide tables and instructions for calculating gore allowances. Samuel Sadler explained that calculating gores was "a very simple matter to all sailmakers" and that he was merely making suggestions regarding "the eating in by the seams, which are widened to make allowance for the stretching of the gore."

Simple perhaps, but while many seamen could stitch canvas, a sailmaker had to have the skill, experience, and competency to cut and sew a sail that would not be seen in full until it was already in the rig. If a sailmaker did not accurately predict the amount of stretch and construct his sail accordingly, "an uneven and pressing sail [would] result."⁸ A sailmaker's reputation secured his business ashore or his position afloat. There was no room for error; sails had to fit. Once gore calculations were made, the sail was cut. The symmetry of square sails allowed a sail to be laid out and cut with no wasted cloth. For fore and aft sails, cutting techniques varied with different sailmakers. Some cut from the leech to use remnants of canvas on shorter panels closer to the tack. Sadler warned to strike and mark panels as they were cut, so that, later, they could tell if the cloth had shrunk, as it "often [did] in damp weather."⁹ Marking cloths also reduced confusion once individual panels were taken off the floor to be sewn.

⁶ Sadler, *The Art and Science of Sailmaking*, 29.

⁷ Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 68.

⁸ Sadler, *The Art and Science of Sailmaking*, 59.

⁹ *Ibid.*, 79, 81.

Sails were made from many panels of sailcloth, generally twenty-four inches wide, sewn together with overlapping seams. It would have been impossible to make a proper sail out of a single piece of sailcloth, even if canvas were made that wide. The sail would stretch, unable to hold its shape, much like a large canvas hammock that draws out into hard lines at the edges and sags in the middle. The sail's leech would curl around at right angles to the surface of the sail and form a back sail, slowing the boat. In this scenario, the force of the wind concentrated on the after part of the sail, turned the vessel up into the wind, and resulted in weather helm. "The greater the expanse of whole cloth, the greater the stretch. By making the sail of narrower cloth, you will decrease the stretch."¹⁰ Larger sails generally had seams 1½ inches wide, smaller sails one inch. An experienced sailmaker could average approximately ten yards per hour, or one hundred yards of single seaming in a nine or ten hour work day.¹¹

Because narrow cloth reduced the amount of stretch in a sail, it was preferred but not always available. Sailmakers would "false seam" (also known as bight, lap, or middle seam) widely woven cloth by folding over the middle of the panel and sewing it down with a flat seam. The resulting false seam would appear no different from a regular seam, and by doing so, they could reduce stretch substantially in the final sail. E. A. Sawyer of Portland, Maine, made boat sails for the schooner *Stephen G. Pinkham*, specifically ordered with a "bite seam" in 1875. Sails needed reinforcement layers, or patches, in areas subject to great strain or chafing. A square sail required 65 to 75 percent more canvas than its sail area to allow for reinforcement patches, reef bands, seam overlap, tablings, and linings; a fore and aft sail needed 20 to 30 percent depending on whether it was a gaff sail or a staysail.¹² To prevent chafing against the masts, square topsails

¹⁰ Alan Gray, *Sailmaking Simplified* (New York: The Rudder Publishing Co., 1940), 19.

¹¹ Vanderdecken, *Yachts and Yachting*, 193; Ratsey and de Fontaine, *Yacht Sails*, 169; Mead, *Bent Sails*, 9.

¹² Nathaniel S. Wilson, Sailmaker, telephone conversation with author, 12 August 2000.

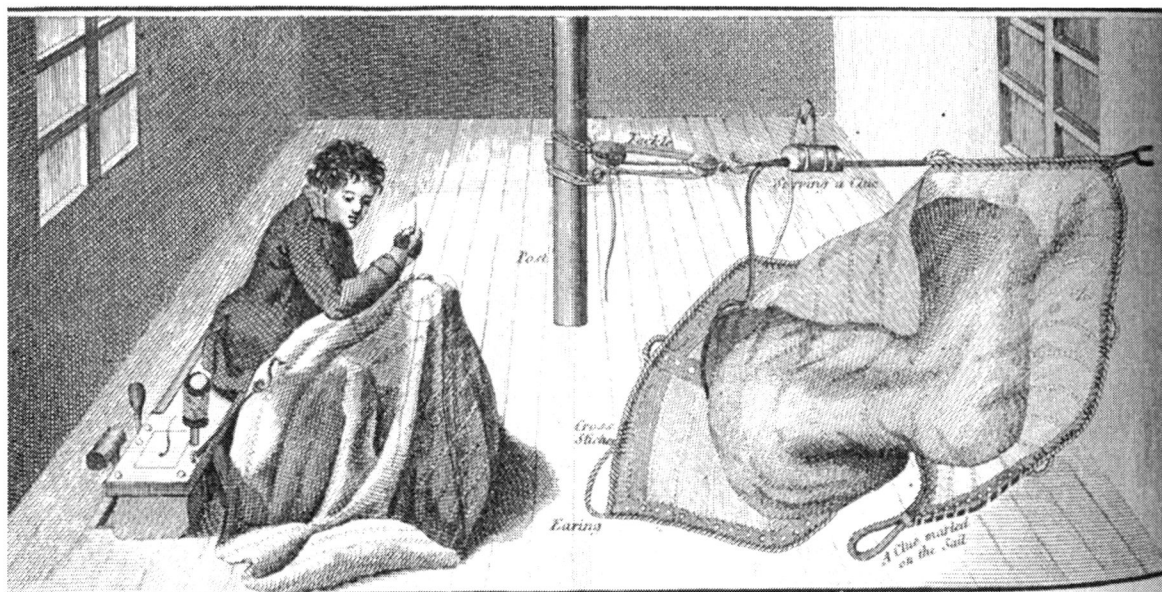


Figure 33. Sailmaker, 1794. (Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 85.)



Figure 34. Sailmaker's bench with bench hook in the sail's boltrope. (Photograph by N. S. Wilson of the *Mayflower II*'s hand-stitched cotton sails.)

needed extra cloth sewn on the after side of the sail. Topsails and topgallant sails had top linings to protect against chafing from the tops or crosstrees. Corner patches provided one of the rare places on a sail for the sailmaker to show his personal style. Some used rounded corners, others square, or various geometrical shapes. With that exception and, later, with innovations in cutting direction, most sailmaking techniques were standardized. For example, holes were cut in the seam overlap to provide two layers of cloth instead of one. If more holes were needed for reef points, robands, or lace lines, one was made in the seam overlap and another halfway between seams. Grommets sewn in the middle of panels would be placed a half-inch higher than grommets in the seams to allow the latter to bear the greater strain. Grommets were made from marline and later from brass. An 1851 account of Massachusetts sailmaker Charles Hannum included sales of both marline and brass grommets to the schooner *George Walters*.¹³ Both were sewn on the sail the same way with a stitch not unlike a circular buttonhole stitch.

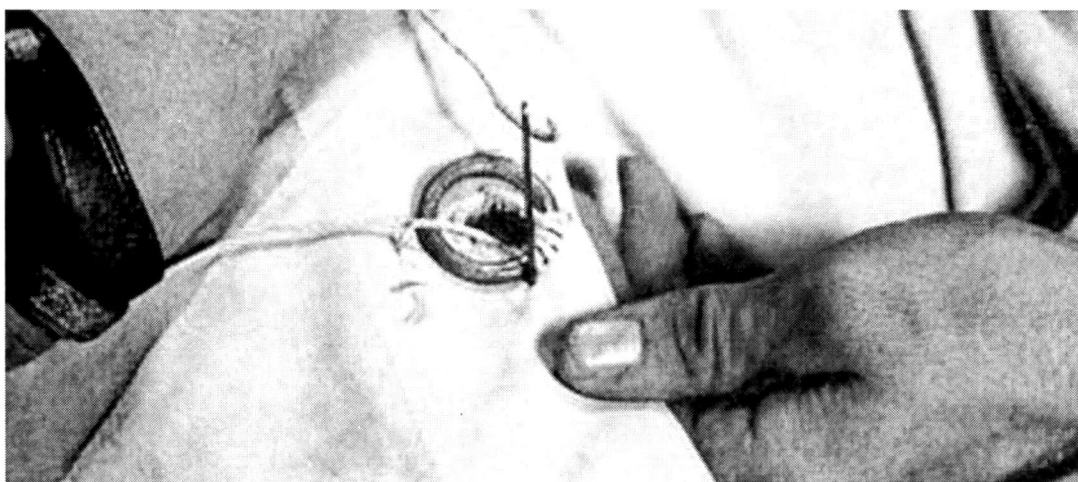


Figure 35. Grommet stitch. In this case, a brass ring reinforces the hole. (Ratsey and de Fontaine, *Yacht Sails*, Plate III.)

Cotton and linen canvas had no chance of remaining intact without reinforcements. One of the more critical components of sailmaking was sewing on the boltrope, a rope sewn along the

¹³ Charles A. Hannum, "Account Book," Manuscripts Collection, G. W. Blunt White Library.

edges of linen and cotton sails to take the strain off the canvas. Square and boom-rigged sails had to bear the weight of the spars below them when set. Those stresses were considerable. The load on a gaff mainsail, when a schooner sailing off the wind dipped her boom in a following sea, could shatter the solid wood spar as it emerged from the water. A tarred hempen rope sewn around the perimeter however strengthened a sail substantially. The boltrope and tablings took the strain and maintained the sail's shape. Roping a sail demanded great skill that could only be gained through observation and experience. Samuel Sadler warned, "However nearly sails may be calculated and put together, if roped by an inexperienced man, they will be practically spoiled."¹⁴

Rope and sailcloth stretched at different rates, and the sailmaker needed to judge these rates as he sewed one to the other. The goal was to have an equal amount of strain against all parts of the sail and maintain "freedom of exit for the wind." Most of the strain was supposed to bear on the rope, saving the canvas from excessive stretching. Roping displaced "threads of the canvas upon certain lines, and [caused] such parts to stretch, requiring ... an allowance to be made."¹⁵ Each edge of a sail needed different sized boltrope and amount of slack sewn into the roping to accommodate the different stresses. The luff of a gaff-rigged sail, for example, bore the majority of the boom's weight as the halyards were hauled tight; it needed roping with larger line and more canvas gathered in per stitch than the other sides.

Alexander Cutler recalled that a typical three-masted schooner used 4½ inch manila rope for the luff but only 2¼ and 2¾-inch hemp rope for the head and foot, respectively.¹⁶ David Steel instructed sailmakers sewing on boltropes to gather in two inches of slack per cloth panel

¹⁴ Sadler, *The Art and Science of Sailmaking*, 101.

¹⁵ Ibid. 2, 5.

¹⁶ Mead, *Bent Sails*, 43.

on a square sail's head and foot and one and a half inches for every yard in the leeches.¹⁷ Using the highest-grade rope available gave sails the best chance of holding up over time and adverse conditions. Riga hemp impregnated with Stockholm tar was considered top quality and the most expensive. Manila rope was often substituted either entirely or for particular sides. Manila weighed less and shrank more than hemp when wet but could return to its original length when dried. Manila rope was sewn on more loosely to accommodate shrinkage; sailmakers called it "roping flat."

