The Delaware Ship and Boat Building Industry, 1830-1940+/-: An Historic Context

by

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with

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PREFACE

This project was undertaken in response to priorities set by the Delaware State Historic Preservation Review Board for the Historic Preservation Fund in FY 1993. The board placed a priority on development of historic contexts dealing with the maritime industries of the state. This context covers just one of those industries—ship and boat building between 1830 and 1940. The Center for Historic Architecture and Engineering (CHAE), University of Delaware, received a matching funds grant from the Delaware State Historic Preservation Office (DESHPO) to carry out the project between September 1993 and July 1994. Bernard L. Herman and Rebecca Siders acted as principal investigators for the project, but graduate student Dean Doerrfeld carried out most of the research and fieldwork and authored major sections of the report. David Ames also contributed to the context, particularly the sections on iron and steel ships. Graduate assistant Kate Krizan helped with documentary research and fieldwork. The authors would particularly like to thank those people who furthered our research by allowing us to observe while they built boats, helped identify potential sites of early ship and boat yards, and consented to be interviewed regarding their experiences in Delaware ship and boat building yards.
I. Introduction

This historic context develops criteria for the evaluation of the physical remains of the ship and boatbuilding industry in Delaware between 1830 and 1940 to determine their significance and potential eligibility for inclusion on the National Register of Historic Places. By examining technology, the construction process of ships and boats, and shipyard organization, this historic context will explore a segment of Delaware's industrial heritage that reached numerous cities and towns along Delaware's coastal waterways and extended well beyond the Brandywine River in the north (traditionally thought of as the industrial center of Delaware).

The National Register of Historic Places and the Delaware Historic Preservation Plan

The National Register of Historic Places, established by Congress in 1966, is the nation's inventory of historic resources worthy of preservation and the repository of documentation on the nation's wide variety of historical property types, containing information on issues such as significance, abundance, and condition. Historic resources that can be considered for the National Register include districts, sites, buildings, structures, and objects that manifest a quality of significance in American history, architecture, engineering, and culture; that possess integrity of location, design, setting, materials, workmanship, feeling, and association; and that meet one of the following criteria:

A. That are associated with events that have made a significant contribution to the broad patterns of our history;

B. That are associated with the lives of persons significant to our past;

C. That embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction;

D. That have yielded, or may be likely to yield, information important to history or prehistory.

The significance of a historic resource can be judged and explained only when it is evaluated within its historic context. An historic context is a body of historic information organized by theme, place, and time by which a specific occurrence, property, or site is understood and its meaning and significance made clear. An historic context is linked with tangible historic resources through the concept of property types. A property type is a grouping of individual resources based on a set of shared physical or associative characteristics. Physical characteristics may relate to structural forms, architectural styles, building materials, or site types. Associative characteristics may relate to the nature of associated events or activities, association with a specific individual or group of individuals, or the category of information about
which a property may yield information.

The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation suggest the following steps for documenting a historic context:

* Identify the concept or theme, chronological period, and geographic area for the historic context.

* Assemble information about the historic context.

1. Collect information about the history of the geographic area encompassed by the historic context, including information about resources already identified. Identify groups of resources that may have important roles in defining historic contexts and values.

2. Assess information to identify bias in historic perspective, methodological approach, or area of coverage.

* Synthesize information. Prepare a written narrative of the historic context, providing a detailed synthesis of the data collected and analyzed. Important patterns, events, persons, architectural types and styles, or cultural values should be identified.

* Define property types.

1. Identify property types that have relevance and importance in illustrating the historic context. Determine how the National Register criteria would apply to examples of each on the basis of the importance of patterns, events, persons, and cultural values discussed in the written narrative of the historic context.

2. Characterize the locational patterns of property types, that is, generalize about where particular types of resources are likely to be found.

3. Characterize the expected condition of each property type.

The Delaware Comprehensive Historic Preservation Plan (hereafter “the Delaware Plan”) identifies eleven elements that must be included in a fully developed historic context:

* historic theme
* geographic zone
* chronological period
* known and expected property types
* criteria for evaluating existing or expected resources
* distribution and potential distribution of property types
* goals and priorities for the context and property types
* information needs and recent preservation activity
* reference bibliography
* method of involving the general and professional public
* mechanism for updating the context

This report addresses each of these elements. Chapter I discusses the relevant historic themes,
geographic zones, and chronological periods. A brief historic overview of the national and regional development of the shipbuilding industry is found in Chapter II. The construction of traditional nineteenth and twentieth-century watercraft is discussed in Chapter III. Chapter IV examines the development of the shipyards that constructed large wooden vessels including schooners and skipjacks. Chapter V discusses the construction of heavy iron and steel ships in Wilmington’s major shipyards—the Pusey & Jones Company and the shipyard of the Harlan & Hollingsworth Company. Chapter VI addresses associated property types such as ships’ chandlers, sailmakers, and block and pump manufactories. Chapter VII sets out goals and priorities for the historic context and property types.

Definition of the Historic Context

To assist in developing historic contexts, the Delaware Plan sets out a comprehensive statewide framework that defines the major themes in the state's history, the significant chronological periods associated with them, and divides the state into five geographical areas that represent distinctive physical regions (Figure 1). The remainder of this chapter describes the major historic themes, chronological periods, and geographic zones from the Delaware Plan used to define this particular historic context. The plan defines eighteen historic themes (including manufacturing which is most relevant to this context) and five chronological periods:

A. 1630-1730 +/-: Exploration and Frontier Settlement
B. 1730-1770 +/-: Intensified and Durable Occupation
C. 1770-1830 +/-: Early Industrialization
D. 1830-1880 +/-: Industrialization and Early Urbanization
E. 1880-1940 +/-: Urbanization and Early Suburbanization.

The plan also divides Delaware into five geographic zones (Figure 2): Piedmont (I); Upper Peninsula (II); Lower Peninsula/Cypress Swamp (III); Coastal (IV); and Urban (V) (Wilmington).

Historic Themes. Central to understanding the state’s history, economic activities comprise ten of the historic themes in the Delaware plan. They include: Agriculture, Forestry, Trapping & Hunting, Mining & Quarrying, Fishing & Oystering, Manufacturing, Retailing & Wholesaling, Finance, Professional Services, and Transportation & Communication. This categorization of activities is the one used in economic analysis and is based on the U.S. Standard Industrial Classification Manual (SIC). The SIC provides a classification of economic establishments by type of activity, and is used for the collection, tabulation, presentation, and analysis of data relating to commercial establishments in the United States. The purpose underlying this classification is the reflection of the way activities in the economy are organized to produce goods. The production process begins with the extraction of raw materials, then raw materials are transformed into products, and finally products are distributed for sale to consumers.
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Figure 1: Framework of Historic Context Elements. Source: Delaware Plan, p. 21.
Figure 2: Geographic Zones.

Source: Delaware Plan, p. 33.
Themes of agriculture, forestry, trapping and hunting, mining and quarrying, and fishing and oystering are all extractive activities. Manufacturing transforms raw materials into marketable products, and retailing and wholesaling distributes products to the consumer. The SIC also includes those economic activities that do not produce tangible products. Finance, professional services, and transportation and communication all fall into the category of services.

This progression of activities also reflects the historical evolution of the American and Delaware economies since the seventeenth century. The colonial economy was one based primarily on extractive industries, principally agriculture, and services in the form of trade. Beginning in the late eighteenth century, the scientific and technological advances of the industrial revolution allowed the growth of manufacturing. By the late nineteenth century, manufacturing became the principle source of growth and wealth in the American economy. In the 1950s, the economy moved to a third major transition as services began to overtake manufacturing as its largest sector.

Of the eighteen historic themes in the Delaware Plan, Manufacturing is the most closely related to this historic context. Broadly defined, ship and boatbuilding encompasses a spectrum of manufacturing activities. The ship and boatbuilding industry responded to certain trends in manufacturing by replacing craft methods of production with improved tools and production processes, by replacing traditional construction techniques with those advocated by the field of marine engineering, and by experimenting with new materials and scientific discoveries such as the iron hull and steam engine. Strictly defined, all types of ship and boat yards are manufacturing establishments. Ship yards manufacture vessels by converting raw material—trees, metals, rope, and textiles—into salable commodities. They create products that did not exist before the raw materials entered the ship yard.

As with other industries in the last two quarters of the nineteenth century, the shipbuilding industry expanded in response to advances in manufacturing technology, both in technologies common to many manufacturing endeavors as well as in ones invented specifically for the industry itself. Hence, ship and boat building also manifested significant trends in engineering which, in the Delaware Plan, is an element of the historic theme of Architecture, Engineering & Decorative Arts. It also reflected important trends in architecture as reflected in naval architecture. Additionally, the vessels constructed in Delaware ship yards altered the way in which goods were transported. In this regard it is an important element of the historic theme of Transportation and Communication. This historic context focuses primarily on the issues and resources related to manufacturing and technological changes.

Geographic Zone. From north to south, Delaware's three counties are New Castle, Kent, and Sussex. Sussex County occupies half of Delaware's land area. Most ship yards operating between 1860 and 1940 were located south of the Chesapeake and Delaware Canal, which separates the northern third of New Castle County from the southern portion of the state. In fact, the majority of Delaware's small ship yards were situated in Kent and Sussex counties. The Delaware Plan divides the state into five
geographical zones (see Figure 2). The Piedmont Zone is the only geographic zone within the state that saw no ship or boatbuilding activity. Wilmington contained the large ship yards of the Pusey and Jones Company and Harlan and Hollingsworth; the Upper Peninsula contained yards in Dover, Smyrna, and Odessa; the Lower Peninsula/Cypress Swamp contained a large shipbuilding industry with activity in Milford, Frederica, Seaford, and Bethel; and the Coastal Zone housed both commercial boat yards in Bowers and the construction of traditional marsh craft.

**Chronological Periods.** Delaware’s shipbuilding industry evolved throughout the history of the state. From the earliest colonization, shipbuilders used Delaware’s natural resources to construct all types of vessels. The earliest yards are extremely difficult to detail. Since they contained no permanent buildings, and the ships they created were constructed exclusively of wood, the ships and ship yards of the first three chronological periods present an exercise in documentary research. The periods 1830-1880+/-: Industrialization and Early Urbanization, and 1880-1940+/-: Urbanization and Early Suburbanization expressed the greatest technological change in ship design and construction and also hold the greatest potential for surviving resources. In the first period, Delaware’s shipbuilding industry represented the retention of traditional forms and methods in the wooden ship industry thriving throughout the state, but also embraced the newest designs with the successful launching of the nation’s first all iron vessel. The most recent chronological period saw the decline of the wooden ship industry and the steady climb of the state’s eminence in the steel vessel business. By the 1920s, however, the entire industry stood in decline and by 1940 only a single major ship yard remained active in the state.

**Property Types.** The ship or boat yard is the primary property type of the shipbuilding industry. But it is part of a larger complex of property types that support, or are associated with, the construction of wooden or steel-hulled vessels. These include property types that directly supported production such as storage buildings, transportation facilities such as wharves or railroad sidings, and sawmills. A broad category of associative property types connects the industry to other manufacturing concerns. Mast and spar makers, blockmakers, chandlers, and sailmakers relied on the state shipbuilding industry for their survival. In addition to property types related to manufacturing production, there are associative property types that connect the industry to the larger community. These are the physical reflection of the impact of the industry on the surrounding community and include such things as worker and owner housing, the businesses supported by the payroll of the industry, or transportation systems.

It is important to understand that the shipbuilding complex was not always contiguous; its elements might be separated by some distance and the products transported from one location to another. Ship yards frequently towed incomplete hulls to urban centers for final rigging, and as the native stands of timber disappeared, raw materials arrived from the west coast and the south Atlantic region. Determining to what extent a ship yard spread its activities across the landscape is problematic. Documentary records provide some insight, but many smaller yards and most boatbuilders are not
represented in archival sources. The exact location of every part of a specific shipbuilding complex may prove difficult to determine.

Another problem with identifying property types related to ship and boatbuilding activities is that the industry has largely disappeared from the landscape. In *Technical Bulletin 42: Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties*, Noble and Spude called attention to problems in analyzing property types of an industry now largely abandoned:

> the greatest challenge involves the issue of property analysis. In this case, property analysis refers to the need to link the now disparate physical remains to the former reality of working mines and related social systems. What now appears to be disconnected and geographically isolated buildings, landforms and machinery, and archeological features once worked together to accomplish ore extraction or beneficiation.1

Even during the peak years of the industry within Delaware, the ship yard represented an ephemeral entity. Shipbuilding did not require special buildings. Some were located on the banks of a river with no permanent resources. Many operated for a single year, lay vacant for half a decade, and then once again began producing ships.

**Research Design**

Undertaking research on shipbuilding presented a number of challenges. Few works comprise the body of knowledge on the state’s shipbuilding industry. Betty Harrington Macdonald’s *Mispillion-Built Sailing Vessels: 1761-1917* and David B. Tyler's *The American Clyde: A History of American Shipbuilding on the Delaware from 1840 to World War I* are valuable for their precision but fail to explore the industry statewide. This is symptomatic of the lack of research on the state’s economic history in general. The development of an historic context is also aided by the location and identification of specific resources representing the context. Since nearly all of the state’s ship yards no longer operate, were housed in buildings that possessed no distinctive structural characteristics that allows identification, or have been demolished, few traces of the industry are left on the landscape. In many ways, undertaking research on ship and boatbuilding presented a problem in historical archeology. A general research design was devised with two major steps: understanding the evolution of shipbuilding in a national context, and understanding the evolution of the industry in Delaware.

**National Context**

1. **To understand the technology of shipbuilding and its historical evolution.** The purpose here was to understand the technology of ship construction and the mechanisms by which it evolved to the present. This included a study of ship design and the transition, both technological and

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economic, from wood to steel. This was to provide a context for interpreting the technological significance of the industry in Delaware. Several secondary sources, combined with oral histories, gave a thorough understanding of the evolution of the industry. Books such as Kelly and Allen's *The Shipbuilding Industry* and the Society of Naval Architects and Marine Engineers's *The Shipbuilding Business in the United States of America* provided a chronological development of shipbuilding technology. Both works, written in the first half of the twentieth century, detail much of the equipment used during the early part of this century.

2. To develop a broad historic context of the origins and geographical diffusion of the industry in the United States. The purpose here was to develop a framework for placing the industry in Delaware in a national context and interpreting its regional and national significance. This information came largely from the *United States Census of Manufactures* which provides detailed accounts of both state and national production statistics.

**Delaware Context**

1. To identify statewide trends in the growth of the industry. Using secondary sources such as the *Census of Manufactures*, statewide trends in number of establishments, employment, and valued added were charted.

2. To identify the characteristics of individual ship yards. A variety of directories were used to develop as comprehensive a list as possible of all of the ship and boat yards in Delaware from 1860 to 1940. Insurance declarations of the Kent Mutual Insurance Company and maps prepared by the Sanborn Insurance Company illustrated the variety of sizes and configurations of the state's ship yards.

3. To determine property type characteristics and identify surviving ship yards. Once the number of establishments and their general locations were known, the next step was to determine the range of physical types of ship and boat yards and how the production sequence was arranged within them. This step included the identification of surviving ship yards so that they could be investigated as a source of information.

3a. *Map analysis.* Where available, Sanborn maps were examined for each town with a ship or boat yard to identify their exact location and layout.

3b. *Case studies of three ship yards.* Three yards in southern Delaware with either substantial documentary or physical evidence were examined and then analyzed for comparisons between shipbuilding activities in a limited geographic area.

Although an extremely important part of the state's economic history, the ship and boat building industry has received little attention outside of the greater Wilmington area. With the exception of survey and Historic American Engineering Record documentation of the Harlan and Hollingsworth facility, no preservation-related activities have taken place. Because the industry has largely disappeared from the Delaware landscape, this context attempts to reconstruct the economic, technological, and architectural attributes of ship and boat building from archival sources and the few surviving examples of the ship yard. This context attempts to interpret the few remaining historic resources related to ship and boatbuilding, and to recreate a sense of what the industry looked like and how it functioned on the Delaware landscape.
II. National Trends in Ship and Boat Building

This chapter provides an overview of the national trends that affected ship and boat building in the United States from the earliest time of settlement through 1945 and the ways that those trends took shape in the ship and boat yards of Delaware. While most of this chapter deals with the national trends that affected ship and boat building as an industry, it is important to note that watermen continued to construct traditional small craft in regional forms all along the Atlantic coast. Their work remained largely unaffected by the technological changes that altered the commercial industry of ship and boat building.

Since the earliest settlement of North America, shipbuilding existed as an industry. The first vessel constructed on what later became American soil, the Virginia, took form on the Kennebec River of Maine in 1607. Scattered enterprises throughout New England produced numerous small vessels during the next three decades and by the close of the seventeenth century, Boston, Salem, and Newburyport emerged as the country’s shipbuilding centers. Shipbuilding activity along the Delaware River, initiated by William Penn, started in the mid 1680s. Most of the early American vessels were small, ranging from twenty to two hundred gross tons. The “annual output of the entire industry can hardly have exceeded 4,000 gross tons at the end of the seventeenth century.”

The Development of the Wooden Shipbuilding Industry

In its earliest form, the American shipbuilding industry relied on the availability of cheap timber to produce vessels sold primarily in the British ship market. This extractive abundance continued into the eighteenth century and the American shipbuilding industry experienced phenomenal growth. New yards sprang up from Maine to the Chesapeake, and by the third quarter of the century, the industry seemed firmly rooted along the entire north Atlantic coast. Ship sizes grew slightly in the 1700s. From an average size of about fifty tons in the 1600s, average tonnage increased to about 150. The demand for vessels proved so great that many British buyers frequently supplied North American builders with ironware, cordage, and sails for ships under contract. By 1774, colonial-built ships accounted for one-third of the British tonnage.

The American Revolution and the European upheavals prompted by the Napoleonic Wars created an erratic economic climate within which American shipbuilders occasionally suffered. Great Britain closed her markets to American shipbuilders, and the market economy turned inward as the American merchant fleet grew. Differing from the period preceding the Revolution, domestic ownership dominated the market. From the American Revolution until about 1830, domestic ship production swelled

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as supplies of cheap timber seemed inexhaustible. Ships constructed in the United States cost about $34 per gross ton; comparable ships produced in Europe cost almost twice that. By 1811, ship production exceeded 147,000 gross tons per year; in 1815 the amount stood at 156,000 tons.\(^3\) This increase in shipbuilding activity rested on two premises: durable ships and low cost. During the next thirty-five years this pattern changed. First, the slow but inexorable exhaustion of local timber supplies soon negated the Atlantic Coast's historic advantage of virgin stands of prime timber and the cost of vessels rose steadily. Secondly, the success of the industry rested on traditional ship designs constructed by time-honored methods. By 1865, new designs, new materials, and the emergence of naval engineering radically transformed the ship itself.

**The “Golden Age” of the Wooden Ship**

From 1830 to 1865 both American shipping and shipbuilding experienced spectacular growth. Developments in naval architecture allowed wooden ships to carry heavier cargoes, dramatically increase in size, and carry literally acres of canvas aloft. In this thirty-five year period, American passenger packets, clipper ships, and large freighters stood as "the best of their respective types in the world."\(^4\) Several factors contributed to this growth. First, the Industrial Revolution in Great Britain forced that nation to import greater quantities of raw materials, and in turn, export larger quantities of finished goods. The British textile industry relied on American cotton to such an extent that New England ship yards dedicated their efforts to the construction of cotton freighters. American exports of cotton rose from 554,000 bales in 1830 to 3,535,000 bales in 1859.\(^5\) Ships provided the only method of moving these cargoes to international markets. Second, the continued population growth and expansion of the United States opened new regions in which raw materials grew in abundance. The development of the domestic railroad system in the 1840s connected these regions with the industrial centers of the east. Combined with these general commercial trends, six specific events placed demands on the world’s shipping network: the famine in Ireland in the 1840s, European revolutions of 1848, the California gold rush of 1849, the repeal of British navigation laws which restricted British citizens to ownership of vessels produced in Great Britain, the Australian gold mining boom of 1851, and the cyclical business spurt influenced by the new

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\(^3\) Ibid., p. 24.

\(^4\) Ibid., p. 25.

Naval architects responded to these demands by improving ship designs. Ships grew larger, hulls stronger, and lines cleaner. The rounded bow and broad, square stern of antiquity vanished as stems tapered to a point and aft quarters rose from the water in graceful curves. In the 1830s, few ships exceeded 500 gross tons; by 1854, ships typically exceeded 1700 tons. These improvements were purely American. The difficulty in obtaining adequate timber in Europe provided few incentives to naval architects and few sought their fortunes on foreign soil. The improvements brought about by American marine engineers led to a boom in shipbuilding between 1847 and 1857. In the fifteen year period preceding 1847, more than 1,480 ships and barks left the ways of America’s ship yards. In the ten year period that followed, 2,858 vessels of greater tonnage were produced. The greatest single year proved to be 1855 with a total production of 381 fully rigged ships. Maine emerged as the center of the United States wooden shipbuilding industry. That state’s yards constructed over half of all ships and barks sailing under the American flag.

A counter-effect of this rise in shipbuilding turned out to be the depletion of local timber supplies. As early as the 1830s, New York shipbuilders turned to the eastern Great Lakes for supplies of timber transported by canal and coastal schooner. By 1860, other shipbuilding centers also turned west for supplies. Only the ship yards of Maine and New Hampshire avoided serious over-harvesting of raw materials. Consequently, prices of ship timber and the cost of the ship itself rose. Labor shortages compounded the price increase. With the production of so many ships, yards found skilled labor in short supply. Unionization in many of the larger yards forced a doubling of the hourly rate and a diminution in the length of the workday. The price of large freighters rose to about $65 per ton, and clipper and packet prices approached $90 a ton. With prices in Europe remaining stable over the same period, the forty to sixty percent price advantage American producers experienced in the 1830s dwindled to about twenty percent by the late 1860s or early 1870s. The great boom of the mid-nineteenth century ended around 1857. The market became saturated with vessels as the California and Australia trade no longer absorbed the surplus. The wooden sailing ships produced by American yards also felt the intense competition of the emerging iron ship industry and the rise of the steamboat.

The steam vessel was a direct product of the Industrial Revolution that began in Great Britain in the eighteenth century and found application on American rivers in the nineteenth. The mechanical expertise of Watt and Boulton harnessed the power of the steam engine and Fitch, Stevens, and Fulton found application for their genius. Like Fulton’s Clermont, the first generation of American steamboats plied the

6 Hutchins, “History and Development,” p. 26
7 Ibid., p. 30.
inland and coastal waterways of the United States. Construction of these wooden-framed, walking-beam powered vessels centered on the lower Hudson River, the Long Island Sound, and the Delaware River. Although futuristic in concept, the earliest steamboat manufacturers knew nothing of marine engineering. Built by blacksmiths turned steamboat makers, every component required finishing by hand. Skilled workmen proved scarce, and the earliest vessels suffered from poor planning and craftsmanship.8 The first vessel to break the bounds of the coastal trade, the Savannah, crossed the Atlantic after a twenty-nine day voyage in 1819. Unfortunately, the voyage proved a financial failure, and the owners subsequently scrapped the vessel. The Savannah's misfortune benefitted Great Britain. The greatest improvements in ocean-going steam vessels stemmed from British overseas interests with regularly scheduled trips between English ports and Alexandria, Calcutta, and Hong Kong by 1857.

By the 1840s, the all-iron sailing vessel and steamer threatened the dominance of the wooden ship and its builders. Two Wilmington ship yards, Harlan & Hollingsworth and Pusey & Jones, achieved international notoriety when one launched America's first all-iron, ocean-going steamer in 1844, and the other built the nation's first iron sailing ship in 1855. The two Wilmington firms exemplified the emergence of the iron shipbuilding industry. Neither firm actively participated in the wooden shipbuilding industry, and entered the business from the boilermaking and machine works fields. Wooden shipbuilders possessed neither the knowledge nor the resources to make the transition from traditional designs and materials to the complexities of working with iron and steel. With the possible exception of one yard in Maine, no major wooden shipbuilder successfully built iron or steel vessels. By 1860, the Delaware River became the national center of the iron shipbuilding industry and the firms of Harlan & Hollingsworth, John Roach of Chester, and Reaney, Neafie & Company of Philadelphia emerged as the dominant builders upon that river.

Wooden Shipbuilding in Delaware: 1850-1860

Available information on Delaware's wooden shipbuilding industry between 1850 and 1860 does not follow the same trends visible in the national industry. While shipbuilders along the Atlantic coast built ever larger ships and impressive square rigged clippers, Delaware firms continued to construct schooners and sloops destined for the coastal trade. The enumerations of the 1850 Census of Manufactures lists only eight shipbuilders, six of whom operated in New Castle County. Seven of the eight built only wooden ships, and total production for the year 1849 totalled only twenty vessels. Mostly schooners and sloops, these vessels grossed around sixty tons each. The largest vessels, two ships built by E. & G. Moore of Wilmington, grossed 528 tons each. Only one firm, W. & A. Thatcher of Wilmington, built wooden-hulled steamships, raising two steamers with a combined value of $20,000. The most prominent

8 Ibid., p 31.
shipbuilders in the area, Harlan & Hollingsworth, listed themselves in that year as "Machinists," producing "Machinery of all kind and Iron Boats." Outside of New Castle County, the state's shipbuilding industry centered in Murderkill Hundred, Kent County, where Samuel Lorchard and John Lank erected two small schooners and two sloops respectively.

By 1860 the state's shipbuilding industry expanded considerably. Although Wilmington continued to lead the state in the production of vessels, new ship yards appeared in Broadkiln and Cedar Creek hundreds. A total of twelve ship yards produced vessels worth over $637,000, making shipbuilding second only to flour milling in the state's economy. In addition to the actual ship yards, the construction of vessels supported numerous ancillary industries. All located within Wilmington and clustered near the confluence of the Brandywine and Christina Rivers, two shipsmiths, a sailmaker, a mast and spar maker, a block and pump maker, and an upholsterer of "Car and Steam Boat Furnishings" manufactured the finished materials needed in the construction of vessels. Both Harlan & Hollingsworth and Pusey & Jones listed themselves as producers of iron steam boats as well as machinists and manufacturers of engines and boilers. Outside of New Castle County, Noah Magee, Samuel Martin, and William G. Prettyman operated yards on the Broadkiln River and each produced a single schooner. Along the Mispillion, James N. Deputy erected two schooners, and H.D. Deputy and William A. Scribner built a single schooner each. Each of the vessels constructed in lower Delaware sold for $9,000. Prices for vessels launched in the Wilmington area ranged from $7,000 to $15,000 but presumably varied considerably in size. Wages of ship yard workers appeared fairly consistent throughout the state. The specialized skills of the sailmakers employed by the firm of Weaver & Femenick demanded slightly more than average yard workers and each received about $50 monthly. Workers in the well established firms of E. & C. Moore or William Thatcher could expect to earn from $35 to $40 monthly. Ship yard workers in Sussex County earned an average of $39 monthly regardless of which yard employed them.

The Decline of the Wooden Ship

Although Delaware's shipbuilding industry appeared to lag behind the rest of the nation in the size and number of ships constructed, the types of vessels constructed by the state's ship yards placed them in a position that assured a continuous market. Between 1866 and the turn of the century, the large wooden packet and clipper suffered a serious decline. The high cost of construction, and diminishing prices of steel and iron, made these huge ships, often grossing more than 3,000 tons and measuring 300 feet in length, uneconomical to own or operate. New York City, one of the primary building centers for large ships and barks, experienced a sharp decline in output from forty vessels in 1855 to none in 1862. The small coastal sloop and schooner, however, continued to be in demand long after the market for

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9 United States Census of Manufactures, Delaware manuscript returns, 1850.
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ocean-going vessels faded. Exacerbating the decline in the market for wooden ships was the
deteriorating timber supply. The great freighters and packets of the 1850s required more than 300 full-
grown trees. With production exceeding 2000 ships per year, it is clear that local resources soon failed to
meet demands. The cost of timber skyrocketed. In 1850, 200,000 feet of ship timber cost $3,600. By
1860 this increased to about $6,000, but by 1870 the same quantity of timber cost almost $18,000.10
The number of independent sawmills producing ship timber in Delaware also declined precipitously, from
eleven in 1860 to none in 1880. Shipbuilders resorted to distant suppliers for their raw materials: the
Great Lakes and Ohio Valley supplied oak for frames, hackmatack from Canada provided the material for
knees, planking of southern pine arrived from the south Atlantic coast by schooner, and mast pines from
the Oregon forests traversed the country by rail.