Boltrope on either side of the clews was served and marled to the sail. After 1811, the entire foot and two or three feet up the leeches were served.¹⁸ By the end of the nineteenth century, wire rope replaced hemp boltropes on larger square sails. Since wire could not be stitched to canvas between each strand, sailmakers had to marl it on with hemp twine or marline. The wire was usually wormed, parceled, and served to prevent rust. To marl the wire boltrope, Cutler described men using steel awls with wooden handles to pierce a hole through the canvas before passing the large roping needle through it. He remarked that it was a "very slow process."¹⁹

Certainly, anyone who sewed could stitch a sail together, but it required skills and experience to design and construct a sail that would perform well, maintain its shape under strain, and hold up over time. While the quality and design of sails naturally varied between sailmakers in the nineteenth century, there were few deviations from the rules of the trade.

¹⁷ Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 75.

¹⁸ James Lees, *The Masting and Rigging of English Ships of War: 1625-1860* (Annapolis: Naval Institute Press, 1984), 138, 140.

¹⁹ Mead, *Bent Sails*, 43, 78.

CHAPTER 10 THE LOFT, TOOLS, MATERIALS

Sailmakers required little capital to set up shop. The shipboard sailmaker needed little besides his personal belongings and tools. His tools could fit in a relatively small canvas bag; many of these he made himself. The sailmaker's bench could be made on board with a few pieces of lumber. The ship provided sailcloth, twine, cordage, and hardware. Ashore, the journeyman sailmaker required no more equipment than his shipboard counterpart. He either sought temporary employment at a local loft or hired himself out to ships in port. To set up a business, a sailmaker needed a loft. Before the end of the 1800s when sewing machines were introduced to the loft, expensive equipment were few. The loft itself demanded certain parameters and often a winch and a derrick to move heavy sails. The loft owner, of course, furnished these items. Loft set-up and tools were fairly standardized for hundreds of years as the nature of the trade changed little over long periods of time.

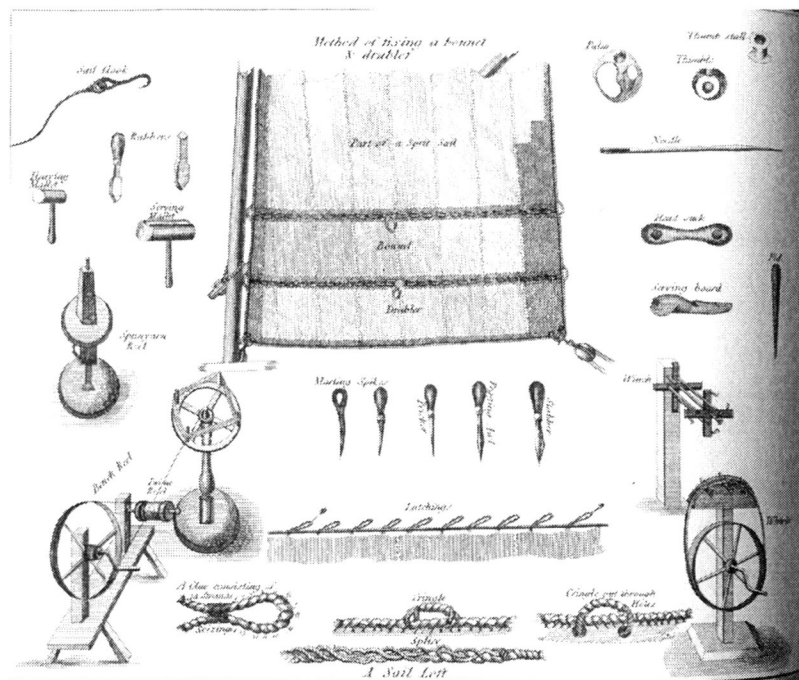


Figure 36. Sailmaking tools as published by David Steel in 1794. (Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 85.)

The loft itself required open floor space unbroken by posts, walls, or supports.

Generally, this restricted its location to the top floor of a building where nothing obstructed the floor. Occasionally, a sailmaker had his loft specially built, but most started by renting space over a shop or in a shipyard. Barns met these specifications well, but most lofts needed to be close to the waterfront, shipyard, and rigging loft. In Simpson Hart's New Bedford loft, sails were hoisted to the upper floor with a rope one and a half inches thick around a capstan that was two stories high.¹ Alexander Cutler worked in his father's sail loft in the mid-nineteenth century. It was small for a loft, twenty-five by forty-five feet – over a grocery store. When his father retired, Cutler moved the loft to a more suitable space measuring fifty by one hundred feet.²

Sail and rigging lofts posed a greater fire risk than other businesses because of the loft's regular inventory of combustible tar, turpentine, oils and cotton sailcloth. Colonial Massachusetts enacted a law that forbid anyone from improving or occupying any building for riggers' or sailmakers' lofts without the express consent of the selectmen, as well as their approval of its location, to reduce this risk.³ Most lofts forbid smoking in the building and many sailmakers chewed tobacco instead. "The spit kid or cuspidor was common sail loft equipment."⁴

A top floor location meant that heavy sails had to be hauled up staircases unless the loft had a derrick to hoist them from the outside. In New Bedford, James Briggs recalled that whaling ships would send their sails to a loft for maintenance and repair when they made port. Seamen would deliver the sails to street level where the sailmakers would throw down long rope straps from the window or upper door. The seamen would sling the sails while the sailmakers manned a capstan to hoist the sails to the upper story.

¹ Briggs, "Sails and Sailmakers," 7.

² Mead, *Bent Sails*, 39.

³ Smith, *Journals of Ashley Bowen*, 139.

⁴ Mikelson, "Sailmakers Tools," 31.

For small fishing vessels, boat sails, and smaller staysails or upper sails of ships, the sailmaker could lay out the sails entirely on the floor. Even in large lofts, as ship sails grew in size, they often needed to loft them in sections. Many a sailmaker saw his sails in full for the first time when they were bent on and set. In addition to floor space, the floors themselves needed to be wooden to allow the sailmaker to secure sails to the floor with awls. The Hart loft floor had wide, pine boards “containing many huge knots.”⁵ Cutler’s second loft was fitted with “native matched boards, narrow and shiny.” He noted that the floor could not be made from wood with wide gaps or wood that might sliver.⁶ A large open floor space permitted the sailmaker to mark the perimeter of the sail to be cut with white chalk. Allowances were made for tablings and reef bands. Even bonnets and drabblers were cut as extensions of the whole sail and cut off after the panels had been sewn together. This saved time and ensured they would match the sail’s dimensions after they had been sewn. Sailcloth panels, rolled out on the floor, were marked with charcoal, if at all.⁷

A nineteenth century sail loft scene included sailmakers sitting throughout the room on simple wooden benches. Benches were inexpensive and easy to construct. Sailmakers made their own or ordered them from a local carpenter. New London sailmaker John K. Pimer bought four benches from carpenter Charles French in 1832 for \$1.25 each.⁸ The United States Navy issued benches to its sailmakers, both ashore and on board ship, beginning in 1844. Before that time, each man provided his own.⁹

⁵ Briggs, “Sails and Sailmakers,” 7.

⁶ Mead, *Bent Sails*, 39.

⁷ Mead, *Bent Sails*, 9; Horsley, *Tools of the Maritime Trades*, 162; Steel, *Steel’s Elements of Mastmaking, Sailmaking, and Rigging*, 68.

⁸ John K. Pimer Papers, Box 3 / Folder 9.

⁹ Brewington, “Sailmaker’s Gear,” 292.

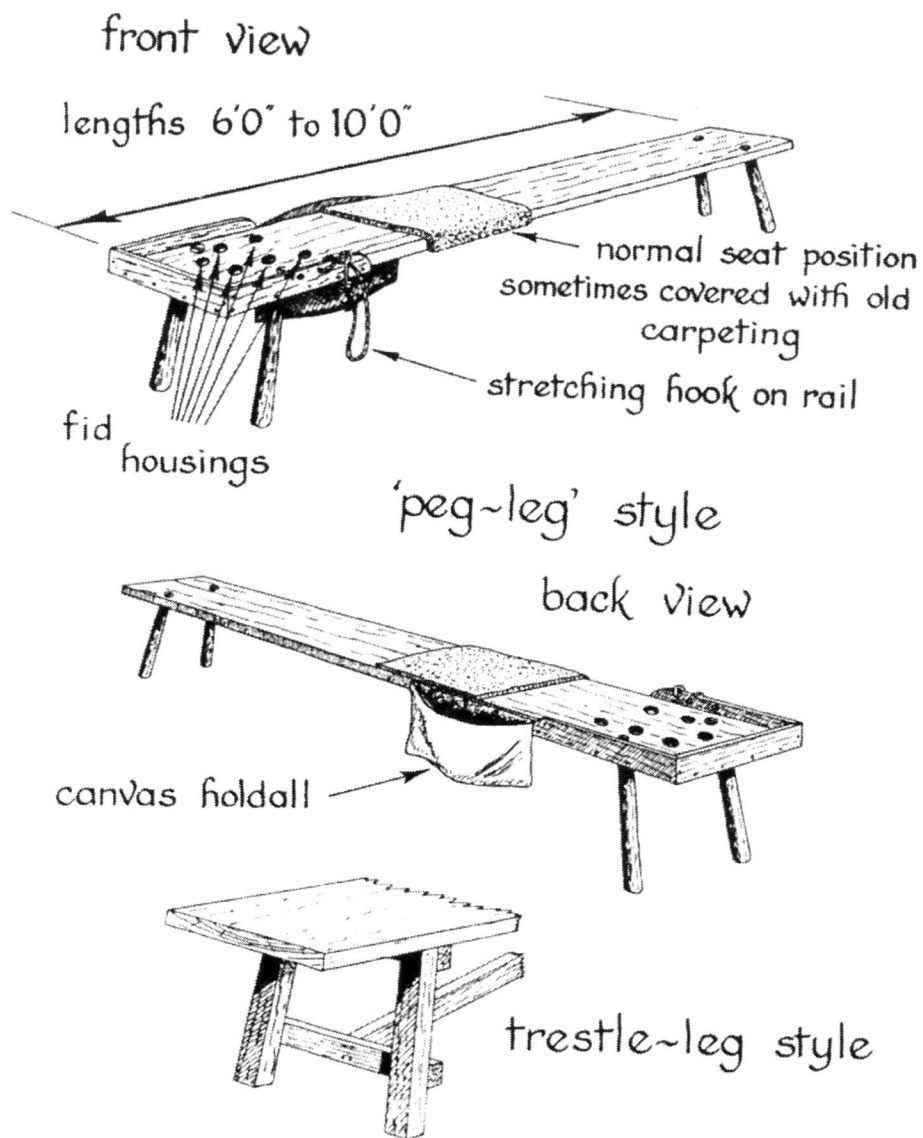


Figure 37. Bench diagram. (Horsley, *Tools of the Maritime Trades*, 160.)

The bench was the sailmaker's personal workspace. Some fitted a piece of carpet or pad of canvas on top to alleviate the discomfort of sitting on a hard bench all day. Bench length varied from sailmaker to sailmaker, but they were typically seven or eight feet long and low to the ground. Bench height varied with the height of the sailmaker and, most importantly, had to be high enough to keep his fids from touching the floor. One end had several holes drilled

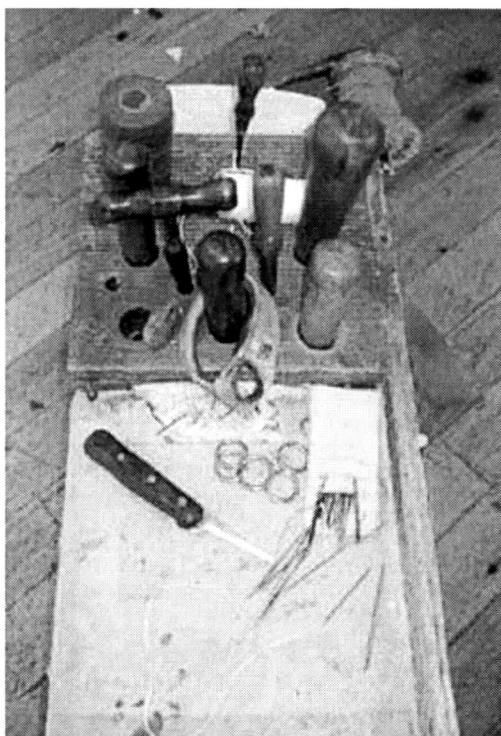


Figure 38. Sailmaker's bench with tools. (Courtesy of N. S. Wilson.)

through it to house his fids, knife, and spool holder. To hold smaller items, such as needles, wax, twine, and awls, the sailmaker attached a small canvas bag to the back of his bench or underneath it, accessible through a sizable hole cut through the wood. Sailmakers worked at their benches

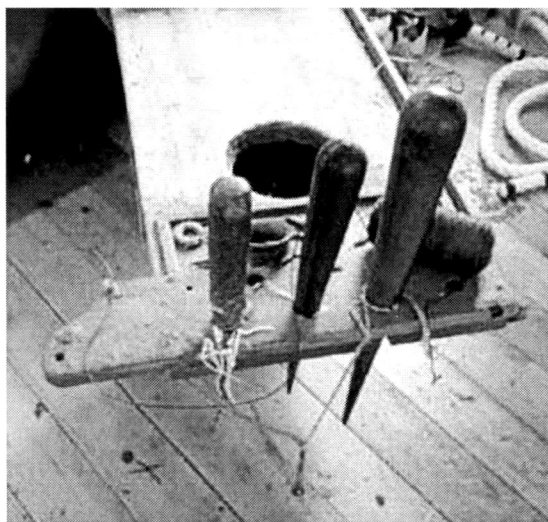


Figure 39. Bench with tool storage underneath, accessible through the hole in the bench. (Courtesy of N. S. Wilson.)

with sails pulled up from the floor onto their laps. For seaming and roping, he slid the canvas across his lap as he sewed, often using a bench hook to anchor the cloth to his right. Grommets, cringles and other finish work could also be accomplished at the bench.

Civilian sailmakers donned distinctive shoes and clothing to protect themselves and the white sails they worked on. They made their own clothes for work out of light canvas. A traditional outfit consisted of a shirt and pants made with no loose pieces that could snag on twine. The pants were made with a front flap with ties on the sides. The shirt had no buttons and was drawn over his head.¹⁰ Sailmakers in Alexander Cutler's loft wore white cotton overalls and carried their personal tools to work in a small canvas bag.¹¹

In the 1814 navy, sailmakers donned the same uniform as boatswains, gunners, and carpenters: "short blue coats, with six buttons on the lapels; rolling cape, blue pantaloons, white vests, round hats, with cockade" and carried no side arms. In 1841, these occupations still shared the same outfit: coats of dark blue material, "lined with the same, double breasted, seven navy buttons on each breast, slashed sleeves with three small navy buttons on each, two large navy buttons under each pocket flap, one on each hip, and one at the bottom of each skirt." After the Civil War, the navy adopted a specialty mark for petty officers, which included master-at-arms, quartermaster, coxswain, gunner, captain of the foc's'le, captain of the top, and sailmaker ratings. Petty officers received three rows of white piping on the collar and three rows on the cuffs. These, of course, were their official uniforms, and not designed for work in the rig or at the bench.¹²

¹⁰ Horsley, *Tools of the Maritime Trades*, 158; Mikelson, "Sailmakers Tools," 31.

¹¹ Mead, *Bent Sails*, 3.

¹² US Naval Historical Center web site. www.history.navy.mil/nhc11.html. Source: General Regulations for the Government of the Navy of the United States. Washington D.C. J. and G. S. Gideon Printers, 1841. Chapter 42, pp. 5-14.

Though simple, the sailmaker's tools were specialized for the job. Many sailmaking tasks overlapped the rigger's, and, thus, both used similar tools. Splicing and rope work were routine in sewing boltropes, making clews and cringles, and earrings. These tasks required fids, marlinspikes, serving mallets, and a "Commander" or wooden "driving mallet." The sailor's marlinspike differed from the sailmaker's only by the presence of the lanyard to secure it to his person when aloft or over the side of the ship. The sailmaker's spike frequently had a wooden handle as on a chisel. Sailmakers ashore and at sea carried knives for cutting twine, marline, and cloth. Serving mallets and serving boards provided tension and leverage to wind marline on fiber and wire rope. Before hardware for thimbles and clews became standard, cringles and earrings were made from fiber rope, often as part of the boltrope and served. The stitching mallet, or heaver, did not make its appearance in the sail loft until the 1850s. Made from wood or iron, it was used to tighten stitches.¹³



Figure 40. Heaver, marlinspike, lignum vitae fid, sail palms. (Courtesy of N. S. Wilson.)

¹³ Brewington, "Sailmaker's Gear," 285, 286.

Both the rigger and sailmaker used fids on a daily basis. Fids have been used for splicing since at least the beginning of the sixteenth century. Fids were wooden, bone, or metal spikes used for splicing fiber rope, stretching grommets and cringles, and for boring holes in canvas.

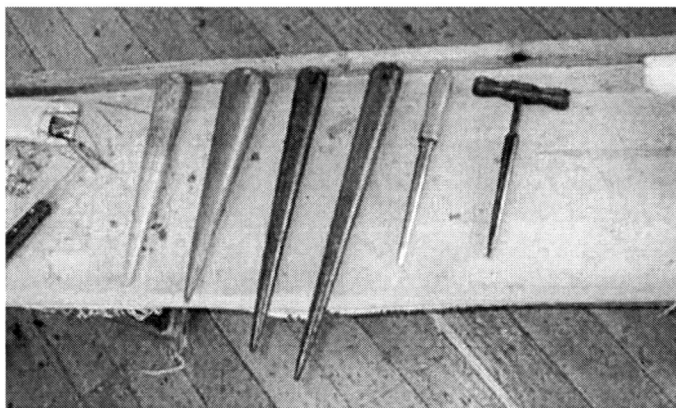


Figure 41. (above) Fids, spike, heaver. (Courtesy of N. S. Wilson.) (below) Fids advertised by Neptune Hardware. (Courtesy G. W. Blunt White Library, Mystic Seaport Museum, Inc.)

Sailmakers' Heavers.

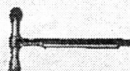


Fig. 1735
\$1.50 each.

Sailmakers' Prickers.
Wood Handles. Steel Points.

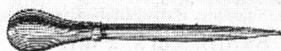


Fig. 1736

Length,	8	10	inch.
	\$0.50	.75	each.

Hand Fids.



Fig. 1737

Number,	1	2	3	4	
Length,	14	16	18½	20½	inch.
	\$0.30	.35	.40	.45	each.

Standing Fids.



Fig. 1738

Number,	1	2	3	4	
Length,	30	32	36	40	inch.
Dia. of Butt,	4	5	6	6½	inch.
	\$2.10	2.50	3.20	3.50	each.

The harder the wood, the better the fid. A broken tip was difficult to ream between rope strands and could catch threads in the cloth. Lignum vitae made the best choice for fids because it is a very hard, oily wood that resists damage and rarely cracks. Alexander Cutler and his employees used hickory wood.

Fids came in a large range of lengths and widths depending on their use. Some were made in the shape of a cow's horn, and indeed were likely to have started out as such. The curved fid faded from general use by 1815.¹⁴ Those with long, even tapers were the most useful and easy to use. Large fids to shape grommets, cringles, and eyes in boltropes were called stretching, setting, or driving fids. They were often two to three feet long and fitted with heavy



Figure 42. 1997 USS *Constitution* sail cringle stretched on a setting fid. (Photograph by N. S. Wilson.)

¹⁴ Brewington, "Sailmaker's Gear," 284.

iron bands at the base so they could stand steadily on the floor when working cringles.¹⁵ Some sailmakers preferred to bore holes for grommets in sailcloth with a fid rather than cut it with a knife. For this job, the sailmaker used a fid block – a wooden cylindrical block with holes cut in one end, deep enough to accommodate two-thirds the maximum diameter of the fid. They placed the canvas over one of the holes and drove the point of a fid through it with a heavy mallet.¹⁶



Figure 43. Mallets from E. W. Smith and Son sail loft, early nineteenth century. (Courtesy of N. S. Wilson.)

Anything involving mallets, of course, is usually tough work and sailmaking was certainly no exception. Working with heavy canvas required strength and dexterity. The corner of a sail could have over a dozen layers of canvas. It would have been impossible for a sailmaker to work the heavy-duty needles through the canvas with bare hands. To accomplish the task, the sailmaker wore a sail palm. The term first referred to the iron thimble sewn into a piece of leather or canvas with a hole cut through for the thumb. Later the term came to represent the

¹⁵ Horsley, *Tools of the Maritime Trades*, 175; Brewington, "Sailmaker's Gear," 284-285.

¹⁶ Brewington, "Sailmaker's Gear," 285.

whole unit. In 1734 Thomas Blanckley described the palm as “round Pieces of iron stamp’d full with round Impressions; [they] are sewed to Leather which comes into the Palm of the Sailmakers Hand, and are made use of by them when sewing the Seams or Boltropes on the Sails.”¹⁷ The thimble was dimpled to receive the head of the needle and prevent it from slipping. Sailmakers also used a thumb stall to protect their thumb when tightening stitches. The thumbstall was a tube of metal, leather, or horn worn on the thumb. The sailmaker would wrap his twine around the thumbstall before pulling it tight. In the 1860s, the thumbstall fell out of use because it had been incorporated into the palm itself and called a roping palm.¹⁸ More heavy duty than a seaming palm, a roping palm also had larger indentations in the thimble to accommodate bigger needles used for this purpose. Seaming palms continued to be made and used without the horn around the thumb, as regular seaming did not require that level of tension.

Sailmakers made their own palms until the mid-1800s when individuals began to manufacture palms for retail. In the Chesapeake region, James Smith manufactured sail palms beginning in 1869 and soon afterwards, the practice of each sailmaker making them for his own use died out.¹⁹ In the mid-nineteenth century, a Bostonian named Hazlitt manufactured seaming palms. Roping palms could be bought from a Mr. Mullins in New York. “Sailmakers from all over New England ordered palms from these two men and always referred to their palms as a Hazlitt seaming or a Mullin roping palm.” Whether homemade or store bought, sailmakers repaired their own palms. If the thimble worked loose, they would “take an oval patch or half moon shaped piece of leather and sew it around the plate on the palm. This patch was called a scab.”²⁰ Sail needles were designed and manufactured for their specific use in sewing canvas.

¹⁷ Thomas Blanckley, quoted in Brewington, “Sailmaker’s Gear,” 281.

¹⁸ Brewington, “Sailmaker’s Gear,” 281.

¹⁹ Ibid.

²⁰ Mead, *Bent Sails*, 4-5.



Figure 44. Sail palms from E. W. Smith and Sons sail loft, Fairhaven, Massachusetts, early nineteenth century. (Courtesy of N. S. Wilson.)



Figure 45. (left) Sail palm, twentieth century; (right) palm from E. W. Smith sail loft, early nineteenth century. (Courtesy of N. S. Wilson.)