The production of steel-hulled sailing vessels provided another reason for the decline of the
American wooden ship industry. Iron proved too heavy for use in sailing vessels, but the manufacture of a
lighter yet stronger material allowed for construction of metal hulls. But the cost of this material proved
prohibitively high. In the 1870s English steel hovered at $100 per ton, twice as expensive as iron and with
a raw material cost that exceeded the price per ton of fully rigged wooden vessels. By the early 1880s, the
cost of steel dropped significantly, and steel-hulled vessels appeared on the market for $50 to $60 per
ton—less than a wooden clipper of the 1860s. While English and Continental shipbuilders embraced this
new technology, American manufacturers failed to follow. Wooden shipbuilding dominated the domestic
market and the transition from wood to metal proved too expensive, both in terms of capital and
technology. This cost prevented all but the most progressive shipwrights from adopting metal
construction. During the late 1870s, wooden ship construction averaged about 80,000 tons annually,
steel and iron construction only about one-quarter of that figure.11 A decade later, annual production of
wooden vessels dropped to only 7,000 tons, plunging the entire shipbuilding industry into depression.
Federal policy also helped doom the wooden shipbuilding industry. Starting in 1789, the registry of
American-flagged ships was restricted to vessels constructed in the United States. By the late nineteenth
century, it became clear that the high cost of vessels produced in this country placed American
shipowners in an uncompetitive position. Although Congressional committees examined the issue from
the 1860s to the early twentieth century, Congress took no action. After 1880, many ship owners chose
to buy foreign vessels and sail them under a foreign flag.

To some extent, the construction of large schooners prolonged the inevitable demise of the
wooden shipbuilding industry. Used exclusively for coastal and short ocean voyages, schooners used

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10 United States Census of Manufactures, Delaware manuscript returns, 1850-1870.

fewer spars and sails, proved easier to operate with a smaller crew than square-rigged ships, consumed no fuel, and successfully competed on a cost basis with comparably sized steel-hulled vessels. During the first five years of the twentieth century, 332,000 tons of schooners slid down the ways of American shipyards. This vitality proved short-lived. Beginning around 1906, coastal shipping centered on barges. With no crew costs, low initial cost, low maintenance, and low timber requirements, the barge soon replaced the schooner. Despite a surge of activity during World War I when the federal government feared that the nation’s capacity to produce steel ships stood critically low, the wooden ship business all but vanished by 1920. In 1919, only thirty-three vessels grossing less than 49,000 tons were built. Most of this activity took place in the Pacific Northwest and Great Lakes regions, areas adjacent to sources of suitable timber.

Although Delaware’s focus on schooners and coastal vessels minimized the damage caused by the overall decline in the wooden shipbuilding industry, it was not immune to it. Between 1880 and 1890, the number of shipbuilding firms within the state declined from eighteen to eleven. The number of wooden vessels produced in the state dropped from thirty-three to nineteen with a gross tonnage of only about 11,000. By 1900, the state’s shipyards built only three wooden sailing vessels. By contrast, the state’s production of barges increased from six in 1890 to twenty-two in 1900. Only a few yards continued to operate in the twentieth century, and even then produced ships erratically. William G. Abbott of Milford, the state’s primary builder of wooden schooners during this period, registered only twelve vessels at the Port of Wilmington between 1900 and 1920. These vessels ranged in size from a sloop of fourteen tons to a four-masted schooner of over 700 tons. John Moore and the firm of Smith & Terry, both of Bethel, continued to build ships into the second quarter of the century. The Wilmington firm of Jackson & Sharp remained the most viable wooden shipyard in the state, but concentrated on barges, floating docks, and specialty vessels. A few manufacturers, such as the American Car and Foundry Company of Wilmington and Vinyard Shipbuilding Company of Milford, maintained a steady business with the construction of pleasure craft. By the end of World War II, no shipyards constructing wooden ships remained in the state.

The Development of the Iron and Steel Shipbuilding Industry

Although the first iron-hulled vessel appeared in the 1840s, the emergence of an industrial system based on metal ships waited until the second half of the nineteenth century. Two factors limited the growth of heavy shipbuilding in the United States. First, American shipyards initially focused on the construction of wooden-hulled, paddle-wheel steamers—vessels ideally suited to the navigation of rivers and lakes, but practically useless for trans-Atlantic voyages. Driven by an intense desire to open American’s interior, shipbuilders such as Robert Fulton turned inland, conquering the Hudson and Mississippi rivers and providing access to the fertile agricultural lands of the Midwest and Great Lakes
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regions.

In conjunction with this internalized approach to the improvement of navigation, slow technological growth in the first decades of the nineteenth century also restricted the rise of the metal ship. While great advances in the development of steam power took place, engines proved heavy, large, and inefficient. Iron, the only metal readily available, limited the size and operating pressures of both boilers and engine cylinders. The sheer weight of iron precluded its use on many ships, and iron-hulled vessels required massive propulsion systems. Guided by "a series of piecemeal uncoordinated innovations" the metal steamship took shape slowly in the first half of the nineteenth century. In this age of the inspired tinkerer, the most significant technical breakthroughs stemmed "more from practical experience and rule of thumb than scientific knowledge." Application seemed always to precede analysis: mechanics installed new propulsion systems before they understood their underlying theories, and knew little of steel’s strengths and weaknesses while using it to construct hulls. Inventors usually worked in isolation. Companies did not begin funding large-scale research and development until the 1890s.

The first key advance in the manufacture of metal vessels took place in the early 1860s with the development of more efficient methods of steel production. Early Bessemer processes and the open-hearth method provided the impetus for increasing American steel production from 6,000 tons in 1850 to 10 million tons in 1900. The low cost, light weight, and high strength of steel gave shipbuilders the opportunity to create a hull capable of withstanding the rigors of the open sea and the pounding of the ship’s own engines. As the metal hull evolved, the ship’s engine also changed. Low-pressure, single-cylinder engines with huge walking-beam paddles disappeared as compound engines and screw propellers emerged. The marine compound engine, an engine using two cylinders that allowed for the reuse of exhaust steam, proved so efficient that smaller furnaces and coal bunkers could now be installed.

With an efficient engine and strong, lightweight hull, shipbuilders possessed the tools needed to produce the ideal vessel. The paddle steamer, "a dead end, incapable of development for either merchant shipping or naval purposes," vanished into obscurity. By the turn of the century the romantic era of the wooden ship and the quintessential stern-wheeler came to a close. The all-steel liner and battleship replaced the packets and frigates of the nineteenth century and ushered in a new area of naval

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13 Ibid, p. 130.

The Focus on River Navigation

The development of steam-powered transportation on rivers and lakes was one part of a three-pronged national priority to develop transportation in the United States during the late eighteenth and nineteenth centuries. This program also focused on the development of railroads and the reduction of the cost of trans-Atlantic shipping. As a result of its emphasis on these areas, the United States produced advanced technology in sailing ships and locomotives, and the American steamboat was without peer elsewhere. The Hudson and Mississippi rivers and their estuaries provided the nautical laboratories for the development of the basic variations of the American steamboat in the first half of the nineteenth century. When Harlan & Hollingsworth and Pusey & Jones started building iron steamers in the 1840s and 1850s, they were building on and experimenting with forms well established on the Hudson, Delaware, and Mississippi rivers.

The first successful steamboat actually ran on the Delaware River in 1778 when John Fitch launched a small boat driven by paddle wheels. In 1790, with an improved ship, Experiment, he began an “infrequent but repeating service from Philadelphia to Trenton”– the first practical and successful application of steam to ship propulsion. Robert Fulton’s boat North River Steam Boat and its trip from New York to Albany in 1807 marked the beginning of the steamboat as a regular form of transportation on American rivers. In 1808, regular steamboat service started on the Delaware River. By 1817, steam vessels appeared on nearly every major waterway on the Atlantic coast.

The prototypical designs for passenger steamboats emerged on the Hudson River in the early nineteenth century. During his monopoly of the Hudson River steamboat trade, Fulton constructed three generations of steamboats, with the classic Hudson River steamer taking form in the 1820s. The first generation of Hudson River steamboats, designed between 1807 and 1815, resembled modified barges and

combined the flat bottom, bluff bow design of a canal barge with a flush deck fitted around the exposed engine and boiler. They carried masts and sails but no deck or pilot houses and passengers who traveled on deck were protected from the elements by awnings at the bow and stern. Those who went below shared the shallow hull with the machinery, boilers and fuel.


16 James E. Vance, Jr., Capturing the Horizon: The Historical Geography of Transportation Since the Sixteenth Century (Baltimore: Johns Hopkins University Press, 1990), p. 441.

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On these boats, passengers could ride from New York to Albany in roughly thirty-six hours for a fare of $7.00.

In the second generation of Fulton's boats, the steamer began to take a more sophisticated form as exemplified in the Chancellor Livingston. Built in 1815, it was 157 feet long with a beam of 33 feet 6 inches and a virtually flat bottom amidships. The location of the machinery was reversed from earlier boats, with the boiler and engine placed in the hull forward of the paddlewheels, located approximately amidships. Equipped with a deck cabin for women aft of the machinery, this configuration evolved into the multideck design typical of later American river steamers. By this time, the machinery was considered reliable enough to be able to safely do away with masts and sails and the paddle wheels were covered with boxes and guards.

The third and defining generation of the classic Hudson River steamers was represented by the 389-ton steamer Albany, built in Philadelphia in 1826, two years after Fulton lost his monopoly. Its design reflected the search in a newly competitive environment for greater speed, reliability, and comfort. It was a large vessel, 289 feet long with a length to beam ratio of roughly eight to one. Hogging trusses, looking like bridge trusses on the deck, added longitudinal strength to the shallow hull. These boats were designed with steeply

18 The narrow width of a vessel at the bow and stern provided less buoyancy than the widest portion of the ship; in effect, the extremes of the hull drooped when loaded. This phenomenon is referred to as “hogging.” Hogging trusses are a mechanical means to counteract the effects of hogging, especially on long narrow vessels, whereby cables, chain or girders are stretched from stem to stern over stantions rather like the strings on a bow.

19 Still, “Steam Navigation,” p 47
raked or sharply pointed bows for docking at river landings and pushing through sandbars, and hulls, superstructure, and cabins were built as lightly as possible to reduce their weight. The shallow hull, of course, required that the boilers and engine be moved out of the hold to the main deck. To compensate for the loss of cargo space in the hull, or holds, the superstructure became multidecked and by the 1830s western river steamers commonly sported three decks. Most western steamboats were sidewheelers with a separate engine powering each wheel. Wilmington shipbuilders later adapted the Hudson River steamer to an iron-hull design and combined it with features from the Mississippi boat to serve the transportation needs on rivers in the far West and in South America.

**Technological Advances**

The high cost of coal and poor efficiency of engines and boilers limited the early use of steamboat transportation to passengers who were willing to pay a premium for convenience, speed, and a smoother alternative to land transportation. But the core of the American demand for steam navigation lay in the transportation of heavy materials of low value, encouraging maritime engineers to place a priority on finding ways to raise steam pressures to reduce fuel consumption. Three other technical advances were required before the steamship could compete with the sailing vessel as a carrier of bulk cargo in overseas trade or become an economical alternative on rivers and lakes: the development of a propelling mechanism without the disadvantages of the side paddle; a compact, fuel efficient steam engine; and a hull that could support these features.20

**Metal Hulls.** Although screw propulsion provided a good alternative to the paddle wheel, steam propulsion and wooden hulls made incompatible partners. The flexible structure of a wooden ship, built of hundreds of separate pieces of timber fastened together by wooden treenails or iron bolts, responded poorly to the vibration and stress caused by the operation of power steam engines, the rotation of crankshafts, and the working of paddles. Maintaining the tolerances necessary for the screw propulsion shaft on wooden ships was nearly impossible. Such ships changed shape when afloat because of hogging. Although corrected by braces enough to make wooden steamers plausible, the problem was never fully solved in a wooden ship.

Iron hulls solved this problem by providing a rigid platform for the screw propeller, but such hulls could not be built until iron plate of tolerable quality at a reasonable price became available. At the same time, iron hulls were not altogether compatible with water. Between 1830 and 1860, builders worked to overcome problems with the construction of iron hulls. Iron was expensive and of uneven quality. It corroded in water, a problem that could be solved with white lead paint. A more formidable problem was the fouling of the hull by marine organisms. Wooden vessels were "coppered" to solve this problem but

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yellow metal over iron in salt water formed a primitive electrolytic cell resulting in disastrous corrosion. This problem seemed solved only by scraping the hulls regularly.

The iron hull and the screw propulsion system came together in the late 1830s and in 1843, the leading builder of seagoing steamships in England synthesized these advances into what has been called the first modern ship: The Great Britain, a huge iron ship 289 feet long displacing 3,270 tons. A year later Harlan & Hollingsworth launched the American counterpart, albeit at a much smaller scale: the twin-screw coasting steamer, Bangor, 212 gross tons. The Bangor represented the first vessel built in the United States for operation outside sheltered waters.21

Steam Engines. The development of a more efficient marine steam engine was the key to making the iron-hulled steamship competitive with sailing vessels on the open seas. For river and coastal ships, where the great advantage of the steam engine was to be able to travel on waters closed to sailing vessels, a more fuel efficient and compact engine freed more room within the ship for cargo and passengers. The simple steam engine consisted of a cylinder driven by steam from an adjacent boiler. It had been known for some time that more power could theoretically be generated by a marine steam engine with the same consumption of fuel "if the steam could be expanded for a second time in a second, bigger cylinder after passed through a first small high pressure cylinder."22 The process was called "compounding," and the two cylinder engine a compound engine. First operated on a commercial vessel in 1854, compound engines began entering service in the 1860s and became the standard marine engine by the 1870s.

The key to continued improvements in engines lay in advances in boiler design and construction made possible first by improved iron and later by the availability of steel. Original iron boilers employed a number of flat surfaces that had to be braced in order to withstand internal pressure. The development of the oval and later of the cylindrical boiler allowed higher pressures to be achieved since circular surfaces could support more pressure than flat ones. The engines of early boats ran on steam pressures of no more than five pounds per square inch (psi); the new boilers achieved pressures of sixty psi. The cylindrical boilers made in the 1870s became known as the Scotch-type boiler, of which Harlan & Hollingsworth was a major manufacturer. By the late 1870s, the use of steel in boilers allowed the attainment of pressures of 125 psi. By 1881, these high-pressure steel boilers permitted the design of an even more efficient triple compound engine that used sixty percent less fuel than older engines.23

21 Hutchins, "History and Development," p. 43

22 Greenhill, The Advent of Steam, p. 9

23 Dennis Griffiths, "Triple Expansion and the First Shipping Revolution," in The Advent of Steam, p. 109
expansion engines, with their greater fuel economy, rapidly replaced two stage engines by 1885. By the
1890s engines proved so economical that "a first class cargo steamer...could carry one ton of cargo one
mile using the heat in her furnace equivalent to that generated by burning one sheet of high quality...
writing paper." 24 By then the availability of high-pressure boilers made of high quality inexpensive steel
finally made the screw steamer competitive with the big steel sailing vessels.

The Rise of Iron and Steel Shipbuilding in Wilmington

Steam navigation on the Delaware River was divided between the upper and lower river with
Philadelphia at the center. The earliest steamboat service beginning in 1808 occurred on the north river
between Philadelphia, Trenton, and Bordentown as the river link on the route between Philadelphia and
New York. The completion of the Delaware and Raritan Canal, which connected the Delaware River with
the Staten Island Sound, created an all-water route to New York in 1838. It served primarily for transporting
freight.25

Although the 156-foot Wilmington provided steamer service from Philadelphia to Wilmington
starting in 1829, steamboat routes on the lower Delaware to cities and towns below Wilmington did not
materialize until later in the nineteenth century.26 The one exception was the connection with stages,
railroads, and canal boats near New Castle and Delaware City, a popular route for those traveling between
Baltimore and Philadelphia until the two cities were connected by railroad in 1840s.27 The rise in the
demand for steam ferries on the Delaware River coincided with the emergence of the iron ship yards of
Harlan & Hollingsworth and Pusey & Jones in Wilmington.

Even though steam navigation on the Delaware River was overshadowed by the Hudson River in
the early nineteenth century, many of the improvements on Hudson River boats were designed and built
in Delaware yards. When Elijah Hollingsworth left the Baldwin Locomotive Works in 1841 to join the firm
which became Betts, Harlan & Hollingsworth in Wilmington, there were no yards in the United States
devoted to building iron steamboats. In fact only two iron-hulled steamboats existed in the country as
more than experiments: the United States, built in 1838 at the West Point Foundry in New York, and the

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p. 187.

National Trends

Valley Forge, built in Pittsburgh in 1839.\(^{28}\)

When Harlan & Hollingsworth accepted contracts on their first four ships in 1844, they represented one of the first companies in the United States to regularly produce such ships. Each of the first four ships represented landmarks in the building of steam-powered iron ships. The first two, the Ashland (182 tons) and the Ocean (191 tons), were each powered by an innovative power train of “twin screws geared together and driven by a single cylinder.”\(^{29}\) The third launched was the first iron-hulled passenger steamboat on the Delaware River, the Wilmon Whillden. After establishing itself as the fastest steamboat on the river, the Wilmon Whillden continued to serve for fifty years.\(^{30}\) The most significant of the four was the previously mentioned Bangor.\(^{31}\) Her construction reflected the trial-and-error tinkering approach to early iron boats. “Her method of construction was unusual, by later standards, in that the shell plates [of the hull] overlapped each other clinker style (like shingles) and, because angle iron was not available, the frames were bent from rectangular bars with wrought iron clasps to fasten them to the plating.”\(^{32}\)

Harlan & Hollingsworth quickly found a market for steam ferries in urban areas. Located mainly on major rivers, bays, and streams, many large American cities in the early nineteenth century required ferries as a means of transportation, both locally and for connection with the hinterlands that supplied their population with foodstuffs. The company filled orders for ferry companies in Boston, Albany, and Troy, New York, as well as building four iron steamboats for service on the Delaware River, and cementing their reputation for this type of ship.\(^{33}\)

The California gold rush also prompted orders for iron-hulled steamships. In 1848, George W. Aspinwall placed an order for the 370-ton steamer Williamette to fulfill his mail contract on the Pacific coast. Although only 129 feet long, she operated on the Columbia and Sacramento rivers after a voyage around

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\(^{28}\) Ibid., p. 70.


\(^{31}\) Hutchins, “History and Development,” p. 43.


\(^{33}\) Tyler, *American Clyde*, p. 11, 13.
Cape Horn. In 1861, the Williamette sailed across the Pacific to provide service on the Yangtze River. In the 1850s, the company also "filled orders for small shallow draft stern-wheel steam boats for Cornelius Vanderbilt's Nicaraguan San Juan River Navigation Company and supplied the New Granada Steam Navigation Company's operations in South America." The iron hulls weathered the "rapids, shallows, rocks and frequent groundings" better than wooden ones.

In 1849, Joshua L. Pusey and John Jones established a second iron shipbuilding firm in Wilmington: Pusey & Jones. Soon joined by Edward Betts and Joshua Seal, owners of a local foundry, this merger of mechanics and foundrymen well represented the knowledge and skills needed for building iron boats. This firm established its reputation and secured its market as quickly as had Harlan & Hollingsworth, constructing iron steamboats for the rivers of North and South America. In 1855, they distinguished themselves by building the first iron sailing vessel in the United States, the Mahon Betts. Pusey & Jones went on to specialize in iron-hulled river boats which they designed for particular river systems, especially in South America.

Harlan & Hollingsworth and Pusey & Jones were not just building iron boats to make money, but trying to prove the worth of these boats to a skeptical American market still devoted to the wooden ship. With higher initial construction costs, iron boats experienced difficulty competing with wooden ones. Advocates for iron boats argued that, because iron lasted longer and carried more cargo per ton of displacement, iron boats should be less expensive to operate in the long run than wooden boats. On the other hand, argued opponents, steam-driven boats consumed expensive fuel inefficiently, lost potential cargo space to coal bunkers, and could not be used in locations where coal was not available.

Yet iron hulls suited the demands made on river steamboats. Writers enumerated the advantages of iron hulls as early as 1856: "We have on the Delaware a few steamboats where its merits have been appreciated, and the savings of a reduced draft of water in consequence of less weight of hull, is of itself more than sufficient to counterbalance any increased first cost of construction." In addition to being lighter, the 1856 advocate claimed that an iron hull had about twenty percent more space for cargo than an equal-sized wooden hull because the iron skin was thinner and, more importantly, the internal structural members took up less space, being narrower than wooden ones. He also argued that an "iron vessel will

34 Ibid., p. 6
35 Still, "Steam Navigation," p. 52
36 Ridgely-Nevitt, American Steamships, p. 223.
outlive three wooden ones." Insurance companies, he claimed, considered the economic life of a wooden ship to be only eleven years. Iron was much stronger than wood and, finally, since iron boats leaked much less than wooden ones, safety was also an important consideration in choosing between wooden and iron vessels.

By the 1860s, Harlan & Hollingsworth and Pusey & Jones led iron shipbuilding firms in the United States. By the 1870s, with the growth of other iron shipbuilding firms on the Delaware, the river became known as the American Clyde. Both firms developed specialties in small to medium size boats (partly because of the small size of the Christiania River), especially ferries, river steamboats, and luxury yachts. Other firms on the Delaware River built the large ocean-going passenger steamships and new steel warships for the United States Navy.
III. The Construction of Small Wooden Water Craft

The vast reaches of the Delaware marshes supported an historically diverse fishery. To harvest the bounty of that environment, Delaware watermen and boat builders developed a variety of regionally distinctive commercial and recreational small craft. But historic changes in the fishery and in the techniques and materials employed for the fabrication of small inshore boats have dramatically reduced the stock of Delaware's small boats. The following chapter offers a basic descriptive catalog of known inshore boat types and the fishery activities with which they were associated.

Small craft of any type typically served more than one fishery. Fishermen employed shad skiffs for taking sturgeon and for family outings; floating cabins provided temporary housing for both fisherman and hunters; hunting guides poled rail bird skiffs through the marsh in fall and used the same craft in other seasons to check trap lines and turtle fykes. The most flexible of all these boats, though, was the bateau. The ubiquitous bateau required only the most basic construction knowledge and could be built by watermen, farmers, and others possessing an elementary understanding of simple carpentry. Shad skiffs, on the other hand, demanded a far greater level of expertise. The swooping lines of the hull and delicate balance required to make the craft seaworthy on the open river and bay demanded considerable design and construction skill. While small craft required different levels of a shipwright's basic knowledge, most were constructed in small frame sheds or open yards. Only larger vessels, like the two-masted oyster schooners, might require the more complex organization of a shipyard with its shipwrights, blacksmiths, riggers, and sailmakers. Still, photographic evidence suggests that even a small schooner could be erected on temporary blocks in an open yard adjacent to a river landing.

The dearth of documentary evidence about boat shops and related activities tends to confirm the sense that building bateaux, shad skiffs, and other small craft required little capital investment and almost no infrastructure beyond certain skills. Watermen generally built their own bateaux and rail bird skiffs in backyard workshops, while more complex boat designs, for example shad and sturgeon skiffs and Jersey schooners, required the knowledge and craft of significantly more skilled boat builders. The lack of durable infrastructure for small craft construction is indicated by its conspicuous absence from the documentary record. The Kent County Mutual Insurance Company neither surveyed nor insured a single boat shop or related structure throughout its entire nineteenth-century history. The manuscript United States census for manufactures contains numerous references for ship yards but only one entry for a boat yard for the full span of the 1800s. In 1870 Thomas Dreire & Son of Wilmington identified themselves as "small boat builders." The firm supported two workers (likely the principles in the concern) and produced twenty-two boats that year. Their $500 investment in the business returned $2500 less $2100 for the annual payroll. The twenty-two boats required 5000 feet of lumber, four tons of iron, twenty-five pounds of copper, and ten of brass. Without waste, the average boat built by the Dreires used 227 feet of wood, 364 pounds of iron for construction and fittings, and slightly over a pound of copper and just under a half
Construction of Small Craft

pound of brass, most likely for marine nails.38

A glimpse of the material culture associated with nineteenth-century boat construction comes from two Wilmington ship carpenters' inventories in the 1820s. George Baker and Enoch Moore were two of only six individuals listed as ship carpenters or shipwrights in the 1814 city street directory. Enoch Moore, who operated a boat yard on Orange Street below Front and adjacent to the Christina River, contracted for larger coastal sailing vessels such as the sloop Norfolk of which he was quarter owner. His 1822 inventory records his property "at ship yard." Moore's list of shipyard fixtures reveal an enterprise that operated on an open lot which may have contained one or two small frame storage buildings and a "Float Stage" at water's edge. Moore's stock in trade included logs, plank, iron, tar, oakum, and unfinished boat parts like anchor shafts and masts. Moore's tools included numerous whip saws, pick poles, cant hooks, hand spikes, crow bars, and block and tackle, all for cutting, shaping, and moving timber. Pitch pots and ladles stood in the yard for heating the tar required to seal the wooden hulls. All the tools individually listed at Moore's estate sale bear out the impression that even the construction of larger vessels was entirely a hand craft enterprise. Moore's tools, such as squares, "patterns" or templates, mallets, axes, adzes, augers, compass saws, and mauls, are those associated with almost all aspects of nineteenth-century woodworking. In addition to his partnership in the Norfolk, Moore also owned a "Boat, Sail & Oars" and a "Batteau".

George Baker operated his boatyard at 35 East Water Street just up river from Enoch Moore. Like Moore, Baker required little in terms of durable buildings and structures. The lot where he worked appears to have been open with the exception of a frame workshop and floating stage. Similarly, Baker's tools, such as augurs, adzes, planes, caulking irons, crow bars, and work bench, represent the same level of handcraft seen in Moore's inventory. Rollers were employed for moving finished hulls into the river. Baker's inventory suggests that he not only built boats but used them in the Delaware fishery. His inventory lists two oyster boats which sold at his estate auction for $365 and $305--amounts that differ significantly from Moore's $15.25 "Boat, Sail, & Oars" and $1.25 "Batteau". Baker's ownership of "oyster teeth" (likely oyster dredges), old sails, and an "oyster sign" indicate he owned and operated early examples of so-called Jersey schooners, the dredge boats associated with the Delaware Bay and which developed into their regional form no later than 1850. Moreover, Baker appears to have marketed his own oysters and possibly ran an oyster house or cellar on his property. Oyster signs were a common fixture on Wilmington, Baltimore, and Philadelphia streets (Figure 3).

The estate records for Baker and Moore indicate several characteristics key to the evaluation of historic small craft construction. First, even in shipyards where vessels such as large multi-masted, ocean-going sloops were fabricated, there appears to have been little investment in buildings. Baker's frame

38 United States Census of Manufactures, Delaware manuscript returns, 1860-70.
Figure 3: Oyster signs on a street in Philadelphia.
Construction of Small Craft

workshop assessed for $50 represents a lightly built wooden building with little concern for more than basic durability. Storage sheds for old sails, tar, iron, and equipment were likely no more than hopefully watertight. Second, the infrastructure included ephemeral structures in the water. Floating stages, which may have been temporary docks tied to the shore, could be moved, hauled ashore, or scuttled. Finally, the bulk of the work occurred out-of-doors in an open shipyard continuing documented eighteenth-century practice. Watermen familiar with traditional small craft construction along the Delaware support these observations: lack of infrastructure (particularly in a task-specific sense), ephemeral structures, and open air work. Carl Morris of Port Penn, for example, built his bateau in the yard and an all-purpose shed behind his house. On occasion lack of foresight produced curious problems as in the case of a southern New Castle County waterman who constructed a shad skiff in his cellar. The finished craft unfortunately was too large to move through the cellar doors and the builder had to dismantle a section of his house to get the skiff to water.39 Watermen also recognize the varying skill levels required for different river and bay craft, a distinction also made in popular guides to small boat construction:

The building of a punt or flat bottomed skiff is comparatively easy and may be attempted by nearly every one, but to build a V or round bottomed boat successfully, the amateur must have some knowledge of form and construction, understand the use of tools, and be a fair workman. As nearly all the joints are the junction of curved surfaces and require to be strong and watertight, it is quite evident that more skill and nicety of fitting are required than for plain carpentry.40

Such a "back lot" process leaves us little to preserve in the way of historic resources with the exception of the small boats themselves. Thus, the purpose of this chapter is to outline and illustrate the construction characteristics of the known small craft used in and adjacent to Delaware's marshlands, describe their common functions and variations, and indicate known examples. Sadly, few examples of these craft are known to survive.