Sailors' Palms.

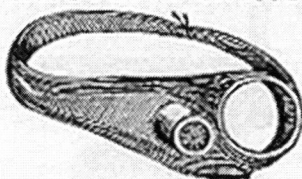


Fig. 1732.

Per Dozen.

1	Half Hide Mounted, Seaming,	-	-	-	\$1.50
2	Full Hide Mounted, Seaming,	-	-	-	2.00
3	Brass Mounted, Seaming,	-	-	-	2.00
4	Hide and Brass Mounted, Seaming,	-	-	-	2.25
5	Hide Mounted, Seaming, with Buckle,	-	-	-	2.50
6	Hide Mounted, Roping,	-	-	-	2.25
7	All Hide, Seaming, Extra Stitched, with Buckle,	-	-	-	5.25

Sailmakers' Palms.

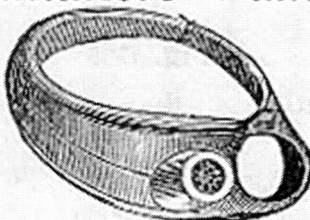


Fig. 1733.

Each.

10	Special Seaming,	-	-	-	\$1.50
11	Special Roping,	-	-	-	2.00
12	Mullen's Pattern, Seaming,	-	-	-	2.00
13	Mullen's Pattern, Roping,	-	-	-	2.50

Sheaths and Belts.

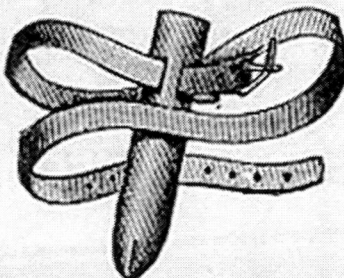


Fig. 1734.

No.		Per Dozen.	Belts Only, Per Dozen.
1	Common, Belts, $\frac{3}{4}$ in. wide,	\$2.75	\$1.85
2	Medium, Belts, $\frac{7}{8}$ in. wide,	3.50	2.25
3	Extra, Belts, 1 in. wide,	4.25	3.10

Figure 46. Palms advertised in Neptune Hardware Catalog, No. 61, 1919. (Courtesy of G.W. Blunt White Library, Mystic Seaport Museum, Inc.)

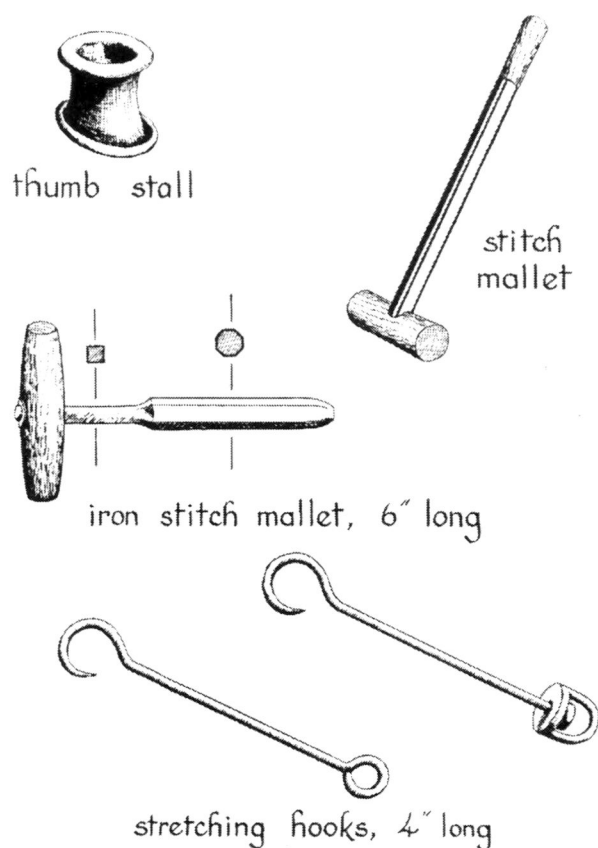


Figure 47. Thumb stall, mallets, bench hooks. (Horsley, *Tools of the Maritime Trades*, 173.)

By 1794, David Steel recorded nine sizes identified by their use: large marline, small marline, double boltrope, large boltrope, small boltrope, store, old work, tabling, and flat-seam. The sailmaker used the smallest needle necessary to pull the cord of twine through the cloth, as larger

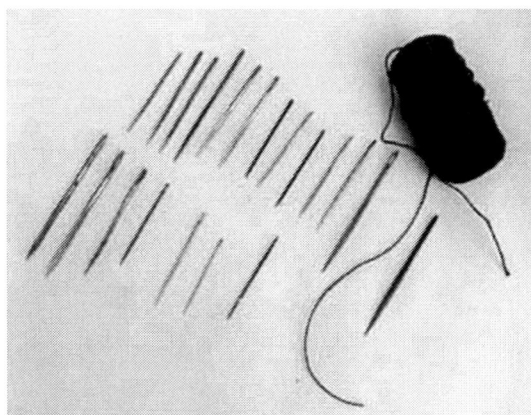


Figure 48. Sail needles and tarred twine. (Courtesy of N. S. Wilson.)

needles made correspondingly large holes in the canvas. To avoid breaking the warp and weft threads of the cloth, sail needles were made with a triangular shape along half its length. With the edges slightly rounded off, the needle could pass between the cloth threads without piercing them. The second half of the shank was round and included the eye. The needle chosen for a particular task was slightly wider than the cord of twine that followed it. This kept the cord from “hanging” as it was pulled through the cloth.

For roping, sailmakers ground down the needle tips to avoid piercing the rope strands as they sewed it to the sail. In 1826, the United States Navy issued four sizes to its sailmakers: sail, roping, marline, and sewing. In 1844, the navy identified needles as: seaming, 4 thread, 6 thread, 8 thread, and 10 thread. In 1880, seaming needles came in four sizes, labeled numbers fourteen through seventeen; plus 4 thread, 6 thread, and 8 thread. Ten years later, the navy identified needles as seam, 4 thread size 12, 6 thread size 9, 10 thread size eight. Today, sail needles are still manufactured with the same basic shape and are identified by number from smallest, size 18, to largest, size 6. Needles are graded to conform to standard wire gauge.²¹ They were shipped in brass cases with the maker’s name stamped on them. A turned wooden case was also popular for carrying needles to the job site.²² At sea, sailors made exotic needle cases out of whalebone, bamboo from tropical islands, and wood with carved intricate designs in them. The shipboard sailmaker generally kept his needles in a cow or sheep horn half-filled with tallow to prevent rust.

An experienced sailmaker stitching a seam or roping was impressive to watch. His work was repetitive, but he performed his tasks quickly and efficiently. Ernest Ratsey maintained that

²¹ Steel, *Steel’s Elements of Mastmaking, Sailmaking, and Rigging*, 64; Ratsey and de Fontaine, *Yacht Sails*, 164.; Brewington, “Sailmaker’s Gear,” 279.

²² Horsley, *Tools of the Maritime Trades*, 170, 172.

an experienced sailmaker could complete three yards of finished seam in an hour — a finished seam meaning three rows of stitching. In Van Nostrand's *The Young Seaman's Manual*, he stated that one man could sew one hundred yards in nine and a half hours, single seam.²³

Alexander Cutler concurred that a man was “considered very good” to complete ten yards of single seam an hour, though he claimed to have known men who could sew twice as fast. Cutler noted that they averaged four stitches to the inch.²⁴

To accomplish these rates, a sailmaker set up their benches, tools, and materials ahead of time. Fids, needles, twine, and wax were within hands reach. He usually sewed with lengths of twine no longer than the reach of his arm so he could tighten each stitch with a single pull. To free his hands from having to hold the cloth, he used a hook, also called sail hook or bench hook. The hook had a sharp point and was tucked in between stitches on a seam and tied to a lanyard to anchor the cloth away from the direction of pull. The right-handed sailmaker sat with his bench hook fastened to the right end of his bench. The iron or steel hook measured three to five inches long, oftentimes had a swivel, and has been in use since at least the eighteenth century. Steel's 1794 treatise on sailmaking includes a woodcut of a sailmaker at his bench using a hook. With a hook keeping the sail taut across his lap and his twine no longer than his arm, he could stitch without having to take the needle from his palm and without using his other hand.²⁵

Never using a knot to start or end his seams, he tucked the twine's bitter end along the seam and sewed over it. This practice saved time and produced a smoother seam. When finished with a seam, the sailmaker used a seam rubber to flatten and smooth his stitches. Rubbers were wood, bone, iron, or steel. Most preferred wooden seam rubbers because they were easy to make, did not rust, and were softer on the twine and canvas. Some used seam rubbers to crease a

²³ Ratsey and de Fontaine, *Yacht Sails*, 169.

²⁴ D. Van Nostrand, *The Young Seaman's Manual*, 193; Mead, *Bent Sails*, 9.

fold in the cloth; others had a separate tool altogether, a creaser, for that purpose.²⁶ Prickers, stabbers, and pegging awls were quite similar to each other. Similar in



Figure 49. Seam rubber from E. W. Smith and Sons sail loft, early nineteenth century. (Courtesy of N. S. Wilson.)

shape to a marlinspike, they were much smaller and some had squared or triangular shanks.

Awls were used for splicing very fine line, opening small holes in cloth, and to anchor measuring tapes, chalk lines, and sailcloth into the wooden loft floor. Steel described an awl as having a round blade, but square at the tip.²⁷ Slightly larger than the awl, prickers were originally squared on the shank, the stabber triangular. Both had wooden handles and eventually lost their angular shanks, becoming round. They differed from marlinspikes only by their size and were used for splicing small stuff.

Sailmaking required specialized tools, but most important was material for the sails: cloth, cordage, twine, and hardware. In the beginning of the nineteenth century, American sailmakers imported nearly all sailcloth from Europe, with a handful of domestic manufacturers supplying quality flax linen canvas. Just before the War of 1812, Boston's Seth Bemis produced cotton duck for sailcloth, but most ship owners continued ordering cloth from Britain, Russia, and the Netherlands. The ideal sailcloth was "impervious to the moisture in the atmosphere. It

²⁵ Brewington, "Sailmaker's Gear," 289-290; Calahan, *The Ship's Husband*, 163.

²⁶ Mikelson, "Sailmakers Tools," 32.

²⁷ Brewington, "Sailmaker's Gear," 286.

would neither shrink nor stretch with changes in humidity, and it would be firm enough not to change its shape under pressure of the wind, when made into sails.”²⁸ These characteristics were the ideal, yet, they were, for the most part, unattainable to the nineteenth century mariner. Until the next century, mariners used and liked baggy, linen sails – great for sailing with the wind, but nearly useless in sailing to weather. Even so, they stuck with them.

Although writing in the second half of the nineteenth century, when cotton sailcloth was commonly acknowledged as superior to flax, Van Nostrand instructed, in *The Young Seaman's Manual*, that all sails should be flax canvas. Cotton should be used for the following purposes:

No. 1	is principally for the construction of Water-tanks for boats.
No. 2	for Mess-cloths.
No. 3	for making Tarpaulins and Head-cloths.
No. 4	for Deck Awnings, Boom-covers, Hammock cloths, &c.
No. 5 and 6	for Wind-sails, Sail covers and Boat-covers.
No. 7 and 8	for Boat Awnings, Awning Curtains, Wheel-covers, &c.
No. 9 and 10	for Binnacle Covers, Side-screens, &c. ²⁹

There were many reasons that mariners resisted the change to cotton canvas, some of which were, indeed, sensible. Cotton canvas was heavier and harder to manipulate. It rotted more quickly than linen. With so many varieties of cloth from which to choose, the choice that is clear in hindsight was not necessarily so obvious at the time.