Small Craft of the Tidal Marshes

Bateaux. The bateau is the small work boat most closely associated with the coast of the Delaware River and Bay from the post-Revolutionary period to the present (Figure 4). The bateau is defined as a light boat generally associated with river use and described as long in proportion to its breadth and wider at its middle than at its ends. The regional usage of the word bateau designates a shallow draft craft that could be poled, rowed, or sailed, and has been current along Delaware's coast


Figure 4: Carl Morris fishing on the Delaware River in a bateau.
since at least the late eighteenth century. Numerous references to bateaux in Sussex County inventories are associated with fishing gear such as nets, gigs, and other implements used in shallow tidal waters. Historic photographs and a few surviving examples enable us to identify the basic characteristics of the bateau (Figure 5). Fourteen to eighteen feet in length and approximately five feet abeam at their widest point, bateau are very slightly concave or flat-bottomed, shallow-draft working craft. The typical bateau of the early twentieth century widened from a pointed bow to their full width at midship and then tapered slightly at their stern. Although more modern examples have been constructed from marine plywood, older boats are built of roughly one-inch sawn plank. The bottom, reinforced by a board keel, consists of boards running the width of the vessel and made water-tight with caulk, tar, or oakum (Figure 6). Ribs of roughly one by two inch scantling and a board strip strengthen the sides. The sides of the bateau may be constructed in either clinker (lapped) or carvel (butted) style. Oarlocks are placed in the gunwales midway down the length of the bateau and aligned with the center thwart. Although bateaux rowed by a single oarsman were most typical, local residents recall four-oar bateaux in use on the Broadkill River during the early to mid twentieth century. In more modern examples, the transom or stern boards may be notched for an outboard motor.

Although the term bateau possesses a somewhat generic quality it is clearly associated with boats exhibiting the characteristics listed above. Historic photographs from the Port Penn area show relatively little variation within the form even though individual craft may display distinguishing details in construction and fittings. The area of greatest variation appears to be related to the number of thwarts and the relative size of the bateau. Small versions, perhaps as short as thirteen feet, possessed only a single seat, while longer examples could contain two or three thwarts with one at the stern and a smaller one between the middle thwart and the bow. A bateau in the collection of the Port Penn museum provides an index to the basic features of a Delaware bateau. Fifteen feet in length and four feet wide, the carvel built boat possesses three oarlock positions that could be used either for two-man rowing or for positioning oars in response to different working situations. Slightly less than a foot in height, the Port Penn example is framed with eighteen ribs and a keel board. Carl Morris of Port Penn built and used two bateaux. Constructed of marine plywood with board keels, the mid twentieth-century craft had specific fishing functions. The larger, more seaworthy bateau extended seventeen feet in length, nearly five feet at its widest point, and less than two feet in height. Morris employed his big bateau for carp fishing and setting fykes in the tidal creeks of southern New Castle County. The smaller bateau (thirteen and a half feet long by three and a half feet wide and just over one foot in height) was used on the more sheltered and shallower waters of Thousand Acre marsh for hunting and trapping.

Delaware's bateaux represent a boat type found all along the eastern seaboard and known by

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Figure 5: Bateau with shad skiff and floating cabins, Port Penn vicinity, Delaware.
Figure 6: Bateau, Odessa vicinity, circa 1976. Note the construction details including carvel sides, board keel, and plank bottom.
various names in each locale. The bateau form associated with Ocracoke Island, North Carolina, for example, is known as a skiff and characterized by shallow gunwales, a fifteen to eighteen foot length and four to five foot beam, two thwarts or bench-like seats, and a pointed covered bow. The North Carolina examples possessed slightly rising bows. Like the Delaware bateau, the Carolina skiff was a small workboat suited to almost any individual activity ranging from mullett fishing to duck hunting. On the Eastern Shore of Virginia, the blunt-nosed Chincoteague scow served the same purpose. Watermen used these easily built wooden boats for tending crab pots, treading clams, working pound nets, hand tonging oysters, and recreational fishing. Delaware’s bateaux, like these other common regional work boats, was distinguished not by fluid lines or distinctive appearance, but by ease of construction, durability in use, and adaptability to a variety of tasks in the waterman’s year.

**Shad and Sturgeon Skiffs.** If the Delaware bateau was the most common small boat on the Delaware River, Bay, and adjacent marshes, the most distinctive was the shad skiff. Photographs and engravings indicate that this high-sterned fishing boat had reached its final form by the Civil War or earlier. Historic photographs provide a basis for describing the basic characteristics of the shad skiff. Averaging eighteen to twenty feet in length and five feet amidships, the typical Delaware shad skiff was an open boat with a covered bow. Regularly spaced steam-bent ribs attached to a slight timber keel formed the hull, which flared upwards from a pointed keel to a height of roughly two feet. Although evidence exists showing shad skiffs with both carvel or clinker built hulls, the norm clearly appears to have been the smooth-sided appearance of a carvel-built vessel. In addition to its graceful lines, the shad skiff possessed a distinctive heart-shaped stern board positioned slightly higher than the deepest point of the hull.

The shad skiff interior generally provided sufficient work space for a crew of two, their nets, and catch. Supporting rails clamped to the inner face of the ribs carried the bench-like thwarts. When in use for shad fishing, one crew member sat on the forward thwart facing the stern and rowed the skiff. The second crew member stood or sat in the stern and worked the nets. Two oarlock-like mounts located in the corners of the stern held metal lantern buoys for night fishing. As the fishermen set out their nets, they attached a lantern buoy to both ends in order to find their nets on the dark river. Oars provided the basic means for maneuvering the skiff while fishing, but many of the small boats were also outfitted with sails for traveling to and from the fishing grounds. Again, photographs suggest a standard arrangement where the skiff contained two slender masts. The forward mast was stepped in the bow, while the aft mast stood approximately two-thirds down the length of the boat. Each mast supported a nearly identical triangular sail hung on a thin boom and an upright sprit. To sail the skiff required a helmsman manning the rudder and mainsail and a crewman handling the centerboard and foresail.

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Although recollections of Delaware skiffs divide them into shad and sturgeon skiffs, the distinction seems to be based more on the fishery than boat design. In fact the same skiffs were used for both activities as well as other aspects of the seasonal fishery. Red Logan of southern New Castle County notes that the distinguishing characteristics between shad and sturgeon skiffs were minimal. The sturgeon skiff, Logan observed, may have tended to be narrower in stern. A circa 1930 photograph of the sturgeon docks at Caviar-Bayside in southern New Jersey shows approximately fourteen sturgeon skiffs at rest. Half the vessels are fitted with sails. Two additional late nineteenth-century photographs show one sturgeon skiff under sail and another at wharf side unloading a roughly ten-foot-long sturgeon. Again, the distinctions between these boats and those identified as shad skiffs are minimal.

**Gunning Skiffs.** Thomas Eakins’s paintings celebrating rail bird hunting on the Delaware River marshes depict one of the lightest, most graceful small craft associated with the river. The gunning skiff was a long, attenuated boat with a flat bottom and identically profiled pointed or blunt-nosed bow and stern. Perhaps three feet abeam at its widest point, rail bird skiffs were poled by means of a long progue. A guide standing in the stern pushed the skiff through the marsh while the hunter stood attentively in the bow waiting for rail to rise from their hiding places in the tall marsh grass. Gunning skiffs represent a work boat developed almost exclusively for the recreational hunting trade and a type of vessel where the crew did not fish, but served as guides. Although too lightly built and unseaworthy for use on the open river, the gunning skiff was also employed in the still waters of shallow marshes for checking trap lines and fykes in locations bateaux could not easily navigate. Gunning skiffs were generally poled through the marsh, sometimes paddled, but never sailed.

Eakins’s double-ended gunning skiffs represent the best of the form. In “Pushing for Rail” the skiff appears to be roughly ten feet in length, pointed at both stern and bow, and perhaps three feet amidships. The shallow draft craft was likely little more than nine inches high and clinker or lap sided over closely spaced bent ribs. Eakins’s depiction of the double-ended gunning skiff in several canvases suggest he was working from direct observation on the broad marshes south of Philadelphia. Surviving gunning skiffs, however, describe a class of light hunting boats of considerably plainer appearance and construction. Ten to fourteen feet in length and perhaps three feet across, the typical gunning skiff of both Delaware and southwest New Jersey was basically a long open box constructed of slightly bent boards forming the hull and horizontally placed planks for the skiff bottom. Cross pieces at bow and stern stiffened and reinforced the craft (Figure 7). A photograph of Bob Beck of Port Penn shows a gunning skiff on Thousand Acre Marsh. Bob Beck stands amidships in the small boat and uses a long pole to push the skiff over the shallow waters.

Delaware duckers relate to the family of gunning skiffs used in shallow water marshes. Although

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43 A progue is a long thin wooden pole used to propel certain types of flat-bottomed boats through shallow water.
Figure 7: Bob Beck in double-ended gunning skiff.
some examples may have been equipped for sailing, most seem to be extremely shallow craft less than a foot in height. An example in the Port Penn museum collection extends just over thirteen feet in length and is four feet wide. The lapped hull construction uses thirty-one ribs and a narrow board keel. Equipped with two sets of oarlocks, the ducker could be rowed or poled through the marsh. An early twentieth-century photograph of a Delaware ducker in use shows a shallow draft, streamlined craft with room for decoys, hunters, and equipment (Figure 8).

Sneak Boxes and Small Hunting Boats. Dr. William Bruette offers the most succinct characterization of a sneak box, "a type of craft representing the highest form of hunting boat." Most closely associated with the New Jersey coast and the Barnegat Bay region, the sneak box and its many local derivatives gained popularity among sporting hunters gunning for wildfowl in Delaware’s dense marshlands. Bruette describes the sneak box as a small inland craft that could be sailed, rowed, poled, or powered by outboard. In his introduction to building one of these small boats, Bruette wrote:

The sneak box is 12 feet long and 4 feet wide. It is round bottomed and round decked, the bottom being laid over steam bent frames, all of which are bent to the same radius, 4 feet. The deck beams are sawn to shape from the boards and have slightly less bow to them than frames.

Designed for one person, his decoys, and other hunting paraphernalia, the sneak box was light weight and durable. As Bruette noted:

From the standpoint of naval architecture it is far ahead of most types and it is a fine sea boat capable of riding out heavy blows with the "crew" protected by a canvas spray hood. In addition, there is a center-board for those who desire to sail and mighty sporting sailing these little boats make. The sneak box is well adapted for use with an ordinary sprit-sail, one of the simplest rigs and one which is highly successful. The small hatchway amidships is covered with a wooden hatch that may be locked in place if the hunter wishes to leave his duffle aboard for a day or so. The interior of these boats is snug and warm and many a man has used them for a night's lodging.

The desire to build small, lightweight, durable craft produced other Delaware hunting boats many of which incorporated one or more elements of sneak box design. The Delaware ducker, mentioned above, was a cross between gunning skiff and sneak box. Longer (up to sixteen feet) with an open interior and room for two passengers, the Delaware ducker and its cousin the Jersey melonseed possessed the same flattened round hull profile of the sneak box and used very similar rib and plank construction. Like both the gunning skiff and the sneak box, the Delaware ducker could be poled or paddled in extremely narrow and shallow tidal ditches where the hunter could conceal himself with marsh grass and wait for the propitious moment to sit up and shoot passing ducks and geese.

44 Dr. William Bruette, American Duck, Goose, and Brant Shooting (New York: G. Howard Watt, 1929). The following observations come from Bruette’s chapter, "The Barnegat Bay Boat," p. 70-77.
Figure 8: Stereopticon view of a Delaware ducker.
**Floating Cabins.** Natalie Peters' work on the floating cabins of the Delaware remains the single best and most comprehensive work on this distinctive river and bay craft. Peters describes the floating cabin in thorough detail.

Fishing cabins, also known as "floating cabins," "cabin scows," "fisherman's houses," "house boats," "shad boat-houses," and "river cabins," were a part of the equipment used in commercial fishing. A floating cabin was a one or two-room waterman's house built on a shallow-draught hull. At one time, many were anchored in the marshes and tidal meadows of the Delaware estuary wetlands. A basic one-room plan (with a single two-room example) is shared by all of the examples still standing today; oral history confirms the frequency of a two-room plan type as well. The convention for either type is rectangular in shape, usually with a door or window at each end. Typically the front is more finished; one surviving cabin exhibits a small landing for easier entrance and exit only at the front of the cabin. The windows are approximately two feet square and slide horizontally in a side sash. This feature is particularly helpful in identifying possible surviving buildings when other, more definitive, characteristics have disappeared.

Floating cabins were used as temporary residences for the shad fishermen throughout the fishing season in the creeks of the Delaware estuary until the early 1920s. Unlike typical houseboats, floating cabins have no engine or other means of self-propulsion. Located on all four corners of the scow-like hull of the floating cabins are metal rings approximately three inches in diameter. When it was necessary to move the cabin from one location to another, a rope was drawn through the front two rings and affixed to the back of a craft that would then tow the cabin to its new location. The rings were also used to stake the cabins in place during the fishing season. Since the Delaware River had a six-foot tide, it was necessary for the cabins to be moored in such a way that they could rise and fall easily with the water. This was accomplished by driving long poles into the river bottom through either the rings themselves or rope loops attached to the rings, allowing easier movement with the tide.

Floating cabins were placed seasonally on the creeks of the Delaware estuary by the local fishermen who sought to maximize the efficiency of the low-powered or man-powered fishing skiffs they employed in their trade. From this location it was possible to net shad and other ocean-dwelling fish as they returned to their natural freshwater streams to spawn. Until the early 1920s, when lowered fish runs due to pollution and overfishing in the estuary drove most of the local fishermen out of business, the continued survival of the fishery depended on the waterman's ability to spend every possible moment on the river during the limited fishing period. The floating cabins enabled the men to avoid time-consuming twice-daily trips from their homes to the fishing grounds.

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46 Material for this section is excerpted from *Floating Cabins on the Delaware River* by Natalie Peters.
Modest in appearance and size, the cabins rarely evidenced any superfluous decorative trim or adornment. Equipped with two, or sometimes four, bunks and a wood or oil stove, the cabins housed two to four men and provided a place for the men to rest, cook, and eat after a hard day on the river. Cabins were staked in groups at the mouths of the creeks that feed the Delaware estuary, sometimes as many as a hundred or more in each creek, creating “floating communities.” The close proximity of the cabins gave the men added security during inclement weather and difficult times.

A cabin was generally owned by one fisherman who employed one or more other men—depending on the size of his cabin—who would reside with the owner in the cabin during the fishing season. When the fishing season ended, the watermen would continue to work together to make a living from the wetlands by hunting water fowl and trapping muskrats and other marsh game, often using their floating cabins as a base of operations.

Coastal and Deep Water Craft

Oyster Schooners. Anne Witty’s 1984 study of the oyster schooners of the Delaware Bay remains the best authority describing the history and characteristics of this once common, sail-driven work boat.47 The Jersey schooner as a Delaware River and Bay workboat was developed by the 1840s as seen in the schooner Cashier built in 1849. The inventory and sale of George Baker’s “oyster boats” and dredging equipment in the early 1820s suggests that the oyster schooner had assumed its basic character a generation or more earlier. Witty divides the types of the Jersey schooner into two major phases followed by a modern period of major remodeling. The first type, old style schooners, date back to the early 1800s; the second phase represented by the new style schooner began in the early 1920s and ran through the 1930s. The period of remodeling reflected in the conversion of the fleet from sail to diesel engine followed World War II. Today, very little of the fleet survives in Delaware. The fate of Delaware’s schooner fleet is illustrated by the Katherine M. Lee. Built in 1912 as an old-style schooner, demasted and retrofitted with a diesel engine in the mid-twentieth century, listed on the National Register of Historic Places in 1983, the Katherine M. Lee was run aground and scuttled around 1990. The following summaries of the types and periods of the oyster schooners of the Delaware are taken from Witty’s longer study.

Old Style Schooners

The “old style” dredgeboats—those built before World War I—were clipper-bowed with a long bowsprit capable of carrying one large or two smaller jibs or headsails. They also carried a main topmast and topsail; while generally only one topsail was “flown,” there

were a few Delaware Bay boats that carried both fore and main topsails. With their long (and treacherous) bowsprits, the old-style schooners sported longheads with carved and painted trailboards. Overall, these schooners averaged between 60 and 70 feet in length.48

New Style Schooners

The 1920s heralded the arrival of several innovations in the design of the Jersey schooners. The hull shapes were changed: the transoms were made smaller, more raking, and were lifted well out of the water, while the bows were changed from the clipper-like, hollow old-style bow to the “spoon bow,” a curving stem shape... The spoon bow enabled a shorter spiked bowsprit to be rigged, eliminating some of the length that was so hazardous to seamen setting sails along the bowsprit. This spike bowsprit and curved stem shape also eliminated the longhead, with its trailboards and decorations, prompting the use of nameboards mounted directly on the schooner's hull at the bows. The sail rig of the new-style schooners also did without the topsail(s), which required additional manpower to handle and could be awkward in case of a sudden blow. The large sails, fore and main, were increased in size by extending the length of the masts and by increasing the angle of the gaff, particularly on the mainsail, so that a greater area of sail could be stretched in what was known as a “gloriana” peak.49

The advent of the new style schooners influenced the remodeling of many working old style models. The desire for increased speed and maneuverability over the Delaware oyster bars reflected the highly competitive commercial aspect of the fishery. The third big change in the design of the Jersey schooner arrived with the introduction of powerful inboard engines after 1945 and as a response to the diminished availability of hands to man the schooners. No longer dependent on wind and sail to dredge the oyster rocks, the fleet embraced the diesel marine engine. Witty summarizes the changes made to the old schooners.

Masts were cut down or taken out; some boats retained the stump of a foremast, or even both masts, and some have continued to use these as loading booms or even to suspend dredges. The bowsprit, along with the longhead and trailboards if these were still retained on an old style boat, were removed, the sails stowed away ashore, large engines installed, and permanent pilothouses built. These changes, which completely altered the appearance and ways of working the oyster fleet, came about as material responses to legislation designed to ease the effects of the manpower shortage and to the opportunities afforded by marine engineering.50

The effects of the post World War II remodeling of the Jersey schooner continue to characterize the

48 Witty, p 80-81

49 Witty, p 82

50 Witty, p 81
remnants of the fleet. All three of the Jersey schooners in Delaware listed on the National Register of Historic Places reflected post-1945 alterations.

**Motor-Driven Work Boats.** Traditional small craft continued in use well into the twentieth century, but by the 1910s new innovations in powering vessels allowed for the steady replacement of hand and sail powered craft. The advent of diesel and gasoline engines in the early twentieth century provided a source of power that permitted larger, faster, and more maneuverable boats that could be operated by a single person. These work boats soon dominated the coastal waters of the Delaware estuary and became the mainstay of the local waterman.

Overall size and general appearance characterized the coastal work boat. Usually grossing under twenty tons, the engine-powered work boat measured between eighteen and thirty-five feet and displayed a long, low profile (Figure 9). A small cabin sat forward of the work deck and afforded the boat's operator limited shelter from the elements. Larger vessels, those intended for work outside of sheltered coastal waters, held small cabins with accommodations for one or two people. The broad deck of the vessel contained shallow bulwarks which allowed the waterman to handle tongs, nets, or pots. The sweep of the hull varied from a shallow V-bottom to a deep-hulled “dead rise” design. These differences afforded handling and stability characteristics to the vessel that best suited the water conditions in which it operated. Flat hull designs provided greater stability but proved less seaworthy in heavy water. Dead rise hulls could withstand the beating of heavy surf and allowed watermen to venture outside sheltered coastal waters, but pitched and rolled making the tending of nets or tongs difficult if not dangerous. The selection of a specific design and configuration of the vessel became a matter of personal choice.

The details of the construction sequence of a work boat followed the same procedure as for larger wooden vessels. This is explained in the following chapter and will not be addressed here. The key difference between the erection of wooden vessels in excess of twenty tons and smaller work boats is in the scale of the operation. While the builders of schooners needed large yards, specialized machinery, and scores of laborers, the boat builder needed only a modest collection of hand tools and an open space in which to work. The boat builder obtained his raw materials from local sawmills and probably purchased fittings and fasteners from suppliers in Wilmington or Philadelphia. He required no permanent buildings. Many waterman constructed their own work boats relying on traditional vessel forms and the skills handed down from previous generations. Few established boat yards existed in Delaware, and the few that operated left few traces on the landscape.

Commercial boat builders in Delaware operated out of a variety of boat yards. The Seaford Boat Works maintained a small shop and yard near the banks of the Nanticoke River (Figure 10). Constructing small craft in the late 1920s and 1930s, Seaford Boat Works utilized a two-story planing mill to prepare lumber and a small blacksmith shop for the manufacture of fittings (Figure 11). The “Boat Shop” served as an enclosed work area for the construction of vessels, and an undated photograph of the shop illustrates
Figure 9: Several types of work boat are visible in this 1922 photograph of Bowers Beach. The Thompson Boat Works stood in South Bowers (to the right) while Tribbitt's yard once stood in North Bowers.
Figure 10: Aerial photograph, circa 1925, shows the Seaford Boat Works on the Nanticoke River. The planing mill is the large structure in the center of the photograph.
Figure 11: Sanborn Fire Insurance Company Map of the Seaford Boat Works, 1931.
the type of vessels Seaford built (Figure 12). Small, lightly framed vessels made-up the primary product of the yard. The vessel shown may be a small sail boat or ship's launch, but craft such as life boats and lighters comprised a significant portion of the output of Delaware's boat yards.\(^5\)

Many characteristics of boat yards are discernable from these views of the Seaford Boat Works. The planing mill stood as a frame, two-story structure configured as an ell with protruding loading docks. This structure probably served multiple functions--planing mill, lumber storage, warehousing, and possibly even office space. The blacksmith shop, also a frame building, housed the forge and accompanying equipment needed in the fabrication of metal components. The large, open space of the boat shop, almost two full stories in height, afforded ample space for boat construction while side walls pierced by numerous windows provided sufficient light for work of all types. Large doors on both ends of the shop allowed access for both vessels and materials. One item noticeably absent from the Seaford yard is a marine railway or other form of ways. The launching of completed vessels must have proven difficult--carefully moved to the water's edge on rollers or skids--rather than sliding down a permanent system of stocks.

The Seaford Boat Works existed as one of the state's major boat yards, at least in terms of physical plant. Yet smaller, more ephemeral yards constructed numerous vessels without the benefit of substantial buildings or specialized shops. Howard B. Thompson built work boats along the south banks of the Murderkill River. Operating in the late 1930s and early 1940s, Thompson's yard epitomizes the family-run boat yards that existed throughout much of Delaware. Working alone, or with the aid of his son or single employee, Thompson built an average of two vessels a year and performed maintenance work on many others.\(^5\)

His boat yard consisted of a single building, a one story workshop measuring approximately fifteen feet square, and a marine railway and transfer table. The shop could easily be mistaken for a modern garage. Small and gable-roofed, the building contained full-length sliding doors on each gable end (Figure 13). Interior examination shows that workbenches, storage shelves, and tool racks lined both walls of the building. The marine railway and transfer table were the most characteristic artifacts of Thompson's yard (Figure 14). A single track--made of light, steel rails on rough cut oak ties--entered the waters of the Murderkill through a gently sloping cut in the river's bank. Wooden bulkheads reinforced the sides of the cut and extended slightly into the river creating a small breakwater. The track then crossed the narrow access road of South Bowers Beach and terminated at a transfer table (Figure 15). A transfer table is a

\(^{51}\) A lighter is a small craft, either sail powered or rowed, used in loading or unloading larger vessels. The term lighter is occasionally associated with light barges towed behind sailing vessels. *United States Census of Manufactures*, 1930

\(^{52}\) Personal communication with Captain "Purn" Potter, South Bowers Beach, Delaware, 15 April 1994.
Figure 12: Interior photograph of boat shop at the Seaford Boat Works. Source: Delaware State Archives, Dover, Delaware.
Figure 13: This small frame building served as the work shop of the Thompson Boat Works in South Bowers.
Figure 14: Marine railway at the Thompson Boat Works.
Figure 15: This transfer table allowed vessels to be moved from the main track exiting the river to one of four service tracks.
moveable section of track that allowed for the movement of vessels between the river access and a series of short, unconnected sections of track. Four wheeled dollies placed under a vessel's hull allowed it to be moved along the river track and onto the transfer table (Figure 16). The table then rolled along a second set of rails, placed at right angles to the main track, until it aligned with one of the individual work tracks. The vessel then rolled onto this track. Thompson’s yard contained four work tracks indicating that up to five vessels (one on each work track and one on the track at the river’s edge) could receive attention at a time. While the marine railway implies that Thompson performed repair work as well as building new vessels, a boat yard at nearby North Bowers Beach concentrated only on new construction.

Among the most productive of Delaware’s ship and boat yards was that of Gilbert F. Tribbitt. Tribbitt worked continuously between 1925 and 1940 registering eighty-seven vessels in Wilmington during this period. In 1927 alone, Tribbitt built fifteen vessels at his North Bowers yard. The second highest year of production, 1936, saw Tribbitt raising thirteen vessels at his own yard, and the construction of a single vessel at a yard in Little Creek. Gasoline-powered screw vessels of thirty-five feet in length and grossing about ten tons characterize the types of work boat Tribbitt concentrated on. While this boat yard stands as one of the most productive in Delaware, in terms of number of vessels, we know little about its physical configuration. It stood in what is now wetland about thirty feet from the water's edge, and directly opposite the yard of Howard Thompson. Tribbitt and his son, occasionally joined by one or two hired carpenters, performed all functions of the yard including the fabrication of small, metal fittings with a home-made forge.53

The variety of sites used in the construction of boats, both traditional craft and the work boat of the twentieth century, ranged from the yard of the waterman to fully developed industrial sites on the banks of a major river. Despite the variety of boat yards and boat building facilities, the construction of small water craft represents an historic link between inland industrial endeavors such as boat building, sawmills, or suppliers of ship hardware and the harvesting of natural resources from the marshes and coastal waters of the Delaware estuary. The boat building industry and traditional water-based activities existed in a symbiotic relationship. The demise of the coastal fisheries and wildlife of the marshes meant the decline of the boat building industry in Delaware. For those waterman resilient to market fluctuations, mass-produced fiberglass hulls replaced the hand-made wooden dead rise and stamped aluminum flat-bottoms replaced the gunning skiff and bateaux. The boat building industry moved to major industrial centers where both raw materials and consumers were readily available. The disappearance of Delaware’s boat building industry is not only an indication of the changing focus of Delaware’s industrial landscape, but a reflection of changing attitudes in the last half of the twentieth century. When describing boat building activities around Bowers Beach, Captain “Purn” Potter pointed across the Murderkill towards the location

53 Personal communication with Captain “Purn” Potter, South Bowers Beach, Delaware, 15 April 1994.
Figure 16: Four-wheeled dolly placed under ships' hulls to remove them from the water.
Construction of Small Craft

of Gilbert Tribbitt’s boat yard: “His [Tribbitt’s] yard sat right over there in that marsh... I guess we call ‘em wetlands now.”

Boat Yards as Property Types

Property types associated with boat building are as diverse as the boat building industry itself. The boat yard stands as a group of resources gathered together to perform a specific function, such as the Seaford Boat Works, or as an undefined site such as the yard and workshop of the builder of traditional marsh craft. Assemblages of structures may in fact constitute a boat yard; however, a vacant lot also represents the same activity. Boat yards must be considered in all their variants. Because few of the boat yards in the state remain intact, the resources defined in the boat yard property type will be difficult to locate, survey, and evaluate. The boat yard as a functional property type serves as the model for evaluating the significance of standing resources, and for predicting what archaeological resources might be present on sites completely cleared of any standing resources.

Given the diversity of boat-building activities, and the low survival rate of boatbuilding-related resources, it is important to identify individual property types that may contribute to our understanding of the boat building industry. In some cases, the linkage between the standing resource and boat building as a craft or industrial endeavor exists only in the documentary record. Oral histories, inventories, or tax lists may show that a site, yard, or building once served as the location of boat building activities. The resource itself may possess no definable characteristics that specifies its use for the construction of water craft.

Yards and outdoor work areas. Due to the ephemeral nature of boat building, especially that associated with traditional water craft, the list of property types for boat building must contain the open yards and river banks where many vessels took shape. Both traditional small boats, and their larger counterparts of the twentieth century, rose where it proved most convenient in terms of the acquisition of raw materials and in the final launching of the vessel. Archaeological evidence may specify the location of ephemeral boat building activities, but it is through oral history and the recollections of local residents that these locations are most likely to be found.