Almost all the types of canvas suitable for sails were called “Duck.” The term derives from the Dutch word for cloth, “doek.” Americans adopted the term to mean canvas sailcloth because imported canvas from England arrived bearing the stencil of a duck for heavier cloth and a raven for lighter weight cloth.³⁰ British sailcloth manufacturers were legally obligated to stamp each bolt of cloth with an identifying mark. The customs inspector marked every bolt of foreign

²⁸ Ratsey and de Fontaine, *Yacht Sails*, 152.

²⁹ D. Van Nostrand, *The Young Seaman's Manual*, 208.

³⁰ Wingate, *Fairchild's Dictionary of Textiles*, 205-206; Ratsey and de Fontaine, *Yacht Sails*, 152.

cloth with a red stamp, eight inches in diameter. In addition, legislation dictated that the sailmaker mark his sails with an eight inch black stamp denoting his “name and abode.”³¹

High quality Russian sailcloth was known as “best blue mark” and was thought to be better and less expensive than the Dutch *kanefas*. Further grades of Russian duck were known as “small blue mark, black mark, green mark, and red mark.” Sailcloth from Sweden was simply known as Swedish cloth. French bolts of cloth measured 21 inches wide, but were longer than English equivalents. The highest quality French sailcloth was known as *toile à trois fils*. *Cotonine*, a mixture of hemp and cotton, was used on French lateen sails. *Cotonine à carreaux* was blue and white checkered and used for awnings and small boat sails. Spain and Portugal imported heavier canvas, identifying them *lona*, *loneta*, and *brim* from heaviest to lightest. The Italians used *cottonina* for lateen rigs and *lona* for squares. *Flemish canvas*, *Russian linen*, *Raven cloth*, and *Westphalian linen* was used by Europeans for topgallants and other light wind sails.³²

Mariners and sailmakers understood that the best sails had the narrowest panels. Cloth stretched more within its body than along the selvage. Nonetheless, more seams meant more stitching and cost effectiveness had to be taken into account.³³ In the eighteenth century, a bolt of British sailcloth was 24 inches wide and 38 yards long. Identified by number, there were ten grades of cloth from No. 1 to No. 10, heaviest to lightest. A bolt of No. 1 sailcloth weighed 44 pounds and the lighter grades decreased by 3 pounds per number, with the exception between No. 6 weighing 29 pounds and No. 7 weighing 24.³⁴ When ships began making regular passages

³¹ Brewington, “Chesapeake Sailmaking,” 141.

³² Karl Heinz Marquardt, *Eighteenth Century Rigs and Rigging* (London: Conway Maritime Press Ltd., 1992), 172.

³³ Samuel Pepys *Diary*, quoted in Ratsey and de Fontaine, *Yacht Sails*, 150.

³⁴ Steel, *Steel's Elements of Mastmaking, Sailmaking, and Rigging*, 62.

around Cape Horn, manufacturers developed even heavier grade canvas labeled No. 0 and No. 00.

Canvas was also designated by the ounce per yard of cloth, but these were generally lighter weight cloth. In the nineteenth century, the American standard width for sailcloth was 28½ inches. Thus, in the twentieth century, the National Bureau of Standards designated that weight for duck was to be calculated by measuring bolts of cloth 28½ inches wide by one yard (or 1,026 square inches).³⁵ Vanderdecken noted in 1873 that although 24 inches was the standard width, 22, 15, and 12 were commonly used as well.³⁶ The schooner yacht *America* had sails made from 22-inch wide canvas, with a false seam in the middle, giving it 11-inch wide panels. Kipping commented that 18-inch wide sailcloth was used for jibs and drivers to “ensure greater strength and better appearance.”³⁷

Maintaining strength and appearance with flax, and especially cotton, sails depended not only on reducing stretch and injury, but also on preventing rot and mildew. Cotton sails, especially, mildewed quickly, and mariners routinely set sails loosely in port and at anchor to dry them. Weavers, sailmakers, mariners, and independent entrepreneurs attempted to deal with mildew and rot by treating cloth at various stages of production. In a Browell & Co. brochure from 1817, they explained that “it has been the constant subject of complaint among nautical men, that sail-cloth of every kind, due to weather and climactic changes, ... has been subject to speedy and often almost sudden rottenness, arising from mildew; this evil, besides great expense ... has in many instances frustrated well-planned naval operations, and sometimes caused the loss of valuable lives, together with ships and their cargoes.”³⁸

³⁵ Ratsey and de Fontaine, *Yacht Sails*, 151.

³⁶ Vanderdecken, *Yachts*, 82.

³⁷ Kipping, *Sails and Sailmaking*, 38.

³⁸ Browell & Co., *Narrative and Documents Relative to the Preservation of Mildew in Sailcloth*, 1.

Some American weavers treated yarns in the loom. The process included “moistening the warp in the loom with a decoction, or gelatinous substance, prepared from the refuse of neat’s-feet..., [it is] then boiled in water until it is converted into a sort of glue.” According to William Falconer, this made the cloth more durable than the British practice of using a paste of flour and water, which would make the cloth brittle.³⁹ Most treatments, if any, were applied to the sails after they were completed. Smaller vessels in Great Britain were treated with a heated mixture of horse fat, tar and red or yellow ochre. Others rubbed a paste of ochre and seawater into wet sails and then brushed linseed oil on both sides.⁴⁰ Other concoctions, favored by fishermen in Northern and Western Europe included ingredients such as oak bark in water, tar, water, ferrous sulfate, and horse grease. These treatments, called tanning, rendered red to brownish colored sails. Although very popular in Europe, tanning was used infrequently in the United States. Although these treatments made sails less likely to mildew, it was debated as to whether they made them outlast untreated sails.⁴¹ Browell & Company applied for a British patent on a chemical finishing to prevent mildew and rot from canvas made from “vegetable substances.” They claimed that their treatments did not injure the mucilage, “which nature has designed to give its strength.” Alkaline treatments removed the mucilage and thus weakened the cloth. The Royal Navy experimented with Browell & Company’s treated canvas and sent reports that they did, indeed, outlast their untreated sails almost two to one.⁴²

Treatments also applied to sail twine. Durability of sailcloth meant little if seams and stitching rotted or let go. A sailmaker purchased “white” twine in skeins and usually tarred and

³⁹ Falconer, *A New Universal Dictionary of the Marine*, 424.

⁴⁰ Steel, *Steel’s Elements of Mastmaking, Sailmaking, and Rigging*, 61; Marquardt, *Eighteenth Century Rigs*, 173.

⁴¹ Alan Gray, *Sailmaking Simplified*, 8.

⁴² Browell & Co. *Narrative and Documents Relative to the Preservation of Mildew in Sailcloth*, 1-5.

⁴² Falconer, *A New Universal Dictionary of the Marine*, 424.

wound it onto spools at the loft. He would dip the whole coil into a barrel of Stockholm tar, hang the twine on a hook, and then rub as much tar into it as it could hold with his hands. He wound it onto spools with a spool winder. Not until the 1930s did manufacturers provide tarred twine wound onto spools for purchase.⁴³ British Admiralty law dictated that sails for naval vessels be sewn with flax twine spun 360 fathoms to 430 fathoms to the pound. One pound of twine seamed four bolts of cloth.⁴⁴

Between 1844 and 1891, the United States Navy issued cotton twine for stitching and roping, flax twine for whipping and marling.⁴⁵ Once threaded on the needle, the sailmaker applied one more treatment before sewing. All twine was waxed before stitching. The wax protected it from weathering, but more importantly, made it easier to sew. British naval vessels required a specific wax mixture of 5/6 beeswax and 1/6 turpentine for sails made from canvas Nos. 1, 2, 3 and 4. They used 2/5 beeswax, ½ hog's lard, and 1/10 clear turpentine for Nos. 5, 6, 7, and 8. English merchant vessels commonly used oil-thinned tar on their sail twine.⁴⁶ American sailmakers used similar wax and tar recipes. Alexander Cutler explained that at his loft, they put rosin, tar, tallow, and beeswax into an iron kettle. Heated and melted, the wax was dumped into cold water. When it had cooled, the men picked it out of the water and formed it into balls.⁴⁷

With waxed twine threaded on his needle, the sailmaker was ready to stitch. Sailmaking rules were generally followed on both sides of the Atlantic from as early as 1628. Sails on the Swedish warship *Wasa* were sewn with round seams, a method replaced by the flat seam by the

⁴² Phenix Mill Catalogue, quoted in Hall, *Sailmaking In Connecticut*, 106-109.

⁴³ Horsley, *Tools of the Maritime Trades*, 159, 162.

⁴⁴ Kipping, *Sails and Sailmaking*, 39.

⁴⁵ Brewington, "Sailmaker's Gear," 280.

⁴⁶ Kipping, *Sails and Sailmaking*, 39.

⁴⁷ Mead, *Bent Sails*, 3.

eighteenth century. *Wasa's* sails, however, did follow some basic principles still used today. The seams were stitched from foot to head. Boltropes were sewn on the after side on square sails and the port side on fore-and-aft sails.⁴⁸ Flat seamed sails were sewn from foot to head with the overlapping panel to the sailmaker's left. Seam widths ranged from 1½ inches on larger sails to one inch on smaller sails.

To avoid using an unfinished edge, sailmakers varied the width of their seams if they needed to taper, or broadseam, a sail. Many sails were made with a bight seam down the center of the cloth to narrow its width and strengthen the sail. Before machine stitching, this method was very tedious, but rendered more durable sails. In flat seaming, sailmakers averaged ten to twelve stitches to the length of the needle; thus, the larger the needle, the longer the stitch. Royal Naval seams were flat seamed with 108 to 116 stitches to the yard.⁴⁹ At the end of the nineteenth century, sewing machines were introduced to the sail loft and their adoption into the industry was rapid. There were three stitches that could be made on a machine: the chain stitch, straight stitch, and zigzag. The chain stitch was never used for sails as it was made with a single thread and would quickly run if broken anywhere along its length. Zigzag was preferred over straight stitching because it was more elastic and would remain intact with the stretching and shrinking of a sail in use. Machine seaming reduced the time to construct a sail considerably. Nonetheless, hand stitched sails remained much stronger and more durable. The twine was bedded into the cloth and pulled tightly; the machine stitch went through the cloth, but could not be made as snug and lay exposed to chafing on top of the seam.⁵⁰ Boltropes were stitched into the edge of a sail

⁴⁸ Sven Bengtsson, "The Sails of the *Wasa*: Unfolding, Identification, and Preservation," *International Journal of Nautical Archaeology* 4, no. 1 (1975), 33.

⁴⁹ Alan Gray, *Sailmaking Simplified*, 20; Mead, *Bent Sails*, 34; Ratsey and de Fontaine, *Yacht Sails*, 165; Marquardt, *Eighteenth Century Rigs*, 173.