Workshops. As defined by this context, a workshop is any building associated with the construction of wooden boats. Workshops existed as enclosed buildings, lean-tos, or open sheds. The workshop becomes a functional property type through either direct evidence relating it to a boat building establishment, such as the existence of a building clearly shown on insurance maps or census enumerations as being part of a boat yard, or by indirect methods such as oral histories or other

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54 Personal communication with Captain “Purn” Potter, South Bowers Beach, Delaware, 15 April 1994.
documentary sources.

**Boat shops.** The boat shop of the Seaford Boat Works illustrates the large buildings occasionally used to shelter boatbuilding activities. The only known example of a boat shop used wood frame construction with heavy timber trusses to support the roof structure (Figure 17). Few yards used electric lights, possibly due to fire risks, and the boat shop, like all boat yard buildings, contains numerous windows to allow for work under natural light. One of the gable ends of the shop was constructed to allow a wide opening that the finished product could be moved through. The building’s high ceilings accommodated the use of internal scaffolding that was tied into the side walls.

**Marine railways.** The marine railway allowed a wheeled dolly to be placed under the hull of a vessel in order to pull the vessel from the water using a railroad-like track system. Marine railways differed from timber ways in that a way only served to launch a vessel and could not be used to remove a ship from the water. Boat yards that performed maintenance and repair work on vessels used marine railways, and their presence indicates a dual purpose for the yard: both new construction and repair.

**Saw and planing mills.** The boat yard saw and planing mill varied little in outward appearance from similar mills that produced lumber for purposes other than water craft construction. Photographic evidence depicts the planing mill of the Seaford Boat Works, as a large frame structure. To be eligible as an integral part of the wooden boat building process, saw and planing mills must contain the machinery used in the shaping of boat’s timbers or sufficient documentary and structural evidence must be present to allow a theoretical reconstruction of the machinery. Documentary research provides the most basic information regarding the machinery in use at a boat yard, but physical evidence such as foundations or the mounting brackets of power transmission devices must be present to accurately define the type, approximate size, and specific location of each piece of equipment. The documentary record fails to provide any information on the methods used to prepare lumber in many cases, and only the existence of artifactual evidence clarifies this aspect of boat construction.

**Offices.** Office buildings may have existed in some of the larger boat yards, but it is unlikely that small operations such as Tribbitt’s Bowers yard found it necessary to invest in separate structures to house clerical tasks. No distinctive architectural form distinguishes a boat yard office from any other. Located near the entrance to the yard, this building probably served both clerical and technical functions, including payroll office, drafting room, and master carpenter’s office.

**Boiler houses/power houses/compressor sheds.** These buildings contained the boilers, engines, generators, and air compressors used to power the boat yard machinery. Documentary evidence suggests that only the most substantial operations, primarily those that operated saw or planing mills, utilized heavy machinery for the production of water craft. The size and configuration of the structure varied with the size, production capacity, and type of boat a yard constructed. These buildings contained all the equipment necessary for the generation of mechanical, electrical, or pneumatic power as well as the
Figure 17: Although modified slightly, the roof framing and loftiness of this structure identify it as the boat shop of the Seaford Boat Works shown in Figure 12.
equipment used to operate the boilers such as draft fans and water pumps. Boiler/power/compressor structures occurred as both separate buildings with steam or air lines connecting them to the mill or ways, or as an ell or shed attached to the mill itself.

**Blacksmith shops.** The need for iron and brass fittings often proved substantial enough to require the construction of a separate shop for the forging and casting or metal parts. The smith’s shop may appear as a small, one-story frame structure or as a shed or lean-to attached to a workshop or other building (Figure 18). As with all other resources associated with the ship and boat building context, blacksmith shops must be clearly associated, either through documentary or physical evidence, to boat building activities.

**Sheds and storage buildings.** A boat yard frequently contained numerous sheds and outbuildings. Some known uses include paint and varnish storage, fittings warehouses, and lumber storage. Like most boat yard resources, shape and construction varied from yard to yard.

**Evaluation Criteria Related to Wooden Boat Yards**

**Evaluation of resources.** The issue of integrity for resources related to the boatbuilding industry is problematic. The construction of boats, either traditional small craft or more substantial powered vessels, did not require a specific type of building. In fact, boatbuilding did not require a building at all. Many small craft took shape on a pair of saw-horses in the back yard of the individual who planned on using it. A nearby shed served as warehouse, tool shed, and workshop for the “boatbuilder,” a term loosely assigned to the waterman who also trapped, fished, and hunted the marshes for his livelihood. Building small craft was typically an effort carried out by the individual waterman in consort with friends or neighbors familiar with the craft; some buying, selling, and trading of boats was carried on in the community. These small craft were usually built in a shed, barn, or yard. The art of building small craft was often passed through the family from father to son. Craftsmen maintained different styles of workmanship. Waterman and boat-builder Bob Beck reports that his father could look at a boat and recognize the craftsman based on the distinctive style of the boat.

While building a bateaux, gunning skiff, or powered launch represented one form of boatbuilding, the firm engaged in the erection of small craft for the commercial market stood as another form. These manufacturing establishments frequently operated out of buildings designed for the specific purpose of erecting small craft, and utilized a variety of mechanical equipment such as planing mills and transfer tables. Physical resources from this type of boat yard may exist on the landscape yet offer few clues as to their original function and association with the boatbuilding industry.

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Figure 18: This small forge is characteristic of the equipment used by many Delaware boat yards.
Paramount to a discussion concerning the evaluation of boatbuilding resources is the concept of process. The construction of small, wooden water craft is a manufacturing process that transforms raw materials, in this case wood, through mechanical action into a different form or configuration. The boat itself is the end product of this process. This low technology manufacturing process does not require significant capital investment, unlike many transformative processes, nor does it require vast quantities of specialized equipment. Evidence suggests that small craft, and even more substantial schooners and sloops, rose on local river banks using nothing more than saw horses and wooden props to assist the boat builder. The actual process of building the vessel did not require a building or any other form of durable construction. In many cases, no physical resources existed, and the likelihood of discovering identifiable archaeological evidence is minuscule. Other alternatives must be sought to allow for the identification and assessment of boatbuilding related resources.

The first step in evaluating resources used in the erection of wooden boats is to establish a documentary link between primary sources and the building, structure, site, or object under consideration. As applied to the construction of traditional water craft, this evidence appears as inventories listing tools normally associated with boat construction, oral histories that place boatbuilding in a specific locale, or the presence of a particular boat type traditionally built by individual watermen for their personal use. Ascertaining the existence of a particular boat links the resource with the boatbuilding process. Sheds or outdoor work areas then become an integral part of the process and merit consideration as an eligible resource.

Yet, this raises several questions concerning the evaluation of what can best be termed an ephemeral resource. The shed may have served multiple purposes, housing other activities at different periods of time. The backlot boat yard expresses no distinctive characteristics that differentiate it from any other outdoor area. The specific location of boatbuilding within this area may be impossible to determine. Assessing these resources requires that the integrity of practice, use, and purpose supersede the presence of physical integrity. Unfortunately, eligibility criteria established by the National Register of Historic Places prevents the nomination of resources lacking physical integrity. Resources connected with the construction of traditional water craft or small, motor-powered vessels, although ineligible as individual entities, may serve as contributing elements of a larger landscape. An estuarine landscape, incorporating numerous activities such as fishing or trapping, also supported boat yards of varying size. While the location of a specific process area proves as difficult to ascertain as a fishing ground, and just as mobile, the presence of this activity supports the broad concept of water-related landscapes. At the same time, integrity issues dealing with location must clearly identify the range of associated places through what we might consider landscape relations--the idea that integrity of location is defined not just by the physical characteristics of a place, but also by the spatial relationships and movement between associated locations.
Commercial boat yards offer a slightly more concrete approach. Using permanent facilities, commercial yards produced vessels regularly and over an extended period of time. Buildings housed and supported the various activities that comprised the boatbuilding process. For a boat yard to retain sufficient integrity to merit listing on the National Register of Historic Places, it must be representative of the manufacturing process. The shed-like building where the vessel took shape does not constitute a yard. It is merely one element of the process.

As with traditional water craft, the first step in assessing the integrity of resources applicable to this context, is the identification of all buildings, structures, objects, and material goods present at the boat yard during the period of significance—its contextual landscape. Only through comprehensive documentary research, augmented by oral histories or site inspections, is a complete reconstruction of boat yard activities possible. Documentary research provides the listing of individual components that comprised the boat yard landscape and serves as the basis for evaluating its eligibility for inclusion on the National Register of Historic Places.

Once the documentary research is complete, surviving physical resources of the boat yard must be evaluated, but it is imprudent to apply the same evaluation methods used for individual buildings to those resources associated with the construction of boats. To properly assess the integrity of these resources it is necessary to evaluate the three components of the yard—its machinery, its buildings, and its documented landscape. To be considered eligible for the National Register under this context, a resource must contain two of the three components of a boat yard. While it is not expected that a site will contain all elements of the manufacturing process, sufficient material integrity should remain to establish the process and place the boat yard within its cultural and ecological context. Machinery applies to the mechanical devices used in the preparation of raw materials, vertical or horizontal movement of materials, or the method by which vessels moved into or out of the water. Buildings are those structures that sheltered the activity of boatbuilding such as saw and planing mills, smith’s shops, or carpenters’ shops. The original use of a building may or may not include machinery. A saw mill, for example, must contain its original equipment or provide sufficient evidence to completely reconstruct the type and configuration of its machinery. Additionally, buildings should maintain sufficient material integrity to establish a physical linkage to the boat yard as described above. To be eligible for the National Register under this context, a boat yard landscape must retain a majority of those resources identified through documentary research as existing in the period of significance. If sufficient numbers of buildings have been destroyed, or the architectural integrity of surviving resources is compromised, the boat yard as a whole is ineligible.

Evaluation of archaeological resources. Many boat yard activities, in fact many complete yards, did not require permanent buildings. Preparing timber took place on open ground, and scaffolding amounted to nothing more than sawhorses or simple frames. Evidence of these activities and structures exist only as underground, archaeological resources. As a result, it is important to include archaeological
resources as one element of the evaluation process. As with standing buildings, the location of potential archaeological sites is driven by documentary research. Maps, plats, photographs, and insurance descriptions frequently detail the sites of both specific activities within a larger yard and the overall configuration of a smaller facility.

The importance of sub-surface resources is reinforced by the low survival rate of complexes. The existence of archaeological evidence can contribute to the integrity of the boat yard as a whole. As stated above, to be eligible for the National Register, a boat yard must contain sufficient material evidence to reconstruct the manufacturing process that once took place. Many activities can only be identified through archaeological excavations. The yard area that once served for the final trimming and fitting of lumber, offers material evidence in the form of tool fragments, nails or spikes, post holes that indicate the location of bracing or cranes, and soil stains or chemical distributions marking heavy concentrations of waste wood or shavings. Bulkheads or wooden structural systems supporting marine railways, due to their moist location and frequent subjection to fluctuations in water level, quickly rot leaving little testimony to their existence, but are frequently preserved intact below low water mark. Machinery foundations or parts of power equipment often provide conclusive evidence as to the type or size of large, stationary machines.

It is not the purpose of this context to define archaeological integrity, only to mention the importance of underground evidence in the evaluation of a boat yard as an historic resource. Findings of this type can be combined with the existence of eligible, standing resources to improve the integrity of the yard as a whole, or serve as the basis for the nomination of a site. The overall integrity standards of the yard as an historic resource cannot be compromised. To be eligible it must contain sufficient evidence of machinery, buildings, and landscape to reconstruct all aspects of the manufacturing process, but this can exist as both standing buildings, structures, or objects and as archaeological evidence.
IV. The Wooden Shipbuilding Industry

This chapter focuses on the large (over roughly twenty-five tons) wooden ships built in ship yards throughout the state of Delaware, establishing the context in which the industry developed, and identifying the property types related to wooden ship yards. Located throughout the state, these yards constructed a variety of different ships for both the domestic and international markets.

For the greater part of recorded history, the wooden ship proved the primary means of navigating the seas. Schooners, barks, brigantines, square-rigged clippers, and coastal sloops carried passengers, exotic spices and teas, and even more mundane cargo such as logs and coal. The economic and military well-being of nations depended on the fleet of wooden ships sailing under that country’s flag. The wooden ship evolved from a general design that served multiple functions to specialized ships that carried a single cargo, sailed only in coastal or inland waters, or served as support vessels.

This chapter does not intend to detail the evolutionary processes that shaped the wooden ship, nor does it intend to describe every type of wooden vessel that ever sailed. In fact, describing every type of vessel constructed even in a limited area such as Delaware would take numerous volumes. The state's shipbuilders constructed schooners, barges, tankers, ferries, work boats, pleasure craft, and even floating bath houses (Figures 19-26). But it is important to understand the shipbuilding process to fully understand the ship yards that constructed the graceful sailing ships once commonplace along the Atlantic coast. Thus, this chapter will describe the basic process of constructing a wooden ship and the specific historic resources associated with the ship yard.

Technology of Wooden Shipbuilding

It is impossible to discuss shipbuilding in general terms. Local traditions and improvements in marine engineering make it difficult to compare vessels constructed at the same time in different locales. Construction of vessels in a Sussex County ship yard might reflect a building style unchanged over centuries of use. A yard a few miles away, or even a few blocks, might be constructing state-of-the-art steel vessels incorporating the latest innovations of nautical science.

Reducing the state’s wooden shipbuilding industry to its simplest terms, Delaware ship yards raised ships premised on two basic construction techniques: the skeletal frame, and the V-bottom frame most closely associated with the skipjack. The skeletal frame represented the largest category of ships. Everything from the smallest sloop to the largest schooner relied on this construction method. This method of construction also found application in the construction of barges and wooden vessels powered by steam rather than wind. Widely distributed throughout the state, ship yards that constructed ships by this method include Enoch Moore and the Jackson & Sharp Company of Wilmington, Nathaniel Lank and Thomas Lacey of Frederica, and William G. Abbott of Milford. The distribution of ship yards building V-
Figure 19: Schooner constructed by the Wilmington firm of Jackson & Sharp. Source: Delaware State Archives, Dover.
Figure 20: Wooden tanker constructed by the Wilmington firm of Jackson & Sharp. Source: Delaware State Archives, Dover.
Figure 21: The schooner Jesse W. Starr constructed by Milford’s Littleton H. Sammons, 1874. Source: Macdonald, Mispillon-Built Sailing Vessels, 220.
Figure 22: Barge constructed by the Wilmington firm of Jackson & Sharp. Source: Delaware State Archives, Dover.
Figure 23: Harlan & Hollingsworth constructed this ferry, *Sandy Hook* for the Central Railroad of New Jersey *circa* 1880. Source: Historic American Engineering Record, Charles Foote, photographer.
Figure 24: Unfinished workboat hull at the site of Howard B. Thompson's boat yard, South Bowers.
Figure 25: The American Car & Foundry Company constructed this yacht for the E.I. duPont Company in 1921. Source: Delaware State Archives, Dover.
Figure 26: This draft for a floating bath house for the Wilmington Free Bath Association illustrates the variety of watercraft produced by Delaware ship yards. Source: Delaware State Archives, Dover.
bottom hulls is not precisely known, but appears to be concentrated along the rivers that drain into the Chesapeake Bay, primarily the Nanticoke River near Seaford, and Broad Creek where it runs through Bethel. The most prolific builders in these towns were the firms of Smith & Terry of Bethel and Charles Marvel of Seaford.

The Skeletal Frame

The skeletal frame uses heavy timber frames attached to a stout keel. Hull planking is then attached to the frames, giving the ship its distinctive sweeping lines. The preliminary steps in erecting a ship of this type, or any type for that matter, are the drafting of a plan and the selection of timber. Major ship yards worked almost exclusively from detailed plans. The most sophisticated merchant sailing ship and the simplest barge were carefully laid out on paper before any work commenced (Figure 27). A contrary situation took place in smaller yards. Small ship yards worked under the direct supervision of a master carpenter or shipwright, rarely using formal plans or designs. Every aspect of the work from the shaping of frames to the stepping of the mast received the master shipwright’s undivided attention. Since large yards delegated work to seemingly independent crews of craftsman and could not benefit from the attentive eye of the shipwright, detailed drawings assured the successful launching of the vessel.

The selection of the proper timber proved as vital as the proper implementation of the ship’s plans. The material of choice for the construction of ocean-going sailing ships was white oak. Originally, local groves provided adequate supplies, but depletion of nearby resources soon necessitated the move to imported logs. Eventually, “inferior” woods replaced oak. Hackmatack from the Great Lakes region arrived by rail and shiploads of southern white pine filled the needs of Delaware’s shipbuilders. The shape of the tree determined the eventual use of the timber. Long, straight trunks supplied planking and beams. The forks or crooks of a tree became the knees and futtocks.

The rough logs needed to be cut to approximate dimensions and squared before use. Many ship yards operated their own sawmills and handled the task of preparing wood on site. Others relied on local mills to prepare lumber. After the initial trimming of the logs, the individual components of the ship began to be cut. As in the case of detailed drawings, large yards used templates or patterns to prepare these parts. Smaller yards used the skill of the master carpenter to carefully lay out each piece. The fabrication of the keel, stem, and sternposts took place first. If possible, a single length of white oak served as the keel. Unfortunately, logs of the size needed to make the keel of a 200-foot ship proved unobtainable by the mid-nineteenth century and smaller timbers, joined by scarf joints, combined to form the main

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56 A wide variety of works are available that detail the construction of wooden ships. Ranging from technical works covering every aspect of ship design to juvenile books filled with illustrations and basic terminology, these publications provide a far more thorough description of shipbuilding than will be attempted here. Two works comprise the primary sources for this section: Basil Greenhill, *The Evolution of the Wooden Ship* (New York: Facts on File, 1988); and James Dodd and James Moore, *Building the Wooden Fighting Ship* (New York: Facts on File, 1984)
Figure 27: Sail plan for a four-mast schooner built by American Car & Foundry. Source: Delaware State Archives, Dover.
longitudinal element of the ship (Figure 28). After the fastening of the stem and stern-posts, workers cut a rabbet along the entire length of the keel and into the front and rear posts (Figure 29). The hull planking, affixed after placement of the frames, fit into this recess.

The frames gave the wooden ship both its form and its strength. Two methods of frame construction existed (Figure 30). If the availability of large lumber allowed, the futtocks and floor timbers were a single timber thick, joined by scarf joints, and securely bolted or treenailed together. More frequently, however, the frames consisted of several pieces of wood joined together, a paired futtock, with each joint staggered to eliminate weaknesses. The outward edge of each frame needed a bevelled edge to account for the changing sweep of the hull from bow to stern. Roughed in during the assembly of the frame, the adze completed the bevel after positioning the frame. The completed frames were then set upon the keel and temporarily held in place with battens or cleats nailed to their outer edge.

After raising all the frames into their final positions, placement of the keelson took place. The keelson added additional stability from the bow to the stern of the vessel (Figure 31). Combined with the keel and frames, the keelson created the backbone of the ship. In absence of large trees, the keelson was made of several pieces scarfed and bolted together. Bolts in this context refer to heavy metal pins driven through the keelson, frame, and keel with mauls and later with pneumatic hammers (Figure 32). Continued blows with a hammer mushroomed the top end of the bolt with the lower end being peened or turned over and clenched. Stem and stern knees added structural stability at the bow and stern of the vessel.

With the completion of the structural elements of the hull, the master carpenter then faired the hull. Fairing refers to the final alignment of the frames to assure an even curve through all segments of the hull and smooth transitions from the bottom of the vessel up through the sides. The installation of two planks, the garboard and sheer strakes, set the frames in place and readied the hull for the installation of deck beams and planking. Near the top of the frames, at the point where the hold ended and the deck began, a beam shelf was installed (Figure 33). Bolts secured the beam shelf to the frames. Transverse deck beams rested atop the beam shelf at each frame. These beams served two purposes, both supporting the deck and holding the shape of the vessel athwartships. The beams received a slight arc to their tops to give a camber to the deck necessary in shedding water. Lodging knees secured the transverse beams to the frames, and hanging knees--frequently made of iron--held the beams fast to the

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57 The term treenail, trunnel, or trenel, is believed to be an adaptation of tree-nail, a wooden peg used in place of iron nails. The dowel used in the construction of timber-frame structures or furniture serves the same function.

58 Strake is a term referring to a plank that runs continuously from the bow of a vessel to its stern. The garboard strake is the lowest plank on a vessel and anchors the frames at the keel. The sheer strake runs near the top of the frames and establishes the spacing of the frames. Final adjustments to the frames' bevel also took place at this time.
Figure 28: Keel construction. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 99.
Figure 29: The stem and stern posts established the sweep of the bow and rise of the stem. A rabbet ran the entire length of the vessel. Source: Greenhill and Manning, *Evolution of the Wooden Ship*, 104.
Figure 30: Open and closed system of fabricating frames. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 114.
Figure 31a: The keelson added stability to the length of the vessel. Resting on top of the frames, heavy bolts connected the keelson, frames, and keel. Source: Greenhill and Manning. Evolution of the Wooden Ship, 128.
Figure 31b: Workers at Wilmington's Jackson and Sharp shipyard adze keelson timbers before final placement in this photograph taken in 1921. Numerous shipbuilding tools including crosscut saws, planes, mauls, and a pneumatic hammer are visible. Source: Delaware State Archives, Dover.
Figure 32: Heavy iron or steel rods, called bolts, fastened timbers together. Either mauls or pneumatic hammers drove bolts through the wood. The keelson of this barge under construction at Jackson and Sharp, ca. 1918, is bolted both vertically and horizontally. Source: Delaware State Archives, Dover.
Figure 33: The basic structural components of a wooden vessel. Source: Greenhill and Manning, *Evolution of the Wooden Ship*, 151.
shelf beam. Carlings, fastened with dovetail joints and treenails, maintained the spacing between beams and framed openings in the deck for hatches and masts (Figure 34). The skeleton of the vessel stood ready for planking.

Planking of the hull commenced soon after the completion of the structural elements of the hull. The hull planking (exterior) and ceiling (interior) needed to follow the exact curvature of the hull. To facilitate installation, shipwrights used a variety of techniques to shape the planks to the frames. First, planks could be steamed. A steam chest allowed for the plank to be subjected to saturated steam, softening it and making it more pliable. Several different devices, including C-clamps, shores, and ring-dogs, applied pressure to the plank, holding it in place until a spike or treenail permanently fastened it to the frame (Figure 35). The same procedures applied to any framing element, such as the beam shelf, that matched the curvature of the hull.

Planking not only added strength to the hull, but made it watertight. In this respect it could well be the most important, and therefore most meticulous, step in the shipbuilding process. Each plank required individual attention. At the center of the ship, the planks were identical in width, but as they approached the bow and stern of the vessel, each slowly tapered to a blunt point. Additionally, planks needed a slight bevel on their edges to minimize the gaps formed when square-edged lumber is butt-jointed on a curved frame. To complicate matters further, hull planking required a slight concavity to properly seat against the frame—ceiling planking needed a convexity (Figure 36). Into the twentieth century, many small yards relied on the eye of the shipwright to prepare each plank. By the late 1910s, bevelling machines and specialized power planes began to replace the experience of the craftsman.

Fastening the planks to the frames took two forms. The earliest required the use of wooden treenails. After fitting the planks to the holes, workers bored holes with an auger and bit. Treenails were then driven into the holes and wedged in place (Figure 37). The treenail material required a moisture content of five percent or less as a treenail could not afford to shrink. Although treenails proved superior in corrosion resistance to metal fasteners, the labor and skill required for their installation mandated a replacement system of fastening. Metal fasteners required less skill and speeded fabrication. Foundries supplied spikes in great numbers and eliminated the manpower needed to make wooden dowels. While some yards employed “shipsmiths,” and manufactured spikes on site, the availability of mass-produced fasteners in the twentieth century eliminated any expense associated with attaching planking to the hull. Installation of spikes proved simple. After drilling and counterboring a hole, workers drove the spikes home (Figure 38). A pellet, or plug, then sealed the opening protecting the metal from salt water. The use of spikes (later replaced by galvanized screws) followed by wooden plugs continued as long as shipyards built wooden ships.
Figure 34: Beams, lodging knees, and carlings supported the deck and framed hatchways. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 135.
Figure 35: A variety of devices served to position planks before securing them in place. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 148.
Figure 36: It required considerable skill to correctly bevel and seat hull and ceiling planking. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 141.
Figure 37: The earliest fastening system on wooden ships used pegs, alternatively called treenails or trunnels. Metal spikes, although susceptible to corrosion, eventually replaced treenails. Source: Greenhill and Manning, *Evolution of the Wooden Ship*, 141.
Figure 38: Method of fastening planks with hand-made spikes. Machine-made spikes were similar in appearance. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 140.
With the hull nearing completion, work commenced on the decking and bulwarks. Laying the deck planks followed a similar procedure as the installation of the hull planking and ceiling. The bulwark stanchions, bulwark planking, and rails served more than one purpose on board ship. While framing the deck and offering some protection from the sea, they also served as attachment points for much of the ship's rigging. With the completion of the bulwarks, only caulking remained.

Before caulking began, the hull and decks received a final finishing pass with the adze and plane. This assured the proper camber of the deck and trued up any rough edges between planks. The caulk itself was of rolled oakum permeated with pitch. Using caulking irons and mallets, workers laid several layers of caulk into each seam, driving successive pieces tightly into the seam (Figure 39). Caulkers frequently worked alone, but occasionally pairs of men using large irons and mauls performed this duty (Figure 40). After insertion of the final strand, a crew "mopped" on additional tar to completely waterproof the joint.

Up to this point, the local ship yard completed most of the work. Itinerant crews of caulkers or ship carpenters sometimes augmented the local workforce, but the primary responsibility for construction of the hull lay with the master carpenter and his crew. After completing the hull, however, the site of the final rigging and outfitting varied. Some yards installed the masts prior to launching, others after floating the vessel. The fitting of rigging and sails frequently took place in a distant ship yard after towing the hull to a new location. If the local yard chose to shape and position the masts, called stepping, long beams free of any defects formed the blank from which the mast took shape. Using adzes, workers then shaped the square timber into an octagonal one and slowly worked in the taper. Near the top, a mast narrowed to less than one half its diameter at the base. The eight-sided mast was then converted into a sixteen-sided one using draw knives. Carpenters used planes with hollow bases and a curved iron to round the mast and bring it to its final shape.

Documentary evidence suggests that few Delaware ship yards owned cranes or other heavy lifting devices. Human muscle, and the occasional horse or mule, provided the only power. Poles and ropes positioned the frames, and workers physically lifted beams and other timbers into position. Raising a mast, usually in excess of fifty feet, required more than just strength however. Sheerlegs served as the temporary crane needed in positioning the vertical spars. Nothing more than two poles lashed together at the top and cabled to the bow and the stern of the vessel, the sheerleg served as a temporary derrick.

59 Bulwarks are that portion of the ship that extends above the deck, offering protection from heavy surf and wind-driven waves (see Figure 33). Although some shipwrights merely extended the frames sufficiently above the deck-line to create the bulwarks, others bolted them through the planking and beam shelf to allow for replacement when damaged by rot or the infrequent collision.

60 The term spar refers to all wooden elements used in the raising and manipulation of sails. Masts, booms, yards, and gaffs are all technically spars.
Figure 39: Caulking a seam in the hull of a wooden ship. Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 154.
Figure 40: A crew of at least twenty-three workers readies the deck of a heavy barge at the Jackson and Sharp yard in 1922. Activities included the trimming of deck timbers around a hatchway and fitting deck planks, but the majority of work appeared to be focused on caulking the decks. To the right of center a row of wedges, used to spread planks prior to caulking, is visible, and to the left a pair of workers inserts cords of oakum into the joints and drives them home with wooden mauls. Source: Delaware State Archives, Dover.
(Figure 41). After positioning the first mast, the sheerleg was easily lowered, dismantled, and reassembled in a new location.

A ship's rigging secured the masts in position and allowed for the raising and lowering of sails. Standing rigging, such as shrouds and stays, anchored the masts and rarely required adjustment. Running rigging, so called because it “ran” through numerous blocks and eyelets, manipulated the sails and spars. Ship yards that chose to fully rig their vessels needed hundreds of yards of manila and hemp rope and as many as three hundred blocks to complete the job. Ship’s chandlers or independent craftsman supplied the necessary supplies. Few, if any, Delaware ship yards employed blockmakers or operated their own ropewalks. The final outfitting of the vessel included the installation of winches, windlasses, hatches, pumps, and the hanging of anchors. Wilmington, Philadelphia, and Baltimore served as market sources for the specialty items needed in the completion of the vessel.