⁵⁰ Ratsey and de Fontaine, *Yacht Sails*, 166-168; Horsley, *Tools of the Maritime Trades*, 181-182.

using a twisted, waxed cord of twine. The sailmaker roped with the sail on his lap and the rope underneath resulting in the rope sitting on the aft side of square sails and port side of fore-and-aft sails. Roping was one of the most crucial aspects of sailmaking. Sewn on too loosely, and the

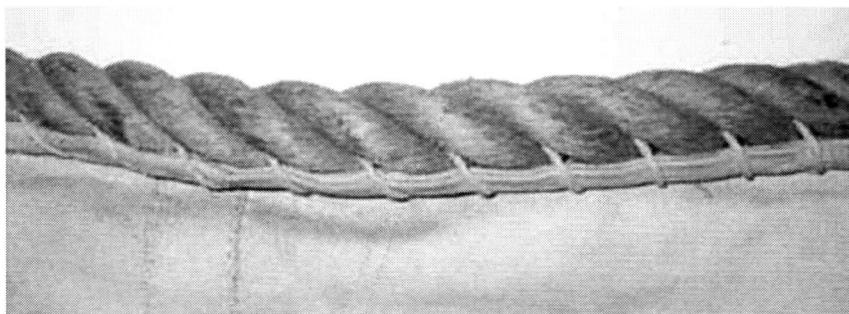


Figure 50. (above) Yacht *Constellation* boltrope; (below) *Mayflower I* boltrope. (Courtesy of N. S. Wilson.)



canvas bore the strain and stretched or tore easily. Roped too taut, the sail set baggy and shapeless, making any attempt at using it as an airfoil futile. The sailmaker attached the boltrope to the sail in a counterclockwise direction, following the lay of the line.

Before metal hardware was used on sails, cringles and earrings were made from bights or eyes in the boltrope and served. Served rope had to be marled on because the needle could not penetrate the service. Later, when wire rope was used for boltropes, it was marled on as well. Fiber rope splices for boltropes differed from the rigger's splice in that strands were tucked with the lay instead of against it. Although the rigger's splice was stronger, it could not be used on

boltropes because the sailmaker needed to access each strand in the rope to sew it to the sail. Wire rope, chain, and metal hardware gradually replaced fiber rope for standing and running rigging and for sail hardware in the nineteenth century. Galvanized iron replaced many brass fittings by the end of the 1860s. Thimbles, iron clews, and brass rings for grommets were easy to

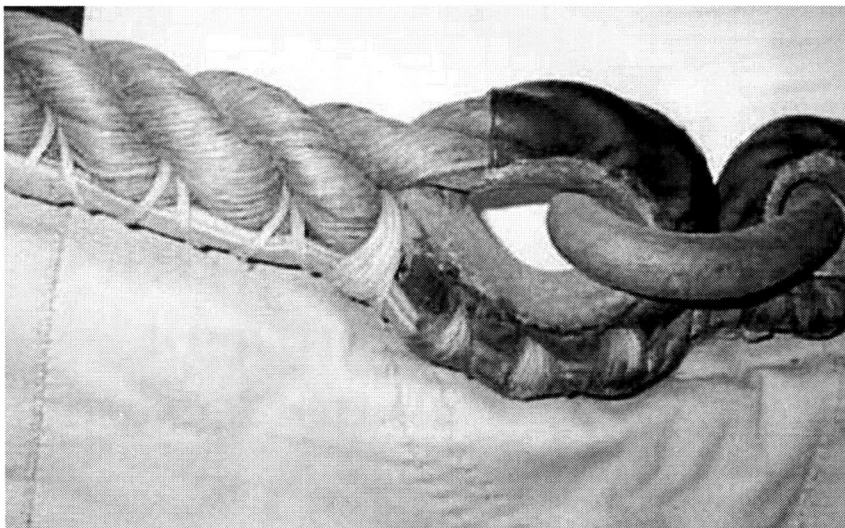


Figure 51. Yacht *Constellation* boltrope splice.

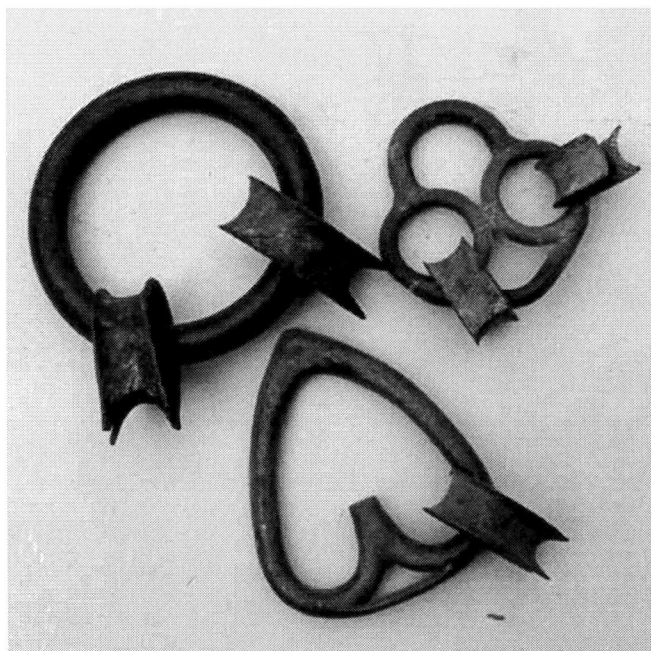


Figure 52. (Clockwise from top left) Ring clew, spectacle iron, heart clew. (Courtesy of N. S. Wilson.)

attach, strong, and resisted chafing. Many sailmakers still used hand-sewn grommets over pressed brass rings because they were not only less expensive, but significantly stronger and less likely to tear out. By the second half of the 1800s, ship chandlers supplied brass, copper, iron, and galvanized iron hardware, available in shops and by catalogue. Alexander Cutler bought his materials from a Boston chandler, the closest supplier he could find.

Sailmaking, like most artisan trades, developed specialized tools, materials, and techniques. Most were standardized from one loft to another. While some businesses may have focused on large ship sails and others on smaller vessels, most accepted a large range of work. The materials and tools would have been the same for either. Only the size of the loft varied depending on the number of men who worked there and the size of sails they made. Not that a small-sized loft, or no loft at all, kept a sailmaker from accepting work on large sails. Sails could be lofted and constructed in sections. Sometimes an open field would do. Techniques and

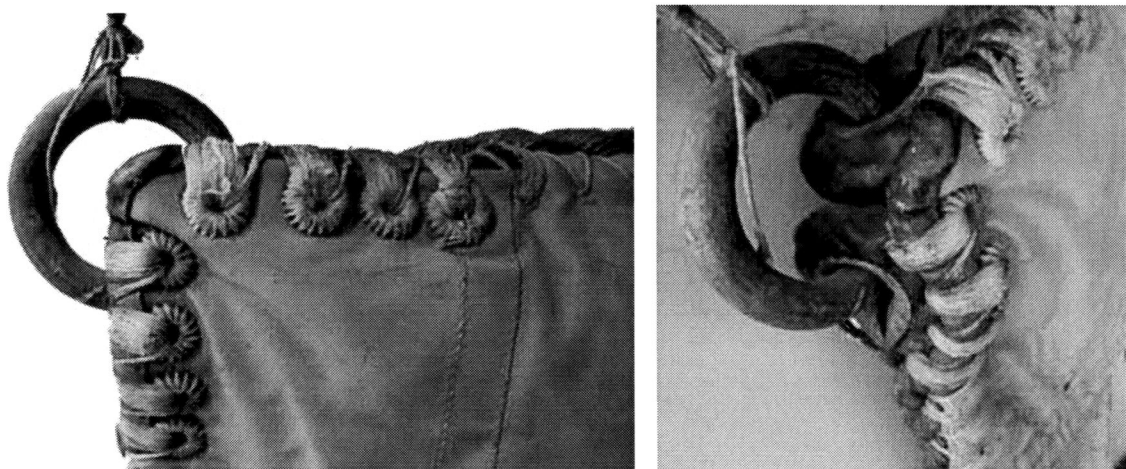


Figure 53. Yacht *Constellation* ring clew with heavy stitching on boltrope splices. (Courtesy of N. S. Wilson.)

traditions developed over hundreds of years, for the sails themselves changed very little during that time. Only the introduction of the sewing machine changed the sailmakers' long days of seaming at their bench. Nonetheless, even with machine-sewn seams, all sails were hand

finished. Grommets, cringles, reef points, and boltropes could only be made by hand. To date, no machine exists that can properly attach a boltrope to a sail.

CONCLUSION

Sailmaking in the twentieth century changed dramatically throughout all aspects of the industry. For materials, synthetics dominated the sailcloth industry after World War II when high quality cotton canvas was in short supply. Nylon, and later Dacron,¹ became the standard cloth for sailing vessels. Today, high-tech synthetic sailcloth powers the elite racing sail vessel. Technicians shape Kevlar-laminate² sails from computer generated, full-size molds. Kevlar threads are placed within the plastic film along the load lines, in patterns determined by computer. The sail area is made from one sheet of material. Only a handful of sailmakers, today, still retain the skills to cut and construct a sail by hand.

Before the 1800s, sailmaking changed little in the hundreds of years leading up to it. Sails were made from flax or hemp linen. Design changed just as slowly. Square sails that simply needed to catch the wind and get pushed along with it did not ask much from naval architects. Strong materials and solid craftsmanship to keep the sails together in a blow represented the most sailmakers, cloth manufacturers, and designers could offer. In the nineteenth century, commerce and warfare demanded specialization in sailing ship design. Ships grew in size and became more efficient on the wind. Likewise, the sails that powered them required greater strength and progressive designs. By the late 1800s, steam powered vessels competed with sail in nearly every type of trade and in the military. In all but a few cases, it defeated them. Not that the advent of steam replaced the sailing ship all at once, but once engineers and mariners mastered steel manufacturing, the screw propeller, and high pressure

¹ Dacron is a polyester cloth and a trademark of DuPont.

² Kevlar, another trademark of DuPont, is also used in bullet-proof vests.

marine engines, commercial sail faded out for good in all but the fisheries and select trades. In the navy, the transition took place even more quickly.

The debate over domestic versus foreign sailcloth and flax versus cotton canvas dominated conversations amongst sailcloth manufacturers, shipowners, and the US Congress during the first half of the century. Experiments and reports resulted in mixed reviews over cotton's ability to replace flax with regard to strength, performance, handling, and durability. Sailmakers seemed to use whatever they had access to and, mostly, whatever their customers requested. The transition from foreign flax sailcloth to domestic cotton occurred over the course of the middle decades of the nineteenth century. After the Civil War, use of cotton prevailed. Steam also began to dominate the waters that sail had navigated since the age of the galley. Many sailmakers maintained their payrolls by producing sails for New England's sizeable fishing fleets and the growing yachting community.

Sailmakers eventually reduced their numbers as the size of sailing fleets dwindled. In the United States, just as they overcame the problems of cloth supply with the improvements in domestic cotton canvas manufacturing, the demand dropped considerably. Nonetheless, their place in maritime New England's history is important when studying the ships and their support industries. Needing years of training before becoming a full-fledged sailmaker, their trade became more complicated as scientists began to understand the principles behind what made them work and how they could work better. In exchange for their skills and labor, the nineteenth century sailmaker in southern New England earned above average wages and regular employment. Aboard ship, whether the official sailmaker or a regular sailor, mariners learned sailmaking skills necessary for the maintenance and survival of their sails. Shipboard sailmakers earned slightly higher wages than able seamen and approximately equal to other skilled hands such as the carpenter and boatswain. Shoreside and shipboard sailmakers were not isolated from

each other. Many sailmakers ashore learned their trade at sea. Likewise, it was not uncommon for a shoreside sailmaker to alternate between the sail loft and the ship. Their training was valuable in both worlds.