The V-Bottom

The V-bottom or skipjack composed the second main category of ship constructed in Delaware. In many ways, the construction of a V-bottom vessel followed the same sequence of steps used in the skeletal frame. Selection of trees, shaping of timbers, and the fastening of beams were virtually identical and will not be repeated here. The key differences lay in the conceptual design of the ship and in the construction of the hull. The first main category, the skeletal frame, emerged from centuries of experimentation and culminated in the application of engineering principles and nautical science. Large vessels constructed in this form followed the plans of skilled professionals. V-bottomed vessels also evolved over decades of use, but rarely benefitted from the marine engineer. Ship carpenters building such ships made no use of formal plans or designs. Trial-and-error perfected the design. Structural problems or poor seaworthiness were corrected in the next vessel. Exchanges between shipbuilders helped to standardize the vessel in a regional context. Most drawings of V-bottom ships come from documentation of existing vessels rather than original plans or designs. The Nathan of Dorchester, a reconstruction undertaken in Cambridge, Maryland, is reported to be the first skipjack built from plans (Figure 42). The second difference in the two vessel types is that the hull of the V-bottom ship was constructed without the use of frames and was built upside down. The keel, chine logs, and bottom

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61 The skipjack represents a traditional watercraft that varied considerably from one location to another. Little documentary evidence exists that details construction methods. Fortunately, renewed interest in the skipjack and other water-based activities prompted the Dorchester Skipjack Committee of Cambridge, Maryland, to reconstruct a skipjack using traditional methods and techniques. This description of V-bottom hull construction is based on interviews with Mr. Bob Ruark and William Abbe, both of Cambridge, Maryland. Additional information on skipjacks and their construction can be found in Howard I. Chapelle, Notes on Chesapeake Bay Skipjacks (St. Michaels: Chesapeake Bay Maritime Museum, no date). The use of the term “V-bottom” is Chapelle’s nomenclature.
Wooden Shipbuilding

Figure 41a: Sheerlegs raised the mast on to the deck of the vessel (see also Figure 59). Source: Greenhill and Manning. *Evolution of the Wooden Ship*, 170.
Figure 41b: Larger ship yards installed sheerlegs, or mast sheers, permanently to a dock or wharf such as those at Wilmington’s Harlan & Hollingsworth ship yard. Source: Historic American Engineering Record, Charles Foote, photographer.
Figure 42: Plans of the *Nathan at Dorchester*, a skipjack built by the Dorchester Skipjack Committee. Drawn by Harold Ruark.
planking provided structural stability. Additional strength was supplied by transverse members, or strongbacks, that ran across the vessel and connected to the chine logs.

The first step in the construction of a V-bottom vessel was the shaping and sizing of the keel. Cut from the heart of a single tree, the keel was placed in an inverted position and the rabbet which received the bottom planking was cut using planes and chisels (Figure 43). It then received a slot for the centerboard. The transom was then connected to the keel at the rear and chunks, solid timbers that gave shape to the bow, drift-bolted to the forward end. The chine logs, in reality doubled planks about two inches thick, gave shape to the vessel and were fastened to the transom and chunks (Figure 44). Bottom planking connected the keel to the chine logs. Usually constructed of two-inch-thick pine, the planking was fastened using metal spikes or screws and then sealed with a wooden plug (Figure 45). After completing the planking, the entire hull was turned over. This allowed work to commence on the sides and deck of the ship. The frames of a skipjack were merely stanchions running from the chine log to the deck. Notched over the chine and securely fastened with drift-bolts, the frames received the few strakes that composed the sides of the vessel (Figure 46). Interior battens reinforced the bottom planking and a series of strongbacks prevented twisting or racking of the hull (Figure 47). Strongbacks were usually located at the bow, stern, and mast locations. Skipjacks rarely received ceiling planking, and a narrow beam shelf supported the heavily cambered deck beams (Figure 48).

Completion of the vessel—the bulwarks, decking, caulking, masts, fitting, and rigging—differed little from the skeletal frame vessel. Unlike ship yards that constructed skeletal vessels, however, yards that erected V-bottom ships usually performed all the rigging operations. Compared to a square-rigged merchant vessel or four-masted schooner, rigging a skipjack was relatively simple. Usually carrying only two or three sails, the amount of standing and running rigging was minimal, and well within the resources of even the most modest yard. Purchasing materials from chandlers, blockmakers, or sailmakers, the shipyard functioned as the only entity physically involved in the construction of the vessel.

These simplified descriptions greatly understate the effort expended in the construction of a wooden ship. Large vessels frequently took more than a year to complete and consumed the lumber produced from about three hundred mature trees. Every part of the vessel required the manual

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62 The chine logs establish the sweep of the ship from bow to transom (the squared stern of the ship). The bottom planking connects the keel and chine logs.

63 In V-bottom vessels, the keel is technically a keelson. Nautical terminology defines a keel as that portion of the frame below the plank rabbet, and the keelson as the portion of the frame above the rabbet. The rabbet in V-bottom vessels is cut on the underside of this main timber, and technically the entire "keel" is above the rabbet.

64 A centerboard is a device that projects below the keel of the vessel. It provides increased stability in rough seas, yet can be pulled up by a winch to give less draught in shallow waters.
Figure 43: Rabbeting the keel. Photo by W. Abbe.
Figure 44: Chine logs of the *Nathan of Dorchester*. Photo by W. Abbe.
Figure 45: Attaching bottom planking at the stern, or transom, of the Nathan of Dorchester. Photo by W. Abbe.
Figure 46: The shallow rise of a skipjack required few strakes, or hull planks. Photo by W. Abbe.
Figure 47: Midship strongback and battens are visible in this view of the Nathan. Photo by W. Abbe.
Figure 48: The camber or arc of a deck beam is visible here. Photo by W. Abbe.
fabrication and installation of components. The task could neither be hurried nor delayed—the loss of a ship or the loss of a contract meant economic disaster for the ship yard. The yard itself proved the focus of this activity. Delaware’s ship yards produced single-masted sloops, four-masted schooners, and diesel-powered yachts; ships that carried passengers, coal, grain, wood, revenue cargo, and rock; ships that worked the sea and harvested its products; and ships that transported the wealthy on their weekend excursions. More importantly though, the ship yards played a vital role in the economy, converting the state’s raw materials into a valuable commodity and making Delaware one of the east coast’s most important shipbuilding centers.

The Wooden Ship Yard

On the morning of August 2, 1917, Miss Bessie Paul, “dressed in an ankle-length white dress and . . . flower-decked broad-brimmed hat,” smashed a bottle of champagne across the bow of the Albert F. Paul, and the largest sailing vessel ever constructed in Milford slid down the ways of Abbott’s ship yard into the waters of the Mispillion River (Figure 49). Built of white oak and hackmatack, the Albert F. Paul grossed at least 1500 tons and measured 175 feet in length, thirty-seven feet in width, and drew over fourteen feet of water (Figure 50). The vessel’s four masts, each more than two feet in diameter, stood ninety feet above her deck. Chains almost two inches in diameter supported her 3500 pound anchors. The Paul sailed in the coal, salt, logwood, and lumber trade, calling on ports throughout the Atlantic and Gulf Coasts, the Caribbean, Maritime Provinces, and South America. After safely completing ninety-nine voyages in the span of twenty-five years, the German submarine U-322 attacked the Albert F. Paul on March 4, 1942. The ship and all hands were lost.

The launching of the Albert F. Paul marked the end of the era when Delaware shipbuilders produced such large merchant sailing vessels constructed of wood. The Paul proved the largest and last of these vessels. Like the vessel itself, the yard that constructed her is also lost. The site of Abbott’s ship yard, now a vacant lot situated along the southern bank of the Mispillion River, retains none of the attributes that identify a ship yard. But, the documentary evidence that does survive allows an almost complete reconstruction of the functional organization, buildings, and activities that once combined in the production of merchant ships.

The launching of a major merchant vessel garnered considerable attention from the local press. The description of “Miss Bessie” as she appeared at the launching is presumably obtained from period news reports. Photographs taken as the ship made its way into the Mispillion show considerable details of the ship yard, as do other photos taken during the construction of large vessels (Figure 51).

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Figure 49: Launching the *Albert F. Paul*, 2 August 1917. Source: Macdonald, *Mispillion-Built Vessels*, 300.
Figure 50: The *Albert F. Paul*. Source: Macdonald, *Mispillion-Built Vessels*, 281.
Several shipyard details, such as launching ways and structures, are visible in this photograph of the *Albert F. Paul*. Source: Macdonald, *Mispillion-Built Vessels*, 301.
excitement that launchings produced in small Sussex County communities generated a record that affords an opportunity to discuss these ship yards that is not available in the urban areas to the north. It is unlikely that the launching of 3000-ton barges built at Jackson and Sharp's Wilmington yard met with the same degree of fanfare (Figure 52).

Using descriptive and photographic evidence, embellished with other documentary sources like historic maps, the Abbott ship yard begins to take substance. Abbott's is representative of the small yards that once flourished throughout Delaware. Sanborn maps prepared throughout the late nineteenth and early twentieth century show that Abbott constructed few permanent buildings in the yard. Although the Paul was the last of the large merchant ships to be built in the region, Abbott's continued to build smaller boats well into the mid-twentieth century. Maximum development of the site occurred sometime around 1930 when two sheds, an office, a frame carpenter's shop with adjoining engine house, and a covered shipbuilding shop occupied the site (Figure 53). No known photographic evidence survives from this period, so the actual appearance and construction characteristics of these buildings is unknown. Substantial evidence exists, however, for the period surrounding the launching of the Albert F. Paul in 1917.

The ship yard began to assume its 1917 form as early as 1910 (Figure 54). At that time a single boiler powered the yard's saw and planing mill. An office and carpenter's shop stood near the corner of McColley and Mispillion streets, and a "general storage" building housed ships' fittings and hardware. The presence of a "marine railway" indicates that repair work also took place at Abbott's at this time. A marine railway was used to transport ships into and out of the water and was usually associated with dry dock activities. The launching of new vessels did not require a railway system as ships simply slid down the ways or stocks. Abbott's interest in repair work appears short-lived as two sets of ship ways replaced the railway by 1917.

The Sanborn map of 1919 shows that Abbott retained the office building, carpenter's shop, planing mill, engine house, tar kettles, and one boiler from 1910 (Figure 55). Construction of the single-story shed housing the air compressor took place between 1910 and 1913. The installation of the second boiler apparently took place after 1913 as only a single stack is visible in the photographs of that date. The storage building and marine railway disappeared by 1919.

Figure 56, taken between 1907 and 1913, gives structural details of the buildings depicted on the insurance maps. The saw and planing mill appears in the center of the image as a rectangular frame building with vertical plank siding. The dark ridges on the roof give the impression of metal sheathing, but a companion photograph (Figure 57) shows that these are formed by the underlying rafters and that the roof covering is shingles. Large sliding doors on three walls provided both ventilation and a way of moving large timbers to the milling machines located inside. Although the engine house and tar kettles are obscured in this view, Figure 51 (which shows the launching of the Albert F. Paul) clearly shows the shed-
Figure 52: This launching of a Jackson and Sharp built barge in 1921 met with little of the fanfare that accompanied such events in Sussex County shipyards. Only a few workers witnessed this vessel slide down its ways. Source: Delaware State Archives, Dover.
Figure 53: Sanborn map showing the Abbott yard in 1930. Source: Sanborn Insurance Company, "Milford."
Figure 54: Sanborn map showing the Abbott yard in 1910. Source: Sanborn Insurance Company, "Milford."
Figure 55: Sanborn map showing Abbott's yard in 1919. Source: Sanborn Insurance Company, "Milford."
Figure 56: The Abbott Shipbuilding Company sometime between 1907 and 1913. Source: Macdonald, *Mispillion-Built Vessels*, 260.
Figure 57: Abbott's yard, taken between 1907 and 1913. Source: Macdonald, *Mispillion-Built Vessels*, 261.
roofed engine house and the gable-roof building that protected the kettles. To the left of this structure stood the boiler house and compressor shed. This structure also had a shed roof covered with shingles and an attached porch sheathed with loosely-spaced, random-width boards. The compressor shed, although masked by a cloud of steam, was probably composed of construction materials similar to the other buildings at Abbott’s yard. Despite the large scale of the buildings (the milling building is estimated to be about seventy-five feet long and thirty feet wide), the most obvious feature of Abbott’s yard was the presence of wood in many forms. Rough logs, sawn slabs, heavy squared timbers, planking, and framing occupied almost the entire site. The entire shipbuilding process, from tree to finished product, is visible in these images.

The buildings within the yard served a single purpose—to shelter the machinery that worked wood. The vessel under construction, in the rear of Figure 56, seems insignificant when compared to the amount of material that went into her construction. The largest visible piece of woodworking machinery is to the left of the milling building. What appears to be a small marine railway with a wooden cradle is referred to as a shotgun carriage. Powered by a steam engine, visible between the mill building and boiler house, this device sawed large slabs from rough logs. In operation, a log was placed on the cradle and held in place by stanchions that moved across the cradle. A pneumatic cylinder or cable system moved the cradle back and forth along the tracks, and passed the log through a saw placed adjacent to the tracks. After each pass, the stanchions would be carefully indexed, moving the log closer to the blade.

After cutting a log into slabs, milling took place. A basic milling machine or plane surfaced the sides of a slab producing a plank of uniform thickness and width. Milling machines used in ship yards performed additional operations. The planks applied to the sides of a vessel did not join at right angles. The curvature of the hull required each plank to have a bevelled edge that matched the planks above and below it. Historically, ship’s carpenters fashioned this bevel by hand using a variety of tools including planes and large chisels or slicks. By the 1910s, machinery began to replace the labor-intensive nature of hull planking and the beveling machine appeared in many ship yards (Figure 58). Machinery eliminated much of the handwork traditionally employed in ship yards and speeded the fabrication process for ships of all sizes. Although no conclusive evidence suggests that Abbott’s employed this type of machinery, beveling machines replaced handwork in many yards by 1920. The mill structure in the center of Figure 56 unquestionably sheltered a surface plane and possibly more specialized equipment.

The use of machinery in a ship yard did not eliminate handwork, however. Figure 57, also of the Abbott yard in the early 1910s, depicts a crew of ship carpenters dressing a heavy beam. There is no evidence that anything other than hand tools was in use. The wheeled device in the right of the photo suggests that the movement of timber throughout the yard also required manual effort. The device assisted with the movement of timber, taking some of the burden off the men. Lifting the tongue allowed a ship’s timber or log to be chained to a beam projecting from the heavy cross-member. Lowering the
Figure 58: Machinery began to replace manual fitting of ship's parts in the early 1910s. This "tilting-frame" band saw, once used at the Vinyard ship yard in Milford, simplified the difficult task of cutting and shaping the ship's keel.
tongue levered one end of the beam off the ground, and it could then be dragged to a different part of the yard. The scaffolding and ramp surrounding the partially completed vessel also suggest that Abbott employed a minimal amount of power equipment. There is no suggestion of cranes, derricks, or other lifting tools. Frames and structural elements required human muscle, assisted by blocks and tackles, to lift them into position.

Documentary sources not only provide detail on the types of buildings and structures present in a shipyard, but also clarify which of the various activities that made up the erection sequence of a large ocean-going vessel took place at a given location. The mold loft—the area where the shape and dimensions of a ship’s components were transferred from drafts or plans to full size templates—does not appear on the maps of the Abbott yard. Molding the frames of a major ship required large expanses of open floor space. None of the buildings at Abbott’s yard seemed to possess an area dedicated to pattern-making. The only structure with adequate space, the carpenter’s shop, contained a single story and presumably housed woodworking operations as well as the storage of tools and fittings. The absence of a mold loft is not surprising since many shipwrights used traditional building practices and built ships by “eye,” relying on years of experiential learning obtained both as master shipwrights and as apprentices.

William G. Abbott, builder of the Paul, carried on the trade of his father, J.W. Abbott. Vessels constructed by different generations of the Abbott family bear striking similarities, and reflect time-honored traditions rather than radically different designs (Figure 59).

In addition to the mold loft, the first step in ship construction, structures needed for the final steps in the fitting and rigging of a vessel are also absent from the Abbott yard—the fabrication and assembly of masts, spars, and sails. Masts and spars do not require specialized structures and the planing and shaping of these items may have taken place outdoors, but the layout and cutting of sails required a space at least as large as the mold loft. Again, inadequate space is available for this operation. Ship’s papers indicate that several vessels obtained their final rigging and sails from Philadelphia and Baltimore ship yards after being towed from Delaware rivers.66

Documentary sources also provide insight into the types of tools used by shipyards. Although much of the shaping and dressing of timbers required the handiwork and expertise of the master carpenter, “much of the boring, fastening, rabbeting, and calking work formerly done by hand was accomplished with the aid of pneumatic tools.”67 Tasks that once required human labor, such as fastening the keelson to the frames and floor with drift-bolts, now used pneumatic hammers (see Figure 31). The presence of an air compressor supports the supposition that the Abbott yard, like many in the nation,

66 Macdonald, Mispillion-Built, 267, 272.

Figure 59: The Charles J. Dumass, constructed by William Abbott in 1904 (top), and the Thomas J. May, constructed by J. W. Abbott in 1882, bear striking similarities to the Albert F. Paul (see Figure 50). Also note sheerlegs in place at the rear of the Thomas J. May. Source: Macdonald, Mispillion-Built Vessels, 221, 141.
converted to air-driven tools in the years surrounding World War I.

Adjacent to Abbott's shipyard stood the Vinyard Shipbuilding Company. Like Abbott's, the Vinyard Shipbuilding Company attained its maximum development prior to 1930. At that time, the yard comprised ten buildings (Figure 60): two frame sheds; a one- and two-story frame storage building; a small frame paint storage building; two large shipbuilding structures that probably sheltered the launching ways (the larger of the two structures abutted brick boiler and compressor buildings); a one-story frame carpenter's shop and attached shed; a two-story brick planing mill; and a one-story office building of concrete block construction. Several of these structures date to the earliest years of the Vinyard operation which began in 1896 (Figure 61). The shed on the western boundary of the property appeared in 1910 designated for "Storage of Boat Buildings Supplies and Chemicals." The 1930 "Storage" building once served as the yard's sawing and planing mill. The paint shed, office building, and carpenter's shop with its adjoining lumber shed date to the 1910s (Figure 62). Although a large "Boat Building" structure also appears on the 1919 map, it is unlikely that it is the same structure that appeared on later maps as the steel frame construction post-dates the early twentieth century.

Many of the Vinyard structures survived into the 1990s, and the yard still serves as a facility used to repair and construct pleasure craft. The steel frame boat building shop is open on both ends and sheathed in vertical wood planking (Figure 63). Large windows on the south gable end illuminates the interior and the steel frame serves as the supporting structure for a travelling gantry crane (Figure 64). The adjoining textured, concrete block shed housed the yard's boilers and air compressor (Figure 65). The brick planing mill retains its associated machinery, and retains its original fenestration comprising nine-over-nine double-hung sash windows and vertical batten doors (Figure 66). The carpenter's shop, though severely deteriorated, exhibits masonry construction, shingled roof, and double doors (Figure 67). The concrete block office building also retains its shingle roof and period windows (Figure 68).

These structures date from between 1919 and 1930, but the earliest structures associated with the Vinyard Shipbuilding Company are visible in a photograph taken about 1916 (Figure 69). On the right of the photograph, directly behind the tug and barge, lies the storage building depicted on the 1910 map. Gable-roofed and sheathed in vertical plank siding, the one- and two-story sections of this building are clearly discernable. To the left-center of the photograph stood the yard's original saw and planing mill. The main section, two-stories in height and gable-roofed, was enlarged by the addition of numerous small sheds. The marine railroad, shown on the earliest map, runs from the river's edge in the approximate center of the photo, behind the large tree, and ends just to the left of the mill. The paint shed occupies the center of the photograph.

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Figure 60: Vinyard’s ship yard as depicted on a Sanborn Insurance Company map of 1930. Source: Sanborn Insurance Company, “Milford.”
Figure 61: In 1910, the Vinyard Shipbuilding Company occupied this set of buildings on the Mispillion River. Source: Sanborn Insurance Company, "Milford."
Figure 62: The Vinyard ship yard in 1919. Source: Sanborn Insurance Company, "Milford."
Figure 63: This large steel-framed building sheathed in wood siding, served as the boat assembly and repair building for the Vinyard Shipbuilding Company.
Figure 64: Steel frame and crane of the Vinyard Shipbuilding Company's boat shop.
Figure 65: Boiler house and compressor shed.
Figure 66: A complete assemblage of woodworking tools exists in the planing mill of the Vinyard ship yard. Visible in this photograph are band saws, tenoning machinery, planers, and joiners.
Figure 67: Shown as a "Carpenter's Shop" on insurance maps, this building presently contains the yard's metal working equipment and a small forge.
Figure 68: Office building, constructed of textured concrete block, of the Vinyard yard.
Maps and photographs provide the information to make reconstructive hypotheses about the Vinyard operation. The saw and planing mill implies that Vinyard employees prepared much of the timber that went into the yard's vessels rather than purchasing planed lumber from commercial sawmills. The presence of a thirty-six inch wide planer and jointer supports this supposition, but the absence of a heavy saw carriage implies that the yard did not purchase untrimmed logs. The tilt-frame band saw produced keels and hull planks, but did not reduce raw timber into usable slabs. (The present owner of the Vinyard property states that the rails of a shotgun carriage, similar to the one depicted in Abbot's yard, once occupied the southern portion of the yard and may be a remnant of the earlier sawmill.) The presence of an air compressor indicates that workers used pneumatic tools. In many ways the Vinyard shipyard is similar to Abbott's. In the types, sizes, and number of buildings the two yards are virtually identical; however, there are important differences between the two businesses.

First, there is no evidence that Vinyard purchased rough logs and operated machinery that reduced it to usable slabs. Sanborn maps do not indicate the location of this type of equipment, but this is not necessarily conclusive: the shotgun carriage in use at Abbott's also failed to make the maps. Further evidence that Vinyard purchased cut lumber is provided by the photograph. Stacks of logs and drying lumber, clearly visible at Abbott's, are not discernable at Vinyard's. The process by which the two yards obtained raw materials is important to the understanding of the market system that supported Delaware's shipbuilding industry. When placing a particular resource within its economic context, the procurement of supplies is as important as the ultimate destination of its products. Local resources, isolated stands of surviving oak or pine, may have provided the necessary raw materials from which Abbott constructed ships. Vinyard, a relative newcomer to the region's shipbuilding industry, may have found himself blocked from these sources and forced to rely on distant vendors.

Another important distinction between the two yards is the type of ships each constructed and the era in which each operated. Abbott built only wooden schooners, continuing a tradition established in the nineteenth century. Dependence on wood and the perpetuation of local shipbuilding practice justified the acquisition of an extensive assemblage of wood-working machinery. Vinyard, however, entered the industry at a time when iron and steel began replacing wood as the primary shipbuilding material. Although Vinyard began building wooden ships and boats, the yard quickly converted to metal construction. While the Abbott Shipbuilding Company quickly faded into obscurity after 1930, Vinyard experienced an era of vitality constructing 165-foot steel submarine chasers until the end of World War II.\(^{69}\) While Abbott's machinery focused on the construction of vessels made entirely of wood, the equipment at the neighboring yard focused on metal. Air compressors powered pneumatic rivet guns, and planing

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mills dressed deck planks and cabin trim, not hull planking and frames.

The Abbott and Vinyard shipbuilding operations represent established concerns with a continuous record of shipbuilding activity, but this type of yard is not characteristic of the industry statewide. Many shipbuilders worked intermittently, building one ship every three to five years. The ship yards that supported this type of venture--intense periods of activity with extended periods of inactivity--possess none of the attributes present in the well-established yards. Buildings appeared as ship carpenter's workshops one year, then stood vacant over the next half decade only to be re-inhabited during the construction of another vessel. Ship ways, stocks, or marine railways were non-existent. Saw mills or structures to house boilers, engines, or power planes never appeared on the landscape. As producers of large wooden vessels, these yards contributed to the state's shipbuilding industry, but left few identifiable resources.

Nathaniel Lank of Frederica erected sloops and schooners along the banks of the Murderkill River from about 1870 to the mid-1890s. Working with Thomas Lacey during the 1870s, Lank registered fourteen vessels during the twenty-two year from 1870 to 1892. Lank operated out of a modest yard with a single building identified simply as “Shipwright” and an area adjacent to the river listed as “Stocks” (Figure 70). This building is listed “vacant” in 1897 and 1904, but in use as a “Sail Loft, Boat Building Tools, etc.” by 1910 (Figure 71). By 1919, all traces of the Lank ship yard vanished--the building was apparently demolished and the stocks abandoned.

The ephemeral nature of Lank's yard is shown in a photograph from the late nineteenth century (Figure 72). The ship yard is quite literally a yard by modern definition. The shaping of timbers took place in the shade of a large oak, and the entire complement of the yard is posed next to their handiwork. The stocks indicated on insurance maps appear to be nothing more than saw horses, and the ways, if they existed at all, can be presumed to be equally simple in design. The photo's caption describes a “Ship yard & Dry-dock” implying that repair work took place during the active years of the yard. The traveling steam engine, visible in the background, may have served as the tractive force for pulling vessels from the water. When compared to the more substantial yards in Milford, it is unlikely that ship yards like that operated by Nathaniel Lank left any physical trace, either above-ground or as an archaeological site. The only correlation between the modern landscape and historic documents is a partially silted channel that may have connected the Murderkill and Lank's stocks (Figure 73).

70 Port of Wilmington, logs of ship registry and licenses, Delaware State Archives, Dover, Delaware.

The previous discussion of three ship yards illustrates the variety of industrial concerns that contributed to Delaware's shipbuilding industry: yards that maintained eighteenth- and nineteenth-century traditions of wooden ships; yards that successfully made the transition from wooden construction to the use of metals; and yards that constructed small vessels with virtually no capital investment and few
Figure 70: Sanborn map depicting Lank's ship yard. Source: Sanborn Insurance Company, “Frederica.”
Figure 71: Lank's yard as it appeared in 1910. Source: Sanborn Insurance Company, "Frederica."
Figure 72: The ephemeral nature of many Delaware ship yards is exemplified by this undated photograph of Nathaniel Lank’s ship yard. Source: Delaware State Archives, Dover.
Figure 73: The only surviving trace of a nineteenth-century ship yard is this partially silted channel of the Mispillion River.
ancillary structures. Historically, Delaware's ship yards represented an important part of a regional shipbuilding industry that stretched from Maine to southern Virginia. Although Delaware contained a rich variety of historic resources that illustrated significant aspects of the industry's development, most of these resources no longer stand on the state's rural landscape. This historic context is the first step towards identifying and evaluating those resources eligible for listing on the National Register of Historic Places.

Ship Yards as Property Types

As a property type, the wooden ship yard is actually a collection of property types gathered together to perform a specific function in a single location--that is, a ship yard will be located in a situation that meets certain requirements and it will contain specific architectural or landscape-related resources. Unlike other industrial activities, with established minimum requirements of machinery and the associated structures that housed it, the resources within a ship yard cannot be enumerated. The only common characteristic is proximity to a navigable body of water, usually a river, and a means of moving vessels into that river. While sawmills, covered shops, or storage buildings may be a part of the shipbuilding complex, they are not integral to the manufacturing process. Assemblages of structures may in fact constitute a ship yard; however, a vacant lot also represents the same industrial activity. Ship yards must be considered in all their variants.

Under this context, a wooden ship yard is defined as an area containing all those buildings, structures, sites, and material goods directly involved in the erection of wood-hulled vessels. It is a complex of related elements including those that readied logs or lumber for installation; mechanical devices used in the vertical or horizontal movement of material (ie, cranes, derricks, or dollies); machinery and tools used in the assembly of vessels; ways or stocks on which the vessel took shape and from which it was launched; buildings that housed activities directly associated with ship construction such as mold or sail lofts, carpenter's workshops, or shipsmith's forges; and those buildings that indirectly supported shipbuilding yet stood within the confines of the ship yard such as offices or storage sheds. Ship yards that constructed wooden-hulled ships ranged in size from river-front lots with a single building to large complexes. Because few of the ship yards in the state remain intact, the resources defined in the ship yard property type will be difficult to locate, survey, and evaluate. This functional property type will serve as a model for evaluating the significance of standing resources, and for predicting what archaeological resources might be present on sites completely cleared of any standing resources.

Given the diversity of ship yard configuration, and the low survival rate of shipbuilding-related resources, it is important to identify individual property types that may contribute to our understanding of the shipbuilding industry. In some cases, an individual resource once composed part of the ship yard, yet
now stands as an isolated fragment of the industrial complex. While not eligible in itself such a fragment could provide important survey information for this context. Production-related property types, such as boiler houses, compressor sheds, or planing mills, include both the machinery and the building that houses it. Resources that indirectly supported the construction of wooden-hulled vessels must have a clear association with a ship yard.

Ways and stocks. Technically, ways and stocks are two different things, but for the purposes of this context they are grouped together as devices used to support ships during construction, and then serving as the framework from which the vessel was launched (Figure 74). Erected adjacent to a body of water, ways normally extended several feet into the river. Ways varied in size depending on the size of vessel they carried, but always maintained an incline that allowed the weight of the ship to carry it into the water. This angled installation often required that the resting baulks be supported by pilings or piers driven into the riverbank at varying depths (Figure 75).

Covered ways. Both the Abbott and Vinyard ship yards contained a covered way. This large structure completely enclosed the ship ways and allowed for year-round production of vessels without interruptions due to weather. The earliest covered ways depicted on insurance maps probably used wood frame construction with heavy timber trusses to support the roof structure. Later structures, such as that currently standing at Vinyard’s yard, used steel trusses and framework to support the roof (Figure 76). Few yards used electric lights, possibly due to fire risks, and the covered way, like all ship yard buildings, contains numerous windows to allow for work under natural light.

Marine railways. The marine railway allowed a wheeled dolly to be placed under the hull of a vessel in order to pull the vessel from the water using a railroad-like track system. Marine railways differed from timber ways in that a way only served to launch a vessel and could not be used to remove a ship from the water. Ship yards that performed maintenance and repair work on vessels used marine railways, and their presence indicates a dual purpose for the yard: both new construction and repair.

Saw and planing mills. The ship yard saw and planing mill varied little in outward appearance from similar mills that produced lumber for purposes other than ship construction. As applied to shipbuilding, these structures varied considerably from yard to yard. The Vinyard yard in Milford contains an impressive two-story brick building that housed the woodworking machinery (Figure 77). Photographic evidence depicts the planing mill of the Abbott Shipbuilding Company, as well as Vinyard’s first mill, as a large frame structure. To be eligible as an integral part of the wooden shipbuilding process, saw and planing mills must contain the machinery used in the shaping of ship’s timbers or sufficient documentary and structural evidence must be present to allow a theoretical reconstruction of the machinery (Figure 78). Documentary research provides the most basic information regarding the machinery in use at a shipyard, but physical evidence such as foundations or the mounting brackets of power transmission devices must be present to accurately define the type, approximate size, and specific location of each piece of
Figure 74: Launching ways of a typical ship yard. Source: Delaware State Archives, Dover.
Figure 75: A gently sloping way at the Abbott ship yard can be seen in the center of this photograph taken in the 1910s. Source: Macdonald, *Mispillion-Built Ships*, 240.
Figure 76: Structural system of a covered way or shipbuilding shop.
Figure 77: Saw and planing mill of the Vinyard Shipbuilding Company.
Wooden Shipbuilding

Figure 78: A jig saw, such as this one at the Vinyard mill, could cut intricate shapes of any size. Unlike conventional saws, this one does not have a frame—the upper portion of the saw is connected to the joists above.
equipment. As illustrated by the Abbott yard, a saw mill did not require a protective structure, and many smaller yards may have used saw pits or trestles to prepare lumber. The documentary record fails to provide any information on the methods used to prepare lumber in many cases, and only the existence of artifactual evidence clarifies this aspect of ship construction.

**Offices.** Office buildings varied from ship yard to ship yard. No distinctive architectural form distinguishes a ship yard office from any other. Located near the entrance to the yard, this building probably served both clerical and technical functions, including payroll office, drafting room, and master carpenter’s office.

**Boiler houses/power houses/compressor sheds.** These buildings contained the boilers, engines, generators, and air compressors used to power the ship yard machinery. The size and configuration of the structure varied with the size, production capacity, and type of ship a yard constructed. These buildings contained all the equipment necessary for the generation of mechanical, electrical, or pneumatic power as well as the equipment used to operate the boilers such as draft fans and water pumps. Boiler/power/compressor structures occurred as both separate buildings with steam or air lines connecting them to the mill or ways, or as an ell or shed attached to the mill itself.

**Sheds and storage buildings.** A ship yard frequently contained numerous sheds and outbuildings (Figure 79). Some known uses include paint and varnish storage, fittings warehouses, and lumber storage. Like most ship yard resources, shape and construction varied from yard to yard. In many cases, an obsolete saw mill served as a storage facility.

**Carpenter’s shops.** The specific purpose of the carpenter’s shop is vague. It may have served as a workshop, protected from the elements, in which ship’s carpenters dressed timbers. Other possible uses include the storage of templates or patterns if a yard used such devices or the storage of tools and raw materials. Whatever the function, virtually every ship yard contained a carpenter’s or shipwright’s shop. Primarily frame buildings, these shops seem to be placed on the periphery of the yard, away from the assembly area.

**Floating stages.** A floating stage allowed ship yard workers to perform work on the hull of a vessel after launching. Many duties, such as rigging or painting, took place while the vessel floated at its yard-side moorings. Yards that performed repair work on damaged vessels also used floating stages (Figure 80). Inventories from the nineteenth century include floating stages among the property of shipwrights, and a reconstruction project undertaken in the 1990s used a floating stage for stepping masts and other activities (Figure 81).

**Wharfs and piers.** Most yards included a wharf or pier for the off-loading of raw materials and the temporary mooring of partially completed vessels. Ship yard wharfs appeared as earthen projections into navigable rivers, usually reinforced with timber bulkheads. Photographs of Milford ship yards show barges, tugs, and merchant vessels at the ship yard wharf. In many cases, raw materials such as logs,
Figure 79: This simple frame shed stands at the Vinyard ship yard in Milford.
Figure 80: Although substantial re-planking of a ship's hull required the use of a dry dock, minor repairs could be carried out from a floating stage such as this one used by workers of Jackson and Sharp in 1920. Source: Delaware State Archives, Dover.
Figure 81: Floating stage used by the builders of the *Nathan of Dorchester*. 
Wooden Shipbuilding

fittings, or cut lumber, and bulk materials like pitch and oakum arrived by water. The final installation of masts and spars often took place after launching the vessel and tying it to the nearby wharf. Although many yards launched ships without masts, like Abbott's, the masts were stepped in place prior to the ship being towed to another yard for final rigging.

**Cranes and derricks.** While many small shipyards relied on the strength of its employees to move timbers throughout the yard, more substantial operations utilized a variety of cranes and derricks. The largest used travelling gantry cranes that moved throughout the yard on a rail system (Figure 82). Powered by electricity and constructed completely of rivetted or welded steel, these cranes towered above the surrounding shipyard. In addition to travelling cranes, larger shipyards also relied on fixed derricks to raise heavy timbers. Using blocks and heavy lines rigged to a movable boom, either a portable engine or human muscle supplied the necessary power (Figure 83). The fixed derrick stood as the device of choice in smaller yards that used lifting aids. Other power devices served to remove vessels from the water. Steam-powered winches of the Vinyard company pulled ships from the Mispillion onto the company's marine railway (Figure 84).

**Miscellaneous buildings.** A variety of ancillary structures appeared in Delaware's ship yards. Insurance maps frequently located small, frame structures but failed to list a function. In other cases, structures protected tar kettles or merely sheltered outdoor activities.

**Evaluation Criteria Related to Wooden Ship Yards**

**Evaluation of standing resources.** The issue of integrity for resources related to the shipbuilding industry is problematic. A ship yard is not a single building, structure, or site of activity. It is the combination of activities that constructed a ship. Specifically, shipbuilding represents a manufacturing process. That process comprises several activities ranging from the conversion of logs into usable timbers to the final rigging of a vessel. These activities may take place within a defined site and assemblage of buildings and structures, on an undefined riverbank, or be dispersed to numerous locations. For a ship yard to retain sufficient integrity to merit listing on the National Register of Historic Places, it must be representative of the manufacturing process. The launching ways and stocks on which a vessel is constructed does not constitute a yard. It is merely one element of the process. The same holds true of the shade tree under which Nathaniel Lank shaped the timber for his sloops.

The first step in assessing the integrity of resources applicable to this context, is the identification of all buildings, structures, objects, and material goods present at the ship yard during the period of significance--its contextual landscape. Only through comprehensive documentary research, augmented by oral histories or site inspections, is a complete reconstruction of ship yard activities possible. Documentary research provides the listing of individual components that comprised the ship yard
Figure 82: A gantry crane frequently served multiple erection sites within the limits of a large shipyard. This one at the Jackson and Sharp yard in 1927 assisted in the construction of two barges, but could be easily moved to another location. Source: Delaware State Archives, Dover.
Figure 83: A series of derricks (at least two are visible in this photo taken in 1912) served in the erection of this schooner at Wilmington’s Jackson and Sharp ship yard. Source: Delaware State Archives, Dover.
Figure 84: This steam-driven winch used a series of well-anchored pulleys to pull vessels up one of three marine railway tracks at the Vinyard ship yard in Milford.
Wooden Shipbuilding landscape and serves as the basis for evaluating its eligibility for inclusion on the National Register of Historic Places. Only those yards that retain sufficient material integrity to represent the shipbuilding process are eligible.

Once the documentary research is complete, surviving physical resources of the ship yard must also be evaluated. It is imprudent to apply the same evaluation methods used for individual buildings to shipbuilding resources. To properly assess the integrity of the resources associated with the Ship and Boatbuilding Historic Context it is necessary to evaluate the three components of the ship yard--its machinery, its buildings, and its documented landscape. To be considered eligible for the National Register under this context, a resource must contain two of the three components of a ship yard. While it is not expected that a site will contain all elements of the manufacturing process, sufficient material integrity should remain to establish the process and place the ship yard within its cultural and ecological context. **Machinery** applies to the mechanical devices used in the preparation of raw materials, vertical or horizontal movement of ships' timbers, or the method by which vessels moved into or out of the water. Ship yard **buildings** are those structures that sheltered the activity of shipbuilding such as saw and planing mills, covered ways, or carpenters' shops. The original use of a building may or may not include machinery. A saw mill, for example, **must** contain its original equipment or provide sufficient evidence to **completely** reconstruct the type and configuration of its machinery (Figure 85). Additionally, buildings should maintain sufficient material integrity to establish a physical linkage to the ship yard as described above. To be eligible for the National Register under this context, a ship yard **landscape** must retain a majority of those resources identified through documentary research as existing in the period of significance. If sufficient numbers of buildings, structures, or objects have been destroyed, or the architectural integrity of surviving resources is compromised, the ship yard as a whole is ineligible.

**Evaluation of archaeological resources.** Many ship yard activities, in fact many ship yards, did not require permanent buildings. Preparing timber took place on open ground, and the scaffolding that once surrounded stocks or ways left little visible trace. Evidence of these activities and structures exist only as underground, archaeological resources. As a result, it is important to include archaeological resources as one element of the evaluation process. As with standing buildings, the location of potential archaeological sites is driven by documentary research. Maps, plats, photographs, and insurance descriptions frequently detail the sites of both specific activities within a larger yard and the overall configuration of a smaller ship yard.

The importance of sub-surface resources is reinforced by the low survival rate of ship yard complexes. The existence of archaeological evidence can contribute to the integrity of a ship yard. To be eligible for the National Register, a ship yard must contain sufficient material evidence to reconstruct the manufacturing process that once took place. Many activities can only be identified through archaeological excavations. The yard area that once served for the final trimming and fitting of ship timbers, offers material
Yard activities.

Figure 85: This shop at the Yard in Millford contains the metal working machinery used in the construction of frames and other structural components. Overhead line-drilling supplied the power to shears, drill presses, and brakes. This level of detail is necessary in the reconstruction process of ship building.
Wooden Shipbuilding

Evidence in the form of tool fragments, nails or spikes, post holes that indicate the location of bracing or cranes, and soil stains or chemical distributions marking heavy concentrations of waste wood or shavings (Figure 86). Ways, stocks, or assembly scaffolding, due to their moist location and frequent subjection to fluctuations in water level, quickly rot leaving little testimony to their existence, but are frequently preserved intact below low water mark and may become apparent during testing or full-scale excavation (Figure 87). Machinery foundations or parts of power equipment often provide conclusive evidence as to the type or size of large, stationary machines.

It is not the purpose of this context to define archaeological integrity, only to mention the importance of underground evidence in the evaluation of a ship yard as an historic resource. Findings of this type can be combined with the existence of eligible, standing resources to improve the integrity of the ship yard as a whole, or serve as the basis for the nomination of a site. The overall integrity standards of the ship yard as an historic resource cannot be compromised. To be eligible it must contain sufficient evidence of machinery, buildings, and documented landscape to reconstruct all aspects of the manufacturing process, but this can exist as both standing buildings, structures, or objects and as archaeological evidence.
Figure 86: Evidence for the construction of the *William W. Ker* may consist of nothing more than soil stains or chemical distributions, or post holes, but may also include scraps of copper or corrosion resistant fasteners used to attach copper cladding to the vessel's hull. Source: Delaware State Archives, Dover.
Figure 87: Shipbuilding required extensive scaffolding. The size and complexity of this temporary structure is evident in this view of the Jackson and Sharp yard taken in 1918. Also evident in this photograph is the waterlogged environment in which many shipyard structures stood. Source: Delaware State Archives, Dover.
V. The Iron and Steel Shipbuilding Industry

The American iron and steel shipbuilding industry was born and grew to maturity in the ship yards of Harlan & Hollingsworth and Pusey & Jones in Wilmington, Delaware. Harlan & Hollingsworth launched their first iron steamboats in 1844, Pusey & Jones their first in 1849; by 1857 the tonnage launched by these two Delaware ship yards exceeded the rest of the country. New iron ship yards appeared on the Delaware River and by 1870, the waterway was known as the “American Clyde,” in recognition of its role as the center of American iron shipbuilding, just as British shipbuilding concentrated on the Clyde River in Scotland.

The construction of iron ships along the Christiana River fostered the industrialization of Wilmington. The need for more workers in the iron ship yards and related industries attracted migrants to the city, causing its population to expand rapidly after 1840. The construction of iron and then steel vessels continued as an important part of the city’s and state’s economy until the Dravo Yards, the corporate descendent of Harlan & Hollingsworth, closed in 1946.

The replacement of wooden ships powered by sail with iron and steel ones propelled by steam was not a smooth transition in maritime engineering. It was, in fact, the displacement of an old industry by a new child of the American industrial revolution. The new technology of iron steamships was invented mostly in the middle of the nineteenth century in the boiler works and machine shops of firms like Harlan & Hollingsworth and Pusey & Jones. Of the hundreds of yards building wooden ships in the United States in the 1850s, only two—the Cramp Ship Yard in Philadelphia and the Sewall Yard in Bath, Maine—made a successful transition to the construction of steam-powered iron and steel ships.71 The historic context for the iron and steel shipbuilding industry thus traces the creation of a new and very significant element of the industrial revolution in the United States. Harlan & Hollingsworth and Pusey & Jones were the first in the United States to manufacture iron ships and continued as innovators in the industry throughout the nineteenth century.

The Impact of Iron and Steel Ships on Ship Yards

Manufacturing creates new goods by changing the form of the raw materials; this can occur chemically, for example, with the transformation of ore, coke, and lime into steel, or it can occur mechanically by assembling already-manufactured parts into a product such as a car or ship. In the nineteenth century, stability of methods and construction material marked the manufacture of wooden ships. Advances in wooden ships occurred primarily in the form of design and engineering to increase size, capacity, and more efficient hulls and systems of sails and rigging.

In contrast, the development of metal ships advanced on a series of inventions: the adoption of new materials such as iron and steel; the development of the industrial technology and capacity to produce these materials in large quantities; and, within the new ship yards, the invention and development of methods and machines for forming, handling, and assembling the new materials into ships. Most significantly, the development of the metal ship was tied to the advancing technology of the marine steam engine and the mechanical means of translating its energy to water propulsion with the paddle wheel, the shaft and propeller, or the screw. The availability of increasingly stronger iron, and later steel, hulls also speeded its evolution.

In the United States, wooden-hulled, paddle-wheel steamboats appeared first on major rivers such as the Hudson and the Delaware. In September 1807, Robert Fulton’s Steamboat made her famous trip up the Hudson River from New York City to Albany, New York. The Delaware River saw erratic commercial steam navigation as early as 1787, with regular steamboat passenger service started in 1809 between Philadelphia and Bordentown, New Jersey, by the paddle-wheeler Phoenix. Mechanics trying to apply steam engines to boats built most of these early steamers; the hull or boat itself was of secondary concern to them. Steam engines and wooden hulls proved to be incompatible partners if only because the vibration of steam engines pulled the flexible wooden hulls apart.

Boiler makers and mechanics started tinkering with the construction of iron hulls because they felt that “iron plates capable of containing the pressure of steam [in a boiler] could easily withstand the pressure of water.” The first experimental iron ships in both the United States and Great Britain were canal boats. The first iron ship in this country was the 60-foot Cororus, built in 1825 by the Pennsylvania boilermaker, John Edgar. By 1840, “iron hull barges were not uncommon in Pennsylvania and more than 100 had been built, primarily for use on canals.” Builders also began experimenting with iron-hulled steamships by this time. In 1841, John Ericsson built four iron-hulled steamboats in New York, and in Philadelphia the Starr family built the tug Camden, the barge Mars, and two small steamboats, while the

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72 Still, “Steam Navigation,” p. 44. According to some scholars, Fulton’s first vessel was named Steamboat until 1809, when she became the North River Steam Boat. She was never named the Clermont.

73 Ibid., p. 51.

74 Tyler, American Clyde, p. 4, 7.

75 Ibid., p. 4

Penn Steam Engine & Boiler Works built the steamboats *Conestoga* and *Barclay*.\(^{77}\)

In 1836, Mahon Betts, a foundry worker, and Samuel W. Pusey, a machinist, founded a company to manufacture railroad cars in Wilmington, Delaware. Betts and Pusey were soon joined by Samuel Harlan, a cabinet maker who led the firm into engine building and shipbuilding. In the 1840s this firm became the leading shipbuilder in the United States devoted exclusively to building iron vessels. The firm became Betts, Harlan, & Hollingsworth in 1841, when Elijah Hollingsworth bought out Pusey. The firm built its first four ships in 1844, beginning with an order from George Aspindale for two 98-foot iron freight boats to operate on the Delaware and Raritan Canal. The third ship launched by the company, the 241-ton iron paddle-wheel steamer *Wilmon Whilden*, served on the Delaware River and Chesapeake and Delaware Canal for fifty years. The fourth ship, constructed by the firm in 1845, was the first iron merchant ship built in the United States for deep sea use.\(^{78}\)

The building of iron and steel ships drove the industrial growth of the Wilmington in the second half of the nineteenth century, along with the manufacture of railroad cars. "In the 30 years following 1840, Wilmington became the first city in the United States in the manufacture of railroad cars and iron ships while its population rose from 8,452 to 30,841."\(^{79}\) By 1857, Wilmington was the leading producer of iron ships in the country: "...more iron tonnage was constructed in that city during the twelve-year period 1845-57 than all the rest of the country put together."\(^{80}\)

Harlan & Hollingsworth started building iron steamships at the time that marked the transition from the first to the second of the three stages in the development of the steamship internationally. The first stage, starting in the early nineteenth century, was the era of the paddle steamer which lasted through the 1860s; the second stage, beginning in the 1830s, was that of the screw-propelled vessel driven by increasingly sophisticated "simple" engines that used the expansion of steam only once; and the third stage, starting in the 1860s, was marked by the introduction of the more fuel-efficient and powerful marine compound engine. Although commercial wooden steamboats had been built since the early nineteenth century, the construction of iron steamships did not exist as an industry in the United States in 1840. By 1850, only three iron shipbuilding companies operated in the United States; Harlan & Hollingsworth in Wilmington, Reanie, Neafie & Company in Philadelphia and, just formed in 1849, Pusey & Jones in

\(^{77}\) Ibid.

\(^{78}\) Ibid.


\(^{80}\) Tyler, *American Clyde*, p. 16.
The evolution of the manufacturing of iron and steel ships from 1840 to 1940 is interwoven with the evolution of the American industrial revolution of the nineteenth century and the maturation of the country's industrially-based capitalist economy. The transition from the construction of wooden sail-powered boats and ships to iron and steel steam-driven vessels reflects a larger movement from a preindustrial to an industrial, or machine, economy. In a machine economy goods are produced by mechanical rather than manual power. Wooden ships, even the largest ones, were crafted and built by hand with a minimum of machines. Iron and steel ships required not only the materials of industrialization but massive machines and production facilities to manufacture them. New forms of corporate and production organization that were invented as part of the industrial revolution made these machines and facilities feasible.

Very few of the builders and financial interests concerned with wooden sailing ship construction made the transition to iron and steel ships, primarily because they could not cope with the new technical and financial problems involved in the construction of such vessels. First, there were new problems in design and construction. No longer restricted by the size, shape and strength of timber, the builders in iron and steel "had wide latitude to increase the size and to alter the form of ships." Second, "the making of templates, and the shaping, cutting, and punching of frames and plates accurately involved a considerable knowledge of drafting and geometry not included in the older art." Third, the construction and installation of machinery was a new field. Fourth, to be economically competitive, the new yards for building metal ships needed to be close to iron and steel producers and the associated engineering trades, which tended to be considerably removed from major centers of wooden ship construction. And finally, the new ship yards needed a considerable capital investment in equipment which required a large output to justify.

The iron ships being built by the 1870s were the largest objects ever manufactured and shipbuilding represented the largest scale industrial activity in the world. Organizationally it was one of the first to become vertically integrated by incorporating all of the activities needed to build a ship under one

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83 Hutchins, "History and Development," p. 41

84 Ibid.
company roof. With this it created an industrial landscape, the iron and steel ship yard, rivaled in size and scale, but not in complexity, only by the great steel mills of Pittsburgh, the Midlands, and the Ruhr.

An 1878 article, entitled "The American Clyde," describes the steps and processes involved in a typical Delaware Valley ship yard. Although the yard is not named, all of the Delaware iron shipbuilding yards followed similar procedures.

The first entrance to an iron ship yard is a trifle confusing. There are buildings of every shape and size scattered about the enclosure in apparent confusion—open sheds with curious iron floors, smiths' shops with glowing fires, carpenters shops, construction places, a wild tangle of masts and iron skeletons, things and tools of strange shapes and still stranger names. The men that swarm through all of the shops and open places appear to be going about in aimless wanderings and the incessant din of hammers only intensifies the sense of confusion. Yet all of this is as regular, as exact and methodical as a piano factory or spinning-mill. An iron ship-building plant must necessarily cover a great deal of ground. Part of the work requires the utmost quiet and neatness, other portions must be in a foundry or machine shop, and still other parts of the work are carried on in the open air. There must be room and scope enough for all that none interfere with or impede any other.85

Yards of this scale did not exist even twenty years earlier, at the beginning of the Civil War. The introduction of iron-clad warships during the Civil War created a demand for iron warships and stimulated the construction of the great iron ship yards along the Delaware River.

Iron and Steel Ship Yards as Property Types

Both Harlan & Hollingsworth and Pusey & Jones reached their peak as shipbuilders in the 1880s and 1890s in two ways: first in terms of the number of ships built, and secondly they found their market niche in the manufacture of small to mid-sized ships ranging from ferries to luxury yachts. Since this period represents the ship yard at its fully mature stage, this section will attempt to reconstruct the iron and steel ship yard of the 1880s, using Harlan & Hollingsworth primarily as the example. The iron and steel ship yard itself is the property type for this section of the ship and boatbuilding context. The ship yard for building iron and steel ships as it developed after 1860 incorporated at least three distinct manufacturing activities: foundry, engine and boiler manufacturing, and ship construction. Shipbuilding was a complicated process and ship yards presented intricate industrial landscapes.

Defining the process of shipbuilding plays a large role in comprehending the property type of the iron and steel ship yard. Little research has been done on these ship yards as they existed in the nineteenth century, partly due to the fact that machinery and industrial processes were often replaced by more modern equipment and systems, leaving few physical resources to study. The literature on the

85 "The American Clyde," Harper's New Monthly Magazine, April 1878, p. 643
evolution of iron and steel steamships concentrates on technological advances, describing the best examples of each type while ignoring broader trends and patterns. The shipbuilding process and yards are discussed only incidentally in this literature. The best source for descriptions of the yards and their activities comes from contemporary articles and insurance maps.

An 1878 magazine article describes the specific steps in building an iron steamship in a typical iron and steel ship yard. 86

1. **Specifications.** The first step in building a ship is the determination of specifications for the ship including vessel type, dimensions and a contract price.

2. **Half model.** The second step is the making of a half-model from which all of the construction drawings and patterns will be made: "Out of this block [of wood] the designer shapes a model of one-half of the hull of the ship. He gives this block the exact shape the future ship is to assume when seen from the side. Only half a model is made as the two sides of the ship will be simply duplicates of the model."87

3. **Pattern shop or loft.** From the model wooden patterns are made in the pattern shop or loft. Since patterns are made the actual size of the ship, the pattern shop must be in building as long and wide as the largest ship the yard can handle is long and deep: "The great hall of the pattern shop fragrant with new wood, light and airy with numerous windows. The men stooping and kneeling on the wide smooth floor, and mapping out great semicircles and curves of the projected ship."88

4. **Smithing shed.** The next step is the making of structural parts of the ship such as its ribs from the patterns in the smithing shed. This is an open building with a perforated iron floor. The wooden patterns are outlined on the metal floor in chalk and iron spikes are dropped in holes that correspond with the chalk lines. The wooden patterns are removed and long angle irons are heated white in furnaces in the shed. Men with tongs lay the soft and glowing angle bars against the curving row of spikes and push them and pull them into the required shape. Flat plate is also bent and shaped in the smithing shed. Parts are also punched with rivet holes and subassemblies of the ship built. This was called the "Steel Mill" which was the "place in which steel frames and plates which constitute the hull of the ship are cut to size, bent to the desired shape, and otherwise prepared for erection. . . It properly includes the milling, shaping and assembling of parts in sections for erecting upon a ship."89

5. **Machine shop.** The machine shop is where the steam engines are built: "Standing grim and

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86 “The American Clyde,” pp 641-653. Although the "typical" yard is not named, David Tyler suspects the yard described is Roach's in Chester, Pennsylvania.

87 Ibid., p. 644.

88 Ibid., p. 648.

black on the floor are the steam cylinders, great hollow barrels mounted on enormous iron legs—a huge unwieldy construction that seems impossible ever to lift into a ship.90 Many ship yards had both machine shops and boiler shops. Harlan & Hollingsworth, for example, was a major supplier of boilers for other shipbuilders on the Delaware River.91

6. Foundries. Foundries are where metal castings are made. Although many ship yards ordered their iron and steel castings, such as anchors, capstans, propellers and the like, from outside foundries, nearly all ship yards maintained brass foundries to cast the specialized high pressure valves and pipefittings needed. 92

9. Boiler or power house. The machines in late nineteenth century manufacturing were driven by belts and pulleys from a single power house which contained a large steam engine.

10. Ways and dry docks. As with wooden boats, this is where the ships are assembled along the river front.

11. Wharfs. Along the Delaware River, much of the raw material for ship building, such as iron plate, was delivered to the ship yard by ships. Wharfs acted as the receiving areas for much of that material.

12. Marine railroad. Ship yards possessed internal railroads for moving the heavy iron and steel plates, bars, and manufactured parts and subassemblies from place to place.

In 1886, Harlan & Hollingsworth published a history of the company’s first fifty years. This documented described the corporate organization of the shipbuilding section and illustrated the facilities in the ship yard with a map (Figure 88). Shipbuilding included six departments, each divided into multiple divisions (Table 1).93 The twenty-one separate divisions on this chart, not counting those in the Department of Docks and Repairs, each represented a separate set of activities and skills and illustrate the complexity of building iron and steel ships. By 1886, Harlan & Hollingsworth occupied a 43-acre site along the Christiana River with 58 buildings and 100 acres of ground under roof, including areas for power, water frontage, dry dock, tools, railway system, roadways, masting shears, derricks, building ways, and lumber system. The individual buildings are not described in the text, nor is the geographic organization of the yard. For these points the map is very useful.

The yard was organized around three ship ways that came in a east northeast direction from the Christiana River. West of these ways were a holding dock and the dry dock. Several sets of buildings

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91 Kelly and Allen, *Shipbuilding Industry*, p. 163.