In the first half of the nineteenth century, the industry was consistently reinforced with young apprentices as older ones retired. Towards the end of the century, the average age of sailmakers increased because fewer sons joined their fathers in the industry. The skills required of sailmaker s varied little from one generation to the next. Their tools and materials were the same as those used for hundreds of years. Benches, fids, needles and palms were simple tools — simple, but efficient. Sailmakers could make most of their equipment by hand and by the mid-1800s, several retailers supplied them as well. The biggest change in their equipment came with the introduction of the sewing machine in the last years of the nineteenth century. Today, the sail needle is of little use in the loft producing performance sails.

BIBLIOGRAPHY

Primary Sources, Unpublished

G. W. Blunt White Library, Mystic Seaport Museum, Inc., Mystic, Connecticut.

Borrensen, Barney. Three Sailmaker Notebooks, 1855-1929.
Cole, Jesse. Sketch and Sail Plan Book, 1865.
Gordon and Hutchins: Sailmakers of Boston, 1915-1923. Account Book.
Hannum, Charles. Account Book.
Mallory Family Papers.
McLaughlin, J. L. and R. H. Bills.
Pilgrim, Ship. Accounts with Sailmaker John R. Taylor.
Pimer, John Kingsbury. Papers
Pinkham, Alfred. Papers
Ratsey and Laphorn Collection.
Sailmaker's Account Book.
Thompson, Edwin. Scattered Papers, 1830-1845.

New Bedford Free Public Library, New Bedford, Massachusetts

United States Bureau of the Census, Manuscripts, 1850. Massachusetts.
United States Bureau of the Census, Manuscripts, 1880. Massachusetts, Rhode Island.

New Bedford Whaling Museum Research Library, New Bedford, Massachusetts.

Simpson Hart Business Records Collection

Rhode Island State Archives and Public Records Administration, Providence, Rhode Island

Rhode Island State Bureau of the Census, Manuscripts, 1865. Newport County.
Rhode Island State Bureau of the Census, Manuscripts, 1885. Newport County.
Rhode Island State Bureau of the Census, Manuscripts, 1905. Newport County.

National Archives and Records Administration, Northeast Region, Waltham, Massachusetts

United States Bureau of the Census, Manuscripts, 1850. Connecticut, Rhode Island.
United States Bureau of the Census, Manuscripts, 1880. Connecticut, Rhode Island.
United States Bureau of the Census, Manuscripts, 1900. Massachusetts, Connecticut, Rhode Island.

Primary Sources, Published

Adams, Sampson and Company. *Boston Directory for the Year 1858, ...and a Business Directory*.
Boston: Adams, Sampson and Company, 1858.

American State Papers. Documents, Legislative and Executive of the Congress of the United States. Class VI. *Naval Affairs, 1794-1836.* Vols. 1-4.

Browell and Company. *Narrative and Documents Relative to the Preservation of Mildew in Sailcloth*. London: Nichols, Son, and Bentley, 1817.

Burgess, Robert H., ed. *The Sea Serpent Journal: Hugh McCulloch Gregory's Voyage Around the World in a Clipper Ship, 1854-55*. Charlottesville: University Press of Virginia, 1975.

Butts, Isaac Ridler. *The Merchant's and Mechanic's Assistant, Being a Collection of Rules and Practical Tables, for the Use of Commercial Houses and Those Interested in Ships. With a Supplement by Ware Branson, Jr., Sailmaker, United States Navy*. Boston: Isaac Ridler Butts, 1858.

Cowan, Malcolm. *An Essay on the Construction of Sails of Ships in Vessels*. London: J. Peck, n.d.

Crapo, Henry H. *The New Bedford Directory...and Town Register*. New Bedford, Mass.: J. C. Parmenter, Printer, 1836.

----- *The New Bedford Directory, 1838*. New Bedford, Mass.: J. C. Parmenter, Printer, 1838.

----- *The New Bedford Directory, 1845*. New Bedford, Mass.: Press of Benjamin Lindsay, 1845.

Crawford, Michael, ed. *Naval Documents of the American Revolution*. Vol. 10. Washington D. C.: Naval Historical Division, Department of the Navy, 1996.

Greenough, W. A., Jr. *Greenough's Directory of the Inhabitants, Institutions, Manufacturing Establishments, Business, Societies, Business Firms, &c. &c. in the City of New Bedford for 1869-70*. Boston: W. A. Greenough Jr., Compiler and Publisher, 1869.

Lainhart, Ann Smith, ed. *First Boston City Directory, 1789*. 1789. Reprint, with annotations by John Haven Dexter, Boston: New England Historic Genealogy Society, 1989.

Morgan, William James, ed., *Naval Documents of the American Revolution*. Vol. 6. Washington D.C.: Naval Historical Division, Department of the Navy, 1972.

Neptune Hardware Manufacturing Company, *Marine Hardware, Sailmakers' Hardware, and Hardware Specialties*. Catalog No. 61, 1919.

Smith, Philip Foster Chadwick, ed. *The Journals of Ashley Bowen (1728-1813) of Marblehead*. 2 vols. Portland, Maine: Anthoensen Press in association with the Colonial Society of Massachusetts, 1973.

Stimpson, Charles, Jr. *Stimpson's Boston Directory, 1839*. Boston: Charles Stimpson Jr., 1839.

Taber, Abraham and Brother. *The New Bedford Directory, 1865*. New Bedford, Mass.: Abraham Taber and Brother, 1865.

Taber, Charles and Company. *New Bedford Directory: Containing the City Register and a General Directory of the Citizens, 1856*. New Bedford, Mass.: Charles Taber and Company, 1856.

Timpson, C. B. and Lawrence. *C. B. Timpson and Lawrence Catalog of Shipbuilders' Hardware, Boat Builders', and Blockmakers' Materials and Tools. Sailmakers' Material and Tools. ...Vessels' Outfits. General Hardware and Commission Goods*. New York, 1855.

Secondary Sources

Albion, Robert G. and W. G. Baker and B. W. Labaree. *New England and the Sea*. rev. ed.. Mystic, Conn.: Mystic Seaport Museum, Inc. 1994.

Alexander, John T. "Catherine II, Bubonic Plague, and the Problem of Industry in Moscow." *The American Historical Review* 79, no. 3 (June 1974): 637-671.

American Home Economics Association. *Textile Handbook*. Rev. ed. N.W., Washington D.C.: American Home Economics Association, 1967.

Anderson, R. C. *The Rigging of Ships in the Days of the Sprintsail Topmast, 1600-1720*. Mineola, New York: Dover Publications, Inc., 1994.

-----, *Seventeenth Century Rigging*. London: Percival, Marshall, and Co., Ltd., 1955.

Anderson, Romola and R. C. *The Sailing Ship: Six Thousand Years of History*. New York: Bonanza Books, 1963.

Bailyn, Bernard and Lotte Bailyn. *Massachusetts Shipping, 1697-1714: A Statistical Study*. Cambridge, MA: Harvard University Press, 1959.

Banks, Bruce and Dick Kenny. *Looking at Sails*. Boston: Sail Books, Inc., 1979.

Baughman, James P. *The Mallorys of Mystic: Six Generations in American Maritime Enterprise*. Middletown, CT: Wesleyan University Press, 1972.

Beane, Rachel. "John Kingsbury Pimer: Nineteenth Century Sailmaker." Research Paper, Munson Institute, Mystic Seaport Museum, Mystic, Conn., 1992.

Bengtsson, Sven. "The Sails of the Wasa: Unfolding, Identification, and Preservation." *International Journal of Nautical Archaeology* 4, no. 1 (1975): 27-41.

Bishop, J. Leander. *A History of American Manufactures: From 1608-1860*. 2 Vols. 1868. Reprint, New York: Augustus M. Kelly Publishers, 1966.

- Bolles, Albert S. *Industrial History of the United States*. Norwich, CT: Henry Bill Publishers, 1881.
- Brandon, Ruth. *A Capitalist Romance: Singer and the Sewing Machine*. Philadelphia: J. B. Lippincott Co., 1977.
- Brewington, Marion V. "Chesapeake Sailmaking." *Maryland Historical Magazine*. 65, no. 2 (summer 1970): 138-148.
- , "The Sailmaker's Gear." *American Neptune* 9 (1949): 278-296.
- Briggs, James Franklin. *Sails and Sailmakers*. New Bedford, Mass.: Old Dartmouth Historical Society, 1937.
- Buhl, Lance. "Mariners and Machines: Resistance to Technological Change in the American Navy, 1865-1869." *The Journal of American History*. 61, no. 3 (December 1974): 703-727.
- Bullen, Frank T. *The Men of the Merchant Service*. New York: Frederick A. Stokes Co. Publishers, 1900.
- Calahan, Harold Augustin. *The Ship's Husband: A Guide to Yachtsmen in the Care of their Craft*. New York: The MacMillan Co., 1937.
- Chanute, Octave. *Progress in Flying Machines*. 1894. Reprint, Long Beach, CA: Lorenz and Herweg, Publishers, 1976.
- Chapelle, Howard I. *The History of the American Sailing Navy*. New York: W. W. Norton Co., Inc., 1949.
- , *The History of the American Sailing Ships*. New York: Bonanza Books, 1935.
- , *The Search for Speed Under Sail, 1700-1855*. New York: Bonanza Books, 1968.
- , *Yacht Designing and Planning*. New York: W. W. Norton Co., Inc.
- Cheney, Robert K. "Industries Allied to Shipbuilding in Newburyport." *The American Neptune* 17, no. 2 (April 1957): 114-127.
- Clark, Victor S. *History of Manufacturers the United States, 1607-1860*. Vols. 1-3. New York: McGraw-Hill, 1929.
- Collier, William. *Classic Sails: The Ratsey and Lapthorn Story*. Cowes, Isle of Wight: Ratsey and Lapthorn, Ltd., 1998.
- Cooke, James E. "Tench Coxe, Alexander Hamilton, and the Encouragement of American Manufactures." *William and Mary Quarterly*. 32, no. 3 (July 1975): 369-392.

- Craig, Hardin, Jr. "An Anchor to Windward: Manuals for Young Americans in the Days of Sail." *The American Neptune*. 30, no. 1 (January 1970): 40-45.
- Dana, Richard Henry, Jr. *Two Years Before the Mast: A Personal Narrative of Life at Sea*. 1840. Reprint, edited and with an introduction by Thomas Philbrick, New York: Penguin American Library, 1981.
- , *The Seaman's Friend: A Treatise on Practical Seamanship*. 1879. Reprint, Mineola, NY: Dover Publications, Inc., 1997.
- Davis, Charles G. *How Sails are Made and Handled*. New York: Rudder Publishing Company, 1931.
- De Hartog, Jan. *The Call of the Sea*. New York: Atheneum, 1966.
- Depew, Chauncy M. *One Hundred Years of American Commerce*. Vol. 2. New York: D. O. Haynes and Co., 1895.
- Dodds, James and James Moore. *Building the Wooden Fighting Ship*. New York: Facts on File, 1984.
- Douty, Esther M. *Forten the Sailmaker: Pioneer Champion of Negro Rights*. New York: Rand McNally and Co., 1968.
- Falconer, John. *Sail and Steam: A Century of Maritime Enterprise, 1842-1935*. Boston: David R. Godine Publisher, Inc., 1993.
- Falconer, William. *A New And Universal Dictionary Of The Marine; Being A Copious Explanation Of The Technical Terms And Phrases Usually Employed In The Construction, Equipment, Machinery, Movements, And Military, As Well As Naval Operations Of Ships*. 1784. Reprint, with additions by William Burney, LL. D., London: T. Cadell and W. Davies in the Strand and J. Murray Bookseller, 1830.
- Fassett, F. G. Jr., ed. *The Shipbuilding Business in the United States of America*. Vol. 1. New York: Society of Naval Architects and Marine Engineers, 1948.
- Fennelly, Catherine. *Textiles in New England, 1790-1840*. Meriden, CT: Meriden Gravure Co., 1961.
- Gardiner, Robert, ed. *The Heyday of Sail: The Merchant Sailing Ship, 1650-1850*. Annapolis, MD: Naval Institute Press, 1995.
- German, Andrew W. *Down On T Wharf*. Mystic, CT: Mystic Seaport Museum, Inc., 1982.
- Glover, John G. and Rudolph L. Lagai. "The Textile Industry." In *The Development of American Industries: Their Economic Significance*. New York: Simmons-Boardman Publishing, Corp., 1959.

- Goldenberg, Joseph A. *Shipbuilding in Colonial America*. Charlottesville: University Press of Virginia, 1976.
- Graham, Gerald S. "The Ascendancy of the Sailing Ship: 1850-85." *The Economic History Review*, 2d ser., 9-10, no. 1-3 (1956-57): 74-88.
- Graves, Donald and Michael Colby. "An Overview of Flax and Linen Production in Pennsylvania." *Pennsylvania Folklife*. 35, no. 3 (1986), 108-126.
- Gray, Alan. *Sailmaking Simplified*. New York: The Rudder Publishing Company, 1940.
- Griffiths, David M. "American Commercial Diplomacy in Russia, 1780 to 1783." *William and Mary Quarterly*, 3d ser., 27, no. 3 (July 1970): 379-410.
- Hacker, Louis M. "The First American Revolution." *Columbia University Quarterly*. (September 1935): 259-295.
- Hall, Elton Wayland. "Sailmaking in Connecticut Prior to 1860." Masters thesis, University of Delaware, 1968.
- Harland, John. *Seamanship in the Age Sail: An Account of Shiphandling of the Sailing Man-of-War, 1600 to 1800, Based on Contemporary Sources*. London: Conway Maritime Press, 1984. Reprint 1987.
- Heinrich, Linda. *The Magic of Linen: Flax Seed to Woven Cloth*. Victoria, B.C.: Orca Book Publishers Limited, 1982.
- Herndon, G. Melvin. "War-Inspired Industry: The Manufacture of Hemp in Virginia During the Revolution." *The Virginia Magazine of History and Biography*. 74, no. 3 (July 1966): 301-311.
- Hoffer, Peter Charles, ed. *American Patterns of Life: Selected Articles on the Provincial Period of American History*. New York: Garland Publishing, Inc., 1988.
- Horsley, John E. *Tools of the Maritime Trades*. Camden, Maine: International Marine Publishing Co., 1978.
- Howard-Williams, Jeremy. *Sails*. Tuckahoe, New York: John de Graff, Inc., 1967.
- Hutchins, John G. B. *The American Maritime Industries and Public Policy, 1789-1914: An Economic History*. Cambridge, MA: Harvard University Press, 1941.
- Jessup, Philip C. and Francis Deak. "The Early Development of the Law of Contraband of War, II," *Political Science Quarterly* 48, no. 1 (March 1933): 62-93.
- King, William F. "The Sailmakers and Ship Chandlers of 79 Commercial Street, Boston." *American Neptune*. 15 (1955): 220-231.

- Kipping, Robert N. A. *Sails and Sailmaking*. London: The Technical Press Ltd., 1936.
- Kulikoff, Allan. "The Progress of Inequality in Revolutionary Boston." *William and Mary Quarterly*. 3d ser., 28, no. 3 (July 1971): 375-412.
- Labaree, Benjamin W., William M. Fowler, Jr., Edward W. Sloan, John B. Hattendorf, Jeffrey J. Safford, and Andrew W. German. *America and the Sea: A Maritime History*. Mystic, CT: Mystic Seaport Museum, Inc., 1998.
- Lavery, Brian. "Sails and Rigging." In *Building the Wooden Walls: the Design and Construction of the 74-Gun Ship Valiant*. Annapolis, MD: Naval Institute Press, 1991.
- The Learning Company, Inc. *Compton's Encyclopedia Online* (Version 3.0.). The Learning Company, Inc. <http://www.comptons.com/encyclopedia/>; INTERNET.
- Lees, James. *The Masting and Rigging of English Ships of War, 1625-1860*. Annapolis MD: Naval Institute Press, 1984.
- Lemisch, Jesse. "Jack Tar in the Streets: Merchant Seaman in the Politics of Revolutionary America." In *In Search of Early America: the William and Mary Quarterly 1943-1993*. Williamsburg: William and Mary Press, 1993, 109-137.
- Lever, Darcy. *A Young Sea Officer's Sheet Anchor*. 1808. Reprint, Boston: Charles E. Lauriat Co., 1930.
- Little, Nina Fletcher. "The Blyths of Salem: Benjamin, Limner in Crayons and Oil, and Samuel, Painter and Cabinet Maker." *Essex Institute Historical Collections*. Salem, Mass.: Essex Institute, January 1972.
- Livermore, Shaw. "The Success of Industrial Mergers." *The Quarterly Journal of Economics*. 50, no. 1 (November 1935): 68-95.
- MacGregor, David R. *Merchant Sailing Ships, 1815-1850*. Annapolis, MD: Naval Institute Press, 1984.
- MacGregor, David R. *The Schooner: It's Design and Development from 1600 to the Present*. Annapolis, MD: Naval Institute Press, 1997.
- Magoun, F. Alexander. *The Frigate Constitution and Other Historic Ships*. New York: Bonanza Books, 1927.
- Marino, Emiliano. *The Sailmaker's Apprentice*. Camden, Maine: International Marine Press, 1994.
- Marquardt, Karl Heinz. *Eighteenth Century Rigs and Rigging*. London: Conway Maritime Press Ltd., 1992.

- Martin, Alfred S. "The King's Customs: Philadelphia, 1763-1774." *William and Mary Quarterly*, 3d ser., 5, no. 2 (April 1948): 201-216.
- Mayr, Otto and Robert C. Post. *Yankee Enterprise: The Rise of the American System of Manufactures*. Washington D.C.: Smithsonian Institute Press, 1981.
- Mead, Janet Cutler, ed. *Bent Sails: A Sailmaking Saga Written in the Words of a New England Craftsman of Square Rigger Days*. Cincinnati, OH: Mail It, Inc., 1962.
- Mikelson, Bob. "Sailmaking and Sailmakers' Tools." *The Chronicle Of Early American Industries*. 14, no. 3 (September 1971): 29-33.
- Morison, Elting. *Men, Machines, and Modern Times*. Cambridge, MA: Massachusetts Institute of Technology Press, 1966.
- Morison, Samuel Eliot. *The Maritime History of Massachusetts, 1783-1860*. 1921. Reprint, Boston: Northeastern University Press, 1961.
- Morris, Richard B. "Maritime Labor Relations." In *Government and Labor and Early America*. New York: Harper & Row, Publishers, 1946.
- Mountaine, William. *The Seaman's Vade-Mecum*. 1781. Reprint, The New England and Virginia Company Historic Reproductions and Reprints, n.d.
- Nash, Gary B. "Slaves and Slave Owners in Colonial Philadelphia." *William and Mary Quarterly*, 3rd ser., 30, no. 2 (April 1973): 223-256.
- , "Forging Freedom: The Emancipation Experience in the Northern Seaports, 1775-1820. In *Race, Class, and Politics: Essays on American Colonial and Revolutionary Society*. Urbana and Chicago: University of Illinois Press, 1986.
- , *The Urban Crucible*. Cambridge, MA: Harvard University Press, 1986.
- Nelson, John R., Jr. "Alexander Hamilton and American Manufacturing: A Reexamination." *The Journal of American History*. 656, no. 4 (March 1979): 971-995.
- Newby, Eric. *The Last Grain Race*. 1956. Reprint, Hawthorn, Australia: Lonely Planet Publications, 1999.
- Peterson, William N. "Supporting Trades in Industries." In *Mystic Built: Ships and Shipyards of the Mystic River, Connecticut, 1784-1919*. Mystic, CT: Mystic Seaport Museum, 1989.
- Price, Jacob M. "A Note on the Value of Colonial Exports of Shipping." *Journal of Economic History*. 36, no. 3 (September 1976): 704-724.
- Rasch, A. A. "American Trade in the Baltic, 1783-1807." *Scandinavian Economic History Review* 4, no. 2 (1956): 32-63.

- Ratsey, Ernest A. and W. H. de Fontaine. *Yacht Sails: Their Care and Handling*. New York: W. W. Norton and Co., 1948.
- Sadler, Samuel B. *The Art and Science of Sailmaking*. 2d ed., London: Crosby, Lockwood, and Son, 1906.
- Saul, Norman E. "The Beginnings of American-Russian Trade, 1763-1766." *William Mary Quarterly* 3d ser., 26, no. 4 (October 1969): 596-600.
- Smith, Philip Chadwick Foster. "William Bentley on Trade and the Marine Artificers." *Essex Institute Historical Collections* 113, no. 3 (July 1977): 204-215.
- Scoville, Warren C. "Spread of Techniques: Minority Migrations and the Diffusion of Technology." *Journal of Economic History* 11, no. 4 (autumn 1951): 347-360.
- , "The Huguenots and the Diffusion of Technology. I." *The Journal of Political Economy* 60, no. 4 (August 1952): 294-311.
- Singer, Charles and E. J. Holmyard, A. R. Hall, and Trevor I. Williams, eds. *A History of Technology*. Vol. 4. New York: Oxford University Press, 1958.
- Sprague, William Peter. "Charles Ware, Sailmaker." *The American Neptune* 3, no. 3 (July 1943): 267-268.
- Steel, David. *Steel's Elements of Mastmaking, Sailmaking and Rigging*. New York: Edward W. Sweetman, 1794. Reprint, 1932.
- Svensson, Sam. *Sails Through the Centuries*. New York: The MacMillan Company, 1965.
- Tucker, Lester. "Classification of Jobs." *Pull Together: Newsletter of the Naval Historical Foundation and The Naval Historical Center* 32, no. 1 (spring-summer 1993).
- Underhill, Harold A. *Masting and Rigging: The Clipper Ship and Ocean Carrier*. Glasgow: Brown, Son and Ferguson, Ltd., Nautical Publishers, 1988.
- Vanderdecken. *Yachts and Yachting*. 1873. Reprint, London: Scolar Press, 1979.
- Van Nostrand, D. *The Young Seaman's Manual. Compiled from Various Authorities, and Illustrated with Numerous Original and Select Designs. For the Use of the U.S. Training Ships and the Marine Schools*. New York: D. Van Nostrand, Publisher, 1875.
- Villiers, Alan. *The Way of a Ship*. New York: Charles Scribner's Sons, 1953.
- Williamson, Jeffrey G. "Embodiment, Disembodiment, Learning by Doing, and Returns to Scale in Nineteenth-Century Cotton Textiles." *Journal of Economic History* 32 no. 3 (September 1972), 691-711.

Wingate, Isabel B. *Fairchild's Dictionary of Textiles*. 6th ed. New York: Fairchild Publications, 1979.