Figure 88: Map of Harlan & Hollingsworth, 1886. Source: Semi-Centennial Memoir of the Harlan & Hollingsworth Company, 1886.
Table 1:
Harlan & Hollingsworth Chart of Organization, 1886

<table>
<thead>
<tr>
<th>DEPARTMENT OF MARINE DESIGN</th>
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<tbody>
<tr>
<td>Compound Engines</td>
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<tr>
<td>Beam Engines</td>
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<tr>
<td>Hulls</td>
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</tbody>
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<tr>
<th>DEPARTMENT OF MACHINERY</th>
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<tr>
<td>Machine Shop</td>
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<tr>
<td>Boiler Shop</td>
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<tr>
<td>Smithy</td>
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<tr>
<td>Millwright Shop</td>
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<tr>
<td>Ship Planing Mill</td>
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<tr>
<td>Pattern Shop</td>
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</tbody>
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<table>
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<tr>
<th>DEPARTMENT OF HULLS</th>
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<tbody>
<tr>
<td>Iron Work</td>
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<tr>
<td>Ship Carpenter Work</td>
</tr>
<tr>
<td>Molds and models</td>
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<tr>
<td>Painting</td>
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<tr>
<td>Female Labor in Painting</td>
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<tr>
<td>Spars</td>
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<tr>
<td>Rigging</td>
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<tr>
<td>Labor</td>
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<tr>
<th>DEPARTMENT OF DOCK AND REPAIRS</th>
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<tbody>
<tr>
<td>Iron Work</td>
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<tr>
<td>Ship Carpenter Work</td>
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<td>Molds and models</td>
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<td>Female Labor in Painting</td>
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<td>Labor</td>
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</tbody>
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<table>
<thead>
<tr>
<th>DEPARTMENT OF JOINERY</th>
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<tbody>
<tr>
<td>No divisions</td>
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<table>
<thead>
<tr>
<th>DEPARTMENT OF FOUNDRIES</th>
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<tbody>
<tr>
<td>Iron</td>
</tr>
<tr>
<td>Brass</td>
</tr>
<tr>
<td>Patterns and Molds</td>
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</tbody>
</table>
surrounded these ways and docks. One set lay at the head of the shipways and housed shipbuilding activities; beyond these structures to the northeast were two large buildings devoted to railroad car manufacturing. The third set sat directly east of the shipways and contained buildings devoted to the construction of steam engines: the boiler and machine shops as well as a blacksmith shop. South of the machine shop were the shops for carpenter, ship joiners, and woodworkers. To the west and northwest stood some eighteen sheds for lumber storage. An 1884 Sanborn map provides more detailed descriptions of the activities in some of the buildings (Figure 89). The heart of the ship yard lay in the shipbuilding ways:

There are three sets of building ways in the Ship Yard. These are built most strongly on the solidest of foundations possible. On natural ground they are bedded and secured beyond all question, and over the softer soil and tide-way of the stream, they are founded on double and treble rows of oaken pilings . . . These way are arranged upon nearly parallel lines, each inclining at an angle of perhaps ten degrees or 15 degrees up stream, so as to allow the largest distance for steamers to float away before being brought up to snubbing lines.\footnote{Memoir, p. 344.}

Three buildings and a shed housing shipbuilding activities stood at the head of the ship ways, containing the functions described in the 1878 magazine article. The building on the west end was the blacksmith shop with ten forges. The second building was labeled simply “Punch Shop” on one map but on another as “Cutting, Punching and Rolling Plate Iron.” The Memoir describes the machinery in this building as “well fitted with power appliances, from heavy plate rolls, plate shears, punches planers, drill presses, beam bending machines, etc., to a steam 'Bull' riveter having a cylinder 36 inches in diameter by 8 inches stroke exerting a pressure on a rivet of at least 36 tons.”\footnote{Memoir, p. 334.} The Sanborn map shows a small building attached on the east side of the punch shop labeled “Bolt'g Rivet M'f'g” which is where the Bull riveter may have been located.

The third building, which is an open shed housing furnaces, is labeled “Bending Furnaces” on the Memoir map and “Ship Iron Bending Shop” on the Sanborn map. This is apparently what was so graphically described as the “Smithing shop” in the Harper’s article. About this shed, the Memoir states, “Then comes the heating furnaces, four in number, for heating plates, beams and angles. The bending floor used in connection with the furnaces mentioned above is of square, perforated cast iron, being 1,487 square feet in area, the whole, both furnaces and the floor being under cover of a partly open frame building.”\footnote{Memoir, 1886, p. 335.} There is a fourth building sited between two of the ways called “Ship Frame Shop” on the
Figure 89: Sanborn Insurance Company Map of Harlan & Hollingsworth yard, 1884.
Iron and Steel Ships

Memoir map and the "Fitting Iron Shop" on the Sanborn map.

Directly west of these ship yard structures, are the three buildings in which engines and boilers are manufactured: the machine shop, the upper blacksmith shop and the boiler shop. (Although the Memoirs do not mention the pattern loft, the Sanborn maps shows the pattern shop on the second floor above the machine shop.) About the machine shop the Memoirs simply says "Foremost among these comes the machines in the Machine Shop, among which are the finest and most perfected specimens of modern iron working machinery, but of which it is unnecessary to make detailed mention."

About the blacksmith shop the writer of the company history is more explicit giving a good sense of the scale of the machinery,

There are three steam hammers in the upper blacksmith shop, one of 2,000 pounds drop, one 1,100 pounds and one of 500 pounds. A heating furnace, 10 feet by 4 feet 9 inches, is operated to supply the largest hammer with hot billets for its forge work . . . In another part of the shop is a very powerful punch capable of punching a six-inch hole through inch plate.

Harlan & Hollingsworth manufactured scotch boilers for other yards as well as for its own needs. The machines in the boiler shop are described in the Memoirs as "an interesting series . . .beginning with a set of power rollers and extending through a number of powerful punches and shears to an immense hydraulic riveting plant. . . This machine exerts 100 tons of pressure upon the plate and rivet." Other large scale equipment included derricks and masting shears. To move materials throughout the yard the 43-acre site a railroad with four and a half miles of track.

The activities and buildings plotted on the Sanborn maps of the Pusey & Jones ship yard in 1884 were similar. They included:

1. Offices
2. Pattern loft (on third floor above the Lobdell Car Wheel Company machine shop)
3. Pattern storage building
4. General foundry
5. Small brass foundry
6. Ship joiners' shop
7. Iron plate rolling shed
8. Bending ship plate shed (open shed surrounding furnace)
9. Riggers, plumbers and paint shop
10. Forge shop
11. Machine shop
12. Three ship stocks.

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97 Memoirs, p. 333.

98 Memoirs, p. 334.

By 1901, the date of the next set of Sanborn maps, the yard revealed some expansion and new construction, but retained basically the same organization (Figure 90). Harlan & Hollingsworth expanded their number of launching ways from four to six and built new buildings and reorganized activities around the ways. A new two-story building was built at the head of the ways with the punch shed on the first floor and the molnew punch shed was built on the southwest side of the ways along with a furnace and a steel bending shed.

Bethlehem Steel modernized the yards after they were acquired from Harlan & Hollingsworth by in 1902 but the Harlan Plant, as it was called by Bethlehem, was "just one in a series of trust-owned ship yards [and] was used only when it offered competitive advantages over others." Although Pusey & Jones escaped this fate, their shipbuilding declined except for a spurt during World War I. The period of greatest significance for iron and steel shipbuilding in Wilmington is 1840 to 1900.

**Evaluation Criteria Related to Iron and Steel Ship Yards**

The criteria for listing on the National Register of Historic Places is that "[t]he quality of significance in American history, architecture, archeology, engineering, culture is present in districts, sites, buildings, structure and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association." A resource must possess integrity in four of the seven areas in order to be eligible for listing. There are four criteria for evaluation and when evaluated within its historic context, a property must be shown to be significant for one or more of the four criteria--A,B,C, or D. They are:

- **Criterion A:** That are associated with events that have made significant contribution to the broad patterns of our history; or
- **Criterion B:** That are associated with the lives of persons significant in our past; or,
- **Criterion C:** That embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master or that possess high artistic values or that represent a significant and distinguishable entity whose components may lack individual distinction; or,
- **Criterion D:** That have yielded, or may be likely to yield, information important to history or prehistory.

A historic context is linked with tangible historic resources through the concept of a property type. A property type is a grouping of individual properties that share physical or associative characteristics.

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100 Hoffecker, p. 158.

Figure 90: Sanborn Insurance Company Map of Harlan & Hollingsworth yard, 1901.
Physical characteristics may be structural forms, architectural styles, building materials and site type. Associative characteristics reflect the nature of associated events or activities, to associations with a specific individual or group of individuals, or to the category of information about which a property may yield information.

The iron and steel ship yards is a physical property type, with singular traits that make it a unique industrial landscape. As a landscape, a nineteenth century ship yard for building iron and steel ships is to be evaluated as a historic district under procedures guiding the National Register. A district is defined as possessing a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.

The organization and coherence of a ship yard reflects the process of building iron and steel ships. As has been described, each step in the process of manufacturing ships had certain historic properties—buildings, structures and objects—associated with it. They were tied together by yet another historic resource which was generally some system of rail circulation which moved materials from step to step until the ship on the way was completed and ready to launch.

Five major functions make up an iron and steel ship yard of the late nineteenth century: model and pattern or mold making; hull fabrication; engine manufacturing and installation; finishing including carpentry and shipjoinery; and circulation system and movement of materials. Each of these includes specific activities each with an associated sub-property type. The shared physical characteristics of a late nineteenth century ship yard are:

A. Model and pattern making
   1. Model shop
   2. Mold loft, the length of which determined the largest ship that could be built in that yard

B. Iron and Steel Fabrication for Hulls
   1. Foundries
   2. Smithy shop or Iron/Steel Bending Shed with Furnaces
   3. Punching Shed
   4. Framing Shop with riveters
   5. Ship ways and drydocks
   6. Material storage

C. Engine Construction and Installation
   1. Machine shop
   2. Boiler shop

D. Ship Finishing and Ancillary Services
   1. Carpentry and shipjoinery shops
   2. Millwright shop

E. Circulation system and other means of moving materials for assembly
1. Rail
2. Derricks, cranes, masting shears
3. Roads
4. Wharfs

Determining the Integrity of a Iron and Steel Ship Yard

A resource must possess integrity in a minimum of four out of the seven area of integrity in order to qualify for listing on the National Register of Historic Places. Of the seven areas, four relate most closely to establishing the significance of an iron and steel ship yard: design, setting, location, and workmanship.

**Design** is the combination of elements that create the form, plan, space, structure, and style of a property. In relation to a ship yard, design refers to the organization of the yard and the historic resources that represent the shipbuilding process. **Workmanship** is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory. For the context of iron and steel ship yards, this refers to the evidence of the crafts and skills practiced in the yard. **Setting** is the physical environment of a historic property. In terms of a ship yard, setting refers to the way in which the ship yard was oriented to the water and how the character of the site and surrounding area influenced the ship yard’s development. **Location** is the physical location where the historic resource was originally constructed or where an historic event took place. To have integrity a ship yard must meet the following criteria:

1. **Setting**: The site must still encompass the area of shipbuilding activity and be free of incursions from new construction. How the yard related to the river in terms of constructing and launching vessels must still be clear.

2. **Design**: The yard must contain historic resources from each of the five major sub-property types to the extent that the shipbuilding process on the yard can be understood. The most important elements are the mold loft, foundries, iron and steel bending and framing structures and shipways or drydocks and machine and boiler shops. Without most of these a yard cannot be considered to have integrity of design.

3. **Workmanship**: Here the concern is with the presence of objects, primarily machinery, that evidence the skills of the workers and heavy industrial nature of shipbuilding. Machine tools and forges would represent the former, and derricks and multi-ton traveling cranes would represent the latter. While actual machinery may not survive, archaeological evidence of its location, mounting, and function would strengthen the integrity of the site.

4. **Location**: The location of an iron and steel ship yard must combine access to heavy raw materials and industrial suppliers, a water body of sufficient size and depth to accommodate the ships to be built in number and size, and accessibility to a market.

5. **Materials**: Materials are not an important consideration in evaluating the integrity of an iron and steel ship yard. Structures and buildings in a ship yard were built to house stages in the shipbuilding process. They varied greatly from one yard to another and showed not architectural uniformity. In addition, these buildings and structures underwent constant expansion and modification as yards grew or changed their product focus.
6. **Feeling:** The most important aspect of feeling in a late nineteenth century ship yard is the sense of the monumental scale of the activity needed to build large iron and steel ships. This can be reflected in the size of the buildings, structures, ways, dry docks, and derricks.

7. **Association:** This area of integrity is less important for iron and steel ship yards. The yards are important not for their construction of one particular ship but for the sheer number and type of ships produced and for the application of new innovations to designs.

**Applying National Register Criteria to Ship yards**

**Criterion A: Event.** To be considered for listing under Criterion A, a property must be associated with one or more events important in the shipbuilding historic context. Ship yards may be associated with both individual events and patterns of events. An individual event might include the launching of a particular significant ship and a pattern of events might include the manufacturing over time of a class of ships significant in the American shipbuilding industry. Events may also be inventions. The ships built in Wilmington seemed to incorporate both individual inventions and patterns of innovations. An event may also be more generically industrial such as a strike.

**Criterion B: Person.** This criterion applies to properties associated with individuals whose contributions to history can be identified and documented. This criterion can apply to owners as well as individuals within the firms who may have made important contributions to the building of iron and steel ships or to their technological innovations.

**Criterion C: Design/Construction.** This criterion applies to properties significant for their physical design or construction. The requirement of this criterion most applicable to ship yards is that the property represent a significant and distinguishable entity whose components may lack individual distinction. To be eligible under this criteria a yard would have to possess a very high degree of integrity.

**Criterion D: Knowledge.** This criterion applies to properties that could provide information related to the context. To retain integrity under this criterion, a ship yard would have to show evidence of machinery fittings, etc., in buildings and structures sufficient to reconstruct the process of shipbuilding; subsurface remains sufficient to identify different functional areas and the layout of the yard and/or to supplement the evidence of standing remains.

**Status of Previous Surveys of Iron and Steel Shipbuilding in Wilmington**

In 1992, Stuart Dixon completed an intensive level survey of the Wilmington Waterfront Analysis Area for the Wilmington Planning Office to determine the eligibility for the National Register of Historic Places of industrial properties in this area. The surviving buildings from both Harlan & Hollingsworth and Pusey & Jones were surveyed and evaluated. Normally, such a survey would have followed the development of a historic context such as this one rather than preceding it. Because the survey
evaluated all the industrial buildings in the waterfront area, its evaluation criteria were necessarily general and detailed criteria for individual industries, such as shipbuilding, were not developed.

Fourteen buildings were surveyed on the Harlan Hollingsworth site (Complex #7) and 16 were surveyed on the Lobdell Car Wheel and Pusey & Jones Company site (Complex #11). On the Harlan & Hollingsworth site, all of the buildings were found to be potentially eligible for the National Register; two as part of the complex and the remaining twelve both individually and as part of the complex. Of the buildings, two were determined to be related to shipbuilding and the rest to railroad car manufacturing. It is our view that because the buildings were not evaluated in the context of the shipbuilding process that more of the resources on the site may be potentially eligible for the National Register of Historic Places under the context of iron and steel shipbuilding. All of the buildings on the Lobdell/Pusey & Jones site were found to be eligible for the National Register. Four were considered to be related to shipbuilding. It is our recommendation that both of these sites should be reevaluated in light of the current historic context on iron and steel shipbuilding in order to determine whether the yards retain sufficient integrity and significance to be eligible for the National Register under that context.
VI. Associative Property Types for Ship and Boat Building

The ship and boat building industry relied on a variety of resources/groups beyond the immediate shipyard itself to support their activities. The physical resources related to these activities are known as associative property types for the ship and boat building context and may include a wide range of resources from housing for itinerant ship carpenters to saw mills that produced ship lumber. This chapter identifies the resources and activities that retained some connection to the ship and boat building industry and discusses ways of documenting both the connection and their significance for the context.

The supporting resources of the ship and boat building industry can be divided into three groups—those that supplied raw materials, those that provided finished items to complete the construction of the boat, and those related to support of the individuals involved in ship and boat building. In most cases, the activities of the people connected with these resources were not solely related to shipbuilding but served a variety of industries and populations.

Raw Materials

The construction of ships and boats, particularly those over a certain size, required specific conditions in the raw materials. Wood, or more specifically ship timber, represented the largest volume of raw material needed for shipbuilding. Ship yards also needed rope, and cotton or canvas cloth for sails if they made their own. In some cases, these products could be obtained locally, but often the ship yards sent for them from some distance away—particularly the ports of Baltimore and Philadelphia.

Saw mills. Ship lumber, for example, needed to be of a minimum length for the construction of large wooden boats, and in many cases ship carpenters preferred certain types of wood for different sections of the boat. Not every saw mill in the region could produce wood to the required specifications, but some mills specialized in ship lumber. In 1850, the census of manufacturing listed four saw mills in Delaware that produced ship timber. Peter Wapley, in Baltimore Hundred, produced 100,000 feet of "vessel timber" and 60,000 feet of frame stuff with a water-powered saw mill and one employee. Ferdinand Hollingworth owned a saw mill in Murderkill Hundred with four workers. His product was more evenly divided between ship timber and ordinary frame stuff—200,000 feet of each. Murderkill Hundred contained a second saw mill producing ship timber that year. William McIraine produced 140,000 feet each of ship timber and frame stuff. The only other saw mill in the state that reported the production of ship timber belonged to D. McConaughey, of Pencader Hundred. With ten employees, he produced an unspecified amount of ship timber valued at $4500—by far the highest dollar value for any load of ship timber produced that year. But cutting ship timber apparently did not remain a consistent product for any one particular mill. None of these four men appeared ten years later with ship timber as a product. Instead, a new group of mills listed ship timber in a variety of new locations. Thomas Walters, for example, owned a
“Steam Saw Mill” specifically for the manufacture of ship timber. He produced 2,000,000 feet of ship timber in Wilmington that year. This pattern repeated in later years as well.

Some wooden ship yards included their own saw and/or planing mills for the preparation of both rough logs and precut slabs. This made sense when the yard used a great deal of timber and needed it cut to certain specifications. Having the mill on site removed the cost of transporting the finished timber and also meant quicker access to the product as needed.

Saw mills for ship timber do not have any specific features to differentiate them from saw mills that produced any other type of lumber. To retain significance under the context of ship and boat building, a saw mill must first possess a documentary link between the mill and the industry—for example, listing ship timber as a product in the census of manufacturing, or account book entries documenting the sale of ship timber to a ship yard. The mill must also retain sufficient evidence of the milling process as it existed at the time the mill produced ship timber. In terms of physical integrity a saw mill must retain evidence of any machinery that dates to the ship timber period, such as water wheels, saw mechanisms, and the physical structure of the mill building itself.

**Rope walks.** Ship yards consumed thousands of yards of rope in the construction of wooden ships—both for use in rigging the sails, and in moving materials around the ship yard during construction. Documentary research to date has failed to turn up any evidence of rope walks in the state. The best description of a typical rope walk comes from *Diderot’s Encyclopedia* (Figures 91 and 92). The main physical requirement for establishing a rope walk was space—a rope walk could be as much as 800 feet in length—but the basic machinery could be installed in any long open building, underground, shed, or partially covered area. Rope was made by twisting the hemp fibers between two sets of wheels. Heavier rope or cable could be made from multiple strands of rope twisted together. More complex systems of rope walks might be built if the market warranted, but more often they stayed simple in nature and often temporary in existence. The most likely location for a rope walk in Delaware would have been in the vicinity of Wilmington. But rope walks represent an historic resource that leaves virtually no trace on the landscape once it closes down its operation. There are few permanent structures associated with the activity and the evidence is most likely to be archaeological. If a site or building is identified through documentary evidence as a possible rope walk location, the most important characteristic needed for integrity would be the machinery—the wheels—or at least archaeological evidence of the machinery. Any site identified as a probable rope walk should be investigated thoroughly to help determine additional evaluation criteria for this property type as it existed specifically in Delaware. It should also be noted that it is highly likely that ship yards obtained much of the rope they needed from ship chandlers who purchased the product from larger manufacturing areas such as Philadelphia and Baltimore.
Figure 91: A small rope walk showing wheels and cables. Source: Denis Diderot, *A Diderot Pictorial Encyclopedia of Trades and Industry* (New York: Dover Publications Inc., 1959), Plate 475.
Figure 92: Twisting multiple strands of yarn into a larger cord. Source: Denis Diderot, *A Diderot Pictorial Encyclopedia of Trades and Industry* (New York: Dover Publications Inc., 1959), Plate 476.
Specialized Products

A variety of artisans produced items specifically for use by ship and boat builders. These included, among others, mast and spar makers, sailmakers, blockmakers, pumpmakers, and blacksmiths. In each of these cases, the artisan produced an element essential to the operation of the boat, but not an integral part of the body of the boat. It is important to note that these artisans and their shops were incorporated into many of the larger shipyards as essential parts of the shipbuilding process.

**Mast and Spar Makers.** Mast and spar makers produced the wooden beams used to rig the sails on sail-powered boats. Spar "is a general name for a mast, yard, or boom" and these pieces ranged in length from ten to over one hundred feet, depending upon the type of boat or ship under construction.\(^{102}\) Spars and masts for smaller boats could be made by ship carpenters on site, but in bigger shipyards sparmaking often had its own specialized shop (Figure 93). Areas with an abundance of ship building occurring might support an independent mast and spar maker such as William Griffenburg, listed as a "Mast and Spar Manufacturer" in Wilmington in 1860. Griffenburg's workshop employed three workers producing masts and spars of various types and sizes out of pine.\(^{103}\) Carpenters preferred pine and spruce for masts and spars. The large lengths of wood needed, particularly for masts, could not always be obtained locally by the mid-nineteenth century. Shipbuilders and mast makers imported timber to fit these needs from Norway and from the northwestern United States by boat and railway.

Little is known about the types of buildings used by independent mast and spar makers. Mast and spar shops were most likely to be located in areas near the shipbuilding yards. Photographic evidence suggests that they worked in open yards with the timbers supported on wooden frames or sawhorses (Figure 94). In larger shipyards, they might work in a long shed with plenty of windows for natural lighting, or in an open space in the yard. Mast and spar makers used traditional woodworking tools, such as axes, planes, draw knives, and rules for their work, but in each case modifications made the tool uniquely useful for mastmaking (Figure 95).

Due to the lack of either physical resources or defining physical characteristics from which to develop evaluation criteria, the best way to identify a particular resource as being associated with mast and spar making, and thus with the ship and boat building industry, is through documentary records. Census of manufacturing or population records, for example, that identify an individual as a mast or spar maker,

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\(^{103}\) United States Census of Manufactures, Delaware manuscript returns, 1860.
Figure 93: Sparmaker's plan used by employees of the Jackson and Sharp yard in Wilmington. Source: Delaware State Archives, Dover, Delaware.
Figure 94: Shipwrights working on masts and booms in an open yard.
Figure 95a: Mast plane used by mast and spar makers on right. Note the difference in the sole of the mast plane and the smoothing plane.

Figure 95b: Mast shave used by mast and spar makers at bottom. Note difference between mast shave and other types of draw knives. Source: R. A. Salaman, *Dictionary of Woodworking Tools* (Newtown, CT: The Taunton Press, 1990), p. 334, 361, 177.
Figure 95c: Mast axe used by mast and spar makers, top right. Note the difference between the mast axe and those for other professions. Source: R. A. Salaman, *Dictionary of Woodworking Tools* (Newtown, CT: The Taunton Press, 1990), p. 54, 59.
combined with a link between that person and the occupation of a particular site may indicate that the site was used for mast and spar making. Another possible documentary link could be the Sanborn Fire Insurance maps that identify all buildings on a property and may label one building or open area as a "mast and spar shop." Much of the information remaining at such sites will probably be of an archaeological nature.

**Blockmaking.** A block "is a wooden housing containing one or more pulley wheels known as sheaves" (Figure 96). Sailors used blocks on ships to help with lifting sails, rigging, and other heavy items like cargo. Shipbuilding provided one of the largest markets for blocks of any industry in the nineteenth century. Production of blocks was essential for any form of wooden boat. Blocks could be made by hand, using woodworking tools modified for that purpose (augers, chisels, claves, and gouges) or with the block making machines developed in the early nineteenth century (Figure 97). As with the manufacture of mast and spars, shipwrights could acquire blocks in one of three ways: 1) purchase them from a local blockmaker, 2) purchase them from a ship chandler or other merchant who bought them at a more distant location, or 3) employ a carpenter with the skills to make blocks on site as needed. The 1850 population census for Delaware lists no blockmakers at all, suggesting that the first alternative received little use. In most cases, blockmaking was incorporated into the larger process of ship building in the wooden ship yards or the blocks were purchased from a location outside the state.

The primary evidence for identifying an artisan as a blockmaker will come from one of two sources--the population census listing of occupation, or the presence of blockmaker's tools in an inventory. If any resources related to this activity survive, they are most likely to be found in the larger wooden ship yards but will probably consist only of frame workshops with no particular distinguishing features.

**Upholstering/car and steamboat furnishings.** One of the finishing touches required by most larger wooden ships, as well as steam boats and ferries, was the upholsterer's work in providing comfortable seating for passengers and some crew members. In 1860, Thomas Clowards operated a business for the manufacture of "Car & Steam Boat Furnishings and Upholstery" in Wilmington. Employing four men and one woman, Clowards's shop produced fittings made of ticking, muslin, plush, and curled hair. We have no evidence of what a shop like this one looked like or where it was located. Identification of such sites will most likely come from documentary sources such as the manufacturing census, street directories, and inventories that list upholsterer's tools (awls, hammers, punches--Figure 98).

**Sailmaking.** One of the essential elements of any wind-powered boat or ship was the sail. "Sails are an assemblage of several breadths of canvas, or other texture, sewed together, and extended on or between the masts, to receive the wind and impel the vessel through the water. The edges of the cloths,

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104 Salaman, p. 465. Much of the following discussion is drawn from Salaman's description of blocks and blockmaking.
Figure 96: A typical block used on boats and ships. Source: Salaman, *Dictionary of Woodworking Tools*, p. 465.
Figure 97: Auger used by blockmaker at top. Note difference in tips between this one and the augers at bottom used by other trades. Source: Selman, Dictionary of Woodworking Tools, p. 32-33.
Figure 98: Upholsterer's tools. Source: Salaman, *Dictionary of Woodworking Tools*, p. 492.
or pieces, of which the sail is composed, are generally sewed together with a double seam, and the whole is skirted round at the edges with a cord called the bolt-rope."\textsuperscript{105} Sails could be made of flax or cotton canvas, and the primary skill involved was sewing. The major property type related to this activity was the sail loft, usually a large open room (often on the second floor of a workshop) where there was enough space to lay out the sails while working on them. The room required plenty of windows to allow the maximum amount of natural light to work by. Like the other associated property types, this resource appears to have existed primarily as part of the large ship yards in Wilmington (Figures 99 and 100). Evidence suggests that many of the smaller ship yards in the state towed their hulls to locations in Baltimore or Philadelphia to be rigged, thereby indicating that a minimum of this activity occurred as a local industry. Given the scarcity of projected resources related to this property type, any surviving resource with evidence of the tools and process of sailmaking should receive a high priority for documentation. This craft required the use of specialized tools (sailmaker's bench, sail hook, grease horn, palm or thimble, needle, stitch mallet, prickers, hand fid, set fid, rubber, serving mallet, rigger's screw, and marble spike--Figure 101). The presence of any of these tools in an inventory may suggest that the owner engaged in sailmaking or rigging, even though his stated occupation was as a tailor or carpenter.

Support Services and Housing

The final group of associative property types related to ship and boat building includes resources that provided support services and housing for people working in the ship and boat yards. Most of these resources were not constructed specifically to serve the industry but became connected with it over time.

Housing. Housing for ship and boat yard workers came in several different forms, depending upon the type and size of the yard. In small towns like Leipsic and Little Creek boarding houses and hotels provided short-term homes for itinerant ship carpenters as they moved from one town to another constructing small wooden boats and ships in both permanent and impermanent yards. The hotels and boarding houses possess no specific physical characteristics that distinguish them from other dwellings or hotels in a given town. The characteristic that identifies them with the ship and boat building context is the documentary link that establishes a connection between individuals known to work in the ship and boat industry and the hotel or boarding house. Most often this comes from the manuscript population census after 1840, which listed every inhabitant of every dwelling and their occupation. In 1850 James Masons operated a hotel in Little Creek Landing. When the census taker visited on August 23 of that year, he found eleven shipcarpenters and one sailor living in the hotel. All of the shipcarpenters were young men between the ages of twenty and thirty, including at least one set of brothers, and came from Delaware,

Figure 99: Sanborn Insurance Company map of Moore's Ship Yard, 1901. Note the sail loft located adjacent to, but not in, the yard.
Figure 100: Sail plan used by employees of the Jackson & Sharp yard in Wilmington. Source: Delaware State Archives, Dover, Delaware.
Figure 101: Tools used by sailmakers. Source: Salaman, *Dictionary of Woodworking Tools*, p. 402.
Associative Property Types

Pennsylvania, and New Jersey. While Masons' hotel may represent an unusual number of occupants involved with shipbuilding, many other hotels in river towns housed smaller numbers of shipcarpenters on a regular basis.

Boarding with local residents, particularly single women householders, provided another housing option for itinerant shipcarpenters. Shipcarpenters throughout the state employed this alternative for housing, creating small communities of such workers in river towns and certain area of cities like Wilmington. Like the hotels, these boarding houses were not constructed with such activity in mind; rather they were the dwellings of families that designated one or more rooms as rental spaces to supplement the family income. The households most likely to provide this service were homes headed by women, often widows with children to support. As with the hotels, the link connecting these boarding houses with the ship and boat building industry is a documentary one, usually the manuscript census identifying ship carpenters living in someone else's household. The 1850 census for Milford Hundred, for example, lists Joseph Buss and R. Dodd, both ship carpenters between the ages of 19 and 35, as living with Mary Buchanan, a single woman aged 59. In the same year William Taylor, a ship carpenter aged 22, found a home in Wilmington with Phebe Mitchel, a single woman aged 40.

The third option for housing of ship carpenters related to the wooden ship and boat industry came in the form of a master-apprentice relationship. A master carpenter who owned his own shipyard and a house nearby might provide housing for his apprentices and other ship carpenters in his own household. This pattern appeared in many places throughout the state, but seems to have been most common in small river towns that contained established shipyards. Again, like hotels and boarding houses, these dwellings contain no known physical features to differentiate them from other dwellings of the same construction period and location. The link that makes them part of the associative property type of ship carpenters' housing is documentary, specifically in the form of the manuscript census.

The final possibility for housing of workers for ship and boat building is formal workers' housing constructed by the larger iron and steel ship yards in Wilmington. This housing is similar to workers' housing for other industrial concerns built in the late nineteenth and early twentieth centuries. Usually the company built these dwellings either on the yard itself or in the nearby vicinity of the yard. Few examples of such housing survive in the area of the Wilmington ship yards. Figure 102 illustrates what may have been typical workers' housing in the vicinity of the Jackson and Sharp or the Harlan and Hollingsworth yards. The dwellings exist as row houses or duplexes, barely two stories in height and only one or two rooms deep, with three bays on the first floor and two on the second. The finish on the buildings is very plain, and the structures fill most of the lot with little room for plantings or grass. Without the discovery of records demonstrating the company's allocation of such housing, it is difficult to say exactly who lived in these houses in terms of occupations related to the ship yard. To retain significance under the shipbuilding context, the dwelling must have a documented link to a shipbuilding yard or company, and
Figure 102: Workers housing near Jackson and Sharp.
must retain the basic form and plan of the house as it existed when occupied by ship yard workers.

**Ship chandlers.** A ship chandler was a store that sold equipment needed by ships and boats for operation, ranging from rope and fixtures to sails and provisions. While ship chandlers most often serviced ships after construction was completed, they also supplied some of these goods to ship and boat yards for construction purposes, ordering goods and materials from Baltimore, Philadelphia, and New York as stock items. No existing buildings have been identified as ship chandlers in Delaware but it is likely that they exist in some of the small river towns, possibly as stores for other purposes. To possess significance under this context, a resource identified as a ship chandler's location would have to retain interior features such as shelves and counters from the period of significance for ship building as well as integrity in terms of basic form and plan from that period.

**Evaluation Criteria Related to Associative Property Types**

The primary link between many of these associative property types and the ship and boat building industry will be documentary sources rather than physical characteristics. To be eligible for nomination to the National Register under the context of ship and boat building, a resource must have an established link to a known ship carpenter or shipyard, or documentation of the production of materials or services directly related to ship and boat building. This may come in the form of account books itemizing transactions between a ship builder and a supplier such as a saw mill or blacksmith, an inventory listing tools specific to one of the activities related to the associative property types, identification of specific products on the census of manufacturing, occupations named in the population census, or businesses named in a street directory or atlas. Without that established link, the resource cannot be considered eligible for the National Register under this context.

Another characteristic of many of these support industries is that they do not seem to have lasted in one place for long periods of time. Griffenburg's spar manufactory appears only in the 1860 census of manufacturing. Whether he moved out of the state, possibly to an area with a larger market for masts and spars, is unknown. Thomas Clowards ran a "Car and Steam Boat Furnishings and Upholstery" shop in Wilmington in the same year, but again disappeared by 1870.

These resources gain significance primarily from their economic link with the ship and boat yards and their employees. In most cases, this link must be established through documentary sources and significance for the context derives from the strength of that link. Issues of integrity must come from the National Register criteria as they relate to the economic activity carried out at the site. For example, in order for a mast and spar maker's shop to possess integrity within the context, it must retain sufficient evidence to document the process of sparmaking as it occurred at that particular site. If there is no evidence remaining for that process, then the resource does not possess integrity under the ship and
boat building context. This system can be applied to any of the associative property types related to the industry.
VII. Goals and Priorities for the Ship and Boat Building
Historic Context and Property Types

An essential part of any historic context are the goals and priorities that it sets for preservation planning activities related to the resources associated with the context. The Secretary's Standards require that goals and priorities be established in four areas: identification of resources, evaluation of resources, registration of resources, and treatment of resources. This chapter sets out the goals and priorities related to the ship and boat building context and its property types.

Goals and Priorities for Identification Activities

A high priority should be placed on the identification, through survey, of all ship and boat yards still existing in the state. While this context has identified some, there is a possibility that others may still survive. This investigation should also determine whether any yards exist as potential archaeological sites. Identification of ship and boat building-related resources is a difficult task as the surveyor is confronted with identifying a manufacturing process that no longer exists. Without process, a ship yard differs little from other industrial or commercial building forms. To minimize the difficulties surrounding the identification of historic resources defined by this context, a process combining archival research, oral history, and reconnaissance survey is recommended. The archival stage obtains information from the documentary record regarding the configuration and location of major ship and boat yards within the state. Guided by this information, survey can then identify those resources associated with ship and boat building and evaluate the surviving elements for eligibility to the National Register. Interviews with Delawareans directly involved with the ship and boat building industry complements the documentary record on larger industrial endeavors, but may prove the only source for minor boat yards and the ephemeral, traditional craft building locales. Driven by information obtained through these initial stages, survey work can then concentrate on those areas likely to retain resources related to this context.

Reconnaissance Survey. A reconnaissance level survey identifies those resources more than fifty years old within a specified geographic area, and must include photographic documentation and completion of a cultural resource survey form in accordance with state guidelines. A comprehensive survey of all resources related to this context must be undertaken as soon as possible. Due to the fragile, and desirable, waterfront locations of ship and boat building activities, this survey must be initiated within one year of the integration of this context into Delaware's preservation planning priorities. Both photographic and documentary recordation of ship and boat yards must include mechanical processes as well as architectural and landscape-related attributes.

In conjunction with reconnaissance survey, the compilation of a "collections guide" of shipbuilding related artifacts should be completed. Items such as tools or fixtures contribute to the context, integrity, and significance of historic resources. In some cases, the artifact remains physically
Goals and Priorities

associated with the resource; in others, it may exist only in a museum or private collection. As these objects are essential to our understanding and interpretation of ship and boat building, every effort needs to be made to inventory these resources.

In connection with this process, we recommend that a program of oral history interviews be conducted to assist with the identification of ship and boat yard sites that may not be readily identifiable on the landscape. This serves as a valuable contribution to the historical record of the state, but also assists in the identification of shipbuilding related resources as many sites will only be identified through the memories of living Delawareans. Additionally, brief interviews will identify and locate documentary, photographic, and artifactual information held in private collections.

Finally, the existing cultural resource survey for areas within the maritime region should be reviewed to identify any resources potentially related to ship and boat building as associative property types. Documentary research should be carried out for these resources in order to determine whether a link exists between the resource and the ship and boat building industry.

Goals and Priorities for Evaluation Activities

An intensive level survey and evaluation of ship and boat building related resources should be undertaken as soon as possible after the completion of preliminary survey activities. Intensive survey reviews the data obtained through the identification process and determines which resources are potentially eligible for the National Register. Any resources identified as ship or boat yards, or as resources associated with ship or boat yards, should be evaluated for their significance and integrity in relation to the context and the National Register criteria. This facet of the preservation planning process may prove the most difficult and costly to complete. Integrity, as defined by this context, is a combination of machinery, buildings, and landscape. The interaction of these three created the manufacturing process of ship and boat construction. Delaware retains few resources that satisfy the integrity requirements established by this context. Many resources will need to be evaluated as part of a thematically organized intensive survey such as the inclusion of saw and planing mills under the thematic heading of forestry or timber harvesting.

The second factor adding to the problem of evaluating ship and boat building related sites is dealing with vanished and ephemeral resources. Many ship yards exist only as below-ground resources. Buildings, machinery, and water oriented structures vanished from view decades ago as ship yards ceased operations, yet may remain as archaeological sites. The only way of obtaining information on the size, configuration, and placement of equipment is through careful analysis of below-ground evidence. The back-yard boat shop creates an additional dilemma. While excavation may indicate an area of high organic deposition, it is difficult to ascertain whether that resulted from the shaping and trimming of boat's
timbers or from more mundane tasks such as cutting firewood. Again, sites with no evidence of durable construction may fall under broad, thematically based surveys. Surveys directed at marshland resources must include the construction of vessels needed in both transportation and the harvest of fish and wildlife.

Although some ship and boat building related resources survive, either as standing structures or as archaeological sites, water-based industrial endeavors such as this present a distinctive problem. Ship and boat yards rose on fast land adjacent to navigable bodies of water. Both rural and urban locations satisfied this condition. As urban waterfront redevelopment and rural resort communities become increasingly important components of late twentieth century growth, the potential for the complete eradication of all resources defined by this context becomes a reality. Significant archaeological sites and standing structures identified through the survey and evaluation processes should be catalogued and investigated as funding becomes available or as threats surface. Coordination with the Delaware Department of Transportation and Department of Natural Resources will assure that projects proposed by either agency take into account important sites.

Goals and Priorities for Registration Activities

The list of potentially eligible resources compiled during the identification and evaluation stages of the preservation planning process should result in the nomination to the National Register of Historic Places those resources deemed significant and possessing adequate integrity. Three alternatives exist for the nomination of ship and boat building-related resources: individual nominations, thematic nominations, and multiple resource nominations. The choice of which form of nomination is chosen depends upon the physical condition of the ship yard itself.

Individual Nominations. Resources that satisfy the requirements of significance and integrity for this context can be nominated as individual resources. An individual nomination must satisfy the stipulation that two of the three elements defining integrity remain. An individual nomination for a ship or boat yard may, and in all likelihood will, contain multiple buildings, structures, and objects. Given the low rate of survival for ship and boat yards and their associated resources, a high priority should be placed on the timely nomination to the National Register of Historic Places of any resources that satisfy the evaluation criteria for the context of ship and boat building and the National Register. An immediate priority should be placed on the nomination of the Vinyard Shipbuilding Company of Milford, one of the surviving yards uncovered by the research conducted for this context. It retains sufficient elements of the shipbuilding process, evidence of the machinery, and the landscape, to be significant under the context as an example of the wooden ship yard property type.

Thematic Nominations. This category may prove the most productive in terms of actual
number of resources nominated to the National Register. Although few resources satisfy integrity requirements for eligibility as ship yards, some resources related to the construction of ships and boats may survive in isolation. Offices, wharves, or workshops that once contributed to the operation of a ship yard are significant to this context as well as the larger context of industrialization in Delaware. These resources could become parts of thematic nominations dealing with diverse yet related topics. Examples of cranes or derricks might comprise a thematic nomination based on the products of a specific manufacturer or type of installation. Wharves or docks represent another category of objects intrinsically linked with ship yard activities yet present at industrial sites throughout the state. Nominations covering multiple industries provides isolated, yet significant fragments of vanished factories the opportunity for eligibility.

**Multiple Resource Nominations.** An expanded perspective applies to the creation of multiple resource nominations for shipbuilding-related resources. The possibility exists that resources from different locations throughout the state representing the best (or only) example of the various components of a ship yard, be combined into a single nomination. In this way, the shipbuilding process is illustrated without requiring that a single yard survive. Given the low number of surviving ship yards, this option may prove very important.

**Goals and Priorities for Treatment Activities**

Treatment refers to the specific actions taken in the preservation of historic resources. Treatment priorities for the preservation of resources related to this context fall into three categories: documentation of threatened resources, the identification of process fragments, and a heritage education program.

**Delaware Threatened Buildings Survey.** Survey completed as part of the identification and evaluation steps should also identify those resources threatened by neglect or development. Industrial sites are frequently abandoned as market conditions fluctuate or as technology renders them obsolete. The financial strain of insurance and maintenance leads many owners to destroy, albeit justifiably, significant elements of Delaware's industrial heritage. Documentation of surviving sites that retain integrity of any of the three elements that define the property type of ship or boat yard (buildings, machinery, landscape) is necessary in order to obtain a higher level of information regarding the physical attributes of the property type. Working under the framework of the Delaware Threatened Buildings Survey, historic resources associated with this context should be recorded to the appropriate level as determined by the Delaware State Historic Preservation Officer. Documentation should be completed in accordance with the guidelines of the Threatened Buildings Survey or those established by federal agencies such as the Historic American Engineering Record.

Threatened resource documentation in Delaware has focused on buildings, structures, or
associated archaeological sites. The resources addressed in this context, based on a manufacturing process, require that documentation methods be expanded. We recommend that threatened resource documentation include both oral histories, and detailed descriptions and drawings of engineering process and equipment, in addition to structural illustrations such as floor plans and elevations. Detailed documentation creates an inventory of photographs and drawings, creating an illustrated library of information on all elements of the ship and boat building process.

**Process Fragments.** While the identification and evaluation of structures and sites is an important issue, shipbuilding stood as an industrial process. The fact that many yards operated without the benefit of durable structures implies that many existed as a compilation of hand tools and assorted power equipment. These fragments of the manufacturing process are as important to our understanding of shipbuilding as the buildings that once sheltered the men who used them. Every effort should be made to locate and preserve these parts of the ship yard. It is imperative that public institutions obtain, catalog, and conserve tools and equipment of the shipwright. The Vinyard yard in Milford contains an unequalled collection of hand and power tools that represent over fifty years of shipbuilding. Every aspect of shipbuilding is represented in the contents of a few buildings. The relocation of this equipment to a secure environment will preserve at least some elements of the shipbuilding process. The alternative is to lose these artifacts through deterioration, neglect, or purchase by private collectors. These tools and equipment, like many portable remnants of the past, have become desirable collector's items, and preservation professionals frequently find themselves in competition with the private sector.

**Public Education Program.** An intense and diverse public education program is needed to preserve this facet of Delaware's economic and industrial history. Due to the lack of resources and the difficulty in preserving these as a public museum, it is unlikely that any resource related to ship and boat building will survive for future generations. The preservation of miscellaneous objects and the documentation of standing resources will provide some sense of the industry, but will not portray the full range or depth of the state's ship and boat building industry. The proposed method of education includes two sections. First, a publication detailing the development and growth of the industry within a regional and national context should be prepared. This will extend beyond the great iron ship yards of Wilmington and address the skiffs and duckers of the marsh, the sloops of Frederica, and the schooners of Milford. Public awareness of the state's industrial heritage must extend beyond the Brandywine and include rural industrial development. The second means of including the general public is through museum exhibits. Unfortunately, the size and complexity of an entire ship yard precludes its use as a museum exhibit, yet basic elements of the process can be depicted through photographs, interpretive text, and process fragments.
Other Information Needs

More information is needed on the actual vessels constructed in Delaware’s ship and boat yards. Research for this context showed that an immense variety of vessels slid down the ways of the state’s yards and saw service throughout the world. As an associative property type of this context, ships and boats become an integral part of the state’s manufacturing system, but also crucial to our understanding of the economic and commercial systems that supported industry, agriculture, and the bay’s fisheries. Delaware vessels saw service as pleasure yachts and as ships of exploration on South American rivers. This diversity can only be fully understood through comprehensive research into the numbers, types, and sizes of vessels, and by exploring the history and ultimate end of key vessels. The possibility exists that some vessels survive either in Delaware or other states.

Delaware’s ship and boat building industry relied on a regional web of exchange that extended at least as far as Philadelphia on the north and Baltimore on the west. As suppliers of goods and raw materials, these cities played an important role in the state’s industrial system. Additionally, smaller ship yards often towed hulls to yards in other cities for final rigging and fitting. More information is needed on this regional exchange system and on the national system that supplied lumber, steel, or iron to the state’s yards.
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Appendix A:
Catalog of Known Ship and Boat Yards in Delaware

Number of vessels greater than (> 20 tons; number of vessels less than (< 20 tons

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Vessels</th>
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<tbody>
<tr>
<td>Wilmington (Steel/Iron Ships)</td>
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<tr>
<td>Wilmington (Wooden Ships)</td>
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<tr>
<td>Milford</td>
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<tr>
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<td>24 &gt; 20T</td>
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<tr>
<td>Bowers</td>
<td>93 &lt; 20T</td>
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<tr>
<td>Millville</td>
<td>1 &gt; 20T</td>
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<tr>
<td>New Castle</td>
<td>1 &gt; 20T; 3 &lt; 20T</td>
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<td>2 &lt; 20T</td>
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<tr>
<td>Drawbridge</td>
<td>1 &gt; 20T</td>
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<tr>
<td>Odessa</td>
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<tr>
<td>Delmar</td>
<td>1 &lt; 20T</td>
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<tr>
<td>Cranston Heights</td>
<td>2 &lt; 20T</td>
</tr>
<tr>
<td>Townsend</td>
<td>1 &lt; 20T</td>
</tr>
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</table>

Milford—Ships over 20 Tons

*Ships with identified builder (Master Carpenter):*
- James W. Abbott - 1874, 1881
- Wm. J. Reville - 1886
- Simpler & Reville - 1883
- J. H. Harper - 1881, 1882, 1883
- John R. Cahill - 1882 (3)
- Thomas Carlisle - 1877, 1887
- Williams & Lank - 1891
- Wm. G. Abbott & Sons - 1891 (2)
- J. W. Abbott & Sons - 1874, 1879, 1880, 1884, 1885, 1891
- G. A. Abbott - 1896
- Wilson M. Vinyard - 1907, 1908, 1911, 1919, 1920 (2), 1921, 1923

Vinyard constructed his first ship in a yard in New London, Wisconsin in 1898—a 95 ton steamer named the “Delaware.” Although Vinyard is listed as a resident of Milford in this year, he is also listed as a Master Carpenter of New London. Vinyard’s Delaware ships seem to approximate this vessel in size.
Wm. A. Scribner - 1874, 1880
George P. & Asher J. Hudson - 1892

No identified builder:
1863, 1864, 1866, 1867(2), 1868 (2), 1872

Milford--Ships under 20 Tons

Ships with identified builder:
E. M. Wallace & Sons - 1935 (3), 1936 (8), 1937 (5), 1938 (2), 1939, 1940
E. M. Wallace also listed as Master Carpenter at Hoopers Island, Maryland in 1932.
Wm. H. Wallace - 1935 (4), 1936 (3), 1938
George Gillespie, Sr. - 1935 (6), 1936 (3)
James B. Gillespie - 1936 (6), 1938, 1939 (3)
Wm. G. Abbott - 1898 (5), 1922, 1928 (2), 1930 (2)
Valvert L. Fox - 1939

No identified builder:
1899

Frederica--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
Nathaniel Lank - 1884, 1886, 1888 (2), 1899 (2), 1890 (3), 1892
Thomas Lacey and Nathaniel Lank - 1870, 1871, 1874, 1875
R. R. Postles - 1907

No identified builder:
1846, 1867 (2), 1869, 1873

Frederica--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
R. R. Postles - 1934 (2)
Wm. E. Holliger - 1934 (2)
W. Marion Stevenson - 1934

Lebanon--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
Henry Deputy - 1887
Maloney & Shif - 1872
Wm. Maloney - 1873
S. C. Wells - 1881
Hendrickson & Wells - 1883

Milton--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
Cornelius C. Davidson - 1887 (2), 1891 (3)
David H. Atleins - 1887
James P. Davidson - 1891, 1892, 1894, 1906 (3)
Rouse J. Potter - 1907 (2), 1913
Theodore S. Wilson - 1879
J. L. Black & Bros. - 1883
Appendix A

No identified builder:
1859, 1864 (2), 1866 (2), 1868, 1870, 1873

Milton--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Rouse J. Potter - 1915
J. D. Short - 1936

Wilmington

The predominant builder of ships in Wilmington was the Harlan and Hollingsworth company, constructing over 80% of all Wilmington's vessels prior to 1915 (total number of vessels about 190). The other major builder of ships, exclusively iron vessels, was the Pusey and Jones Company. While Pusey and Jones did construct complete vessels, the business appears focused on marine engines and boilers as the company experienced extended periods with no shipbuilding activity. For example, active in the 1860s and 1870s, shipbuilding declined slowly until the 1890s when no ships were built. By the late 1890s, activity resumed and continued into the early twentieth century. Both firms remained active into the nineteen-teens with Harlan and Hollingsworth again proving the more active of the two firms. Between 1918 and 1921 the firms built numerous ships for the transportation of oil and for the United States Shipping Board. Pusey and Jones held contracts with the USSB for vessels of 1750 net tons and built five in 1918; six in 1919; and four in 1920. Harlan, now known as the Bethlehem-Harlan Works erected larger ships, approximately 5100 tons, for the USSB (1918-9; 1919-5; 1920-7) as well as five heavy tankers for Sinclair in 1921. Harlan constructed two vessels in 1916 and three in 1917.

In the 1920s, Pusey and Jones continued produced heavy tankers and freighters, Bethlehem's Harlan Works constructed vessels in 1923 and 1926, but then vanishes from the Port Registry by 1927. The Dravo contracting Company began building vessels in Wilmington in the early 1930s. Listings for the 20s and 30s area as follows: 1923--Bethlehem (1) Pusey & Jones (4); 1925--Pusey & Jones (4); 1926--Bethlehem (3); 1927--Pusey & Jones (1); 1928--Pusey & Jones (1); 1929--Pusey & Jones (1); 1930--Pusey & Jones (5); 1931--Pusey & Jones (4); 1932--Dravo (2); 1933--Pusey & Jones (1); 1934--Dravo (2); 1936--Pusey & Jones (1); 1937--Pusey & Jones (1); 1938--Dravo (2) Pusey & Jones (2); 1939--Pusey & Jones (2); 1940--Pusey & Jones (2); 1941--Pusey & Jones (2).

In addition to those ships raised in Wilmington in 1939, numerous ships from Bethlehem's Leetsdale, PA works; Sun Shipbuilding and Dry Dock of Chester, PA; and American Bridge Company of Ambridge, PA were first enrolled at Wilmington. The same type of registry took place in 1937 when the St. Louis Shipbuilding Company enrolled over a dozen tankers at the Port of Wilmington. It is possible that these companies contracted idle yard space (possibly Bethlehem's idle Harlan works) in Wilmington. Dravo Contracting Corporation, although the number of ships with Wilmington listed as port of construction are small, was very active in Pittsburgh and Neville Island, PA. Again this may imply that Dravo's Wilmington facility was physically constructing the vessels, but the registry form listed the company's corporate address.

Other Wilmington yards included Enoch Moore who consistently built one or two vessels each year, and established a family business that stretched form the early nineteenth century (Moore appears in the 1814 Wilmington directory) until the turn of the century when Enoch Moore, Jr. operated the shipyard. Jackson and Sharp, another long-lived Wilmington yard operated throughout the second half of the nineteenth century, constructing from one to three ships annually. Moore and Jackson and Sharp constructed only wooden vessels with Moore erecting two-masted schooners of about 50 tons and 60 feet in length, and Jackson and company building larger barges and steam powered vessels approaching two hundred tons and 100 feet in length. Among the less well-established Wilmington yards were Nes and Levy of the 1890s; A. J. Barnett and Sons active in 1872 and building three, three-masted schooners of 465 tons/145 feet, 454
tons/139 feet, and 353 tons/135 feet; W. W. Smith also active in 1872 raising a three-masted schooner of almost 500 tons; and A. L. Limlins who built a single 250 ton schooner in 1875. The American Car and Foundry Company constructed twelve vessels—one each in 1906, 1911, two in 1912, one in 1916, one in 1918, two in 1917, two in 1919, one in 1929, and one in 1930. M. M. Davis and Son erected a single vessel in 1912, and Wm. A. Thatcher laid the keels of the "Emma" and "Alice" in 1866. A. L. Tomlinson raised a single vessel in 1875.

Information regarding small boats within the city is elusive. While the firm of Thomas Dreire and Son appear on the 1870 Census of Manufactures as "Small Boat Builders," no ships' registry papers carry their name. Builders of vessels under twenty tons include a gas-powered, screw by Wilhelm A. Brosch in 1936; Joe Piersen in 1909; B. F. Anderson in 1915; George C. King in 1919; Broddus Jones in 1935; as well as two unidentified builders both working in 1896. The American Car and Foundry Company built a single vessel under twenty tons, a steam yacht for the E. I. duPont Company, in 1939.

**Dover--Ships over 20 Tons**

*Ships with identified builder (Master Carpenter):*

Thomas Draper - 1881

*No identified builder:*

1886

**Dover--Ships under 20 Tons**

*Ships with identified builder (Master Carpenter):*

Irvin S. Lynch - 1931

**Holly Oak--Ships under 20 Tons**

*Ships with identified builder (Master Carpenter):*

George C. Morris - 1908, 1931

**Holly Oak--Ships over 20 Tons**

*Ships with identified builder (Master Carpenter):*

Samuel Banner (listed as "boatbuilder") - 1893

**Millville--Ships over 20 Tons**

*Ships with identified builder (Master Carpenter):*

John G. Collins (listed as "boatbuilder") - 1893

**Bethel--Ships over 20 Tons**

*Ships with identified builder (Master Carpenter):*

John M. C. Moore - 1889, 1891 (3), 1892, 1893 (2), 1894 (2), 1895, 1896, 1898, 1899, 1900 (2), 1901 (2), 1902 (2), 1903, 1904, 1907, 1908

John M. C. Moore is also listed as a Master Carpenter for a yard in Sharpstown, Maryland. Moore's ships are consistently schooners of about 190 tons and ranging in length from 120 to 150 feet. The vessel constructed by Moore in 1901 is one of the largest ever floated in southern Delaware—a barge of 703 tons.

Smith & Terry - 1917
Appendix A

Seaford--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
Joseph Milligan - 1901
M. Griffith - 1875
Allen P. Vane - 1920, 1921, 1922, 1925
Delaware Shipbuilding Company - 1918

No identified builder:
1873

Seaford--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Charles R. Marvel - 1929, 1930 (3), 1931 (2), 1934 (2)
John S. Smith - 1934 (2), 1935, 1936 (2), 1940
John W. Gladhill - 1933

Brandywine--Ships over 20 Tons

No identified builder:
1842, 1868

Little Creek--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
Hobson and Collins - 1871
H. C. Deputy - 1872

Little Creek--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
John W. Short - 1927 (3), 1930 (4), 1931, 1932, 1935 (5), 1936 (7), 1937, 1939, 1940 (2)
Gilbert F. Tribbitt - 1936
E. M. Wallace - 1934 (2)
John R. Davis - 1927 (2), 1930 (2)
Alford T. Moore - 1930
Isaac M. Burris - 1930

Lewes--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
W. S. Maul - 1883
H. R. Mcllvuise - 1879

No identified builder:
1859

New Castle--Ships over 20 Tons

No identified builder:
1857
New Castle--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
George I. Sutton - 1940 (2)
George E. Wilhelme - 1936

Smyrna--Ships over 20 Tons

No identified builder:
1873

Smyrna--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Frances A. Smith - 1931

Drawbridge--Ships over 20 Tons

No identified builder:
1865

Bowers--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Tribbitt constructed gas screws of about 10 tons and 35 feet in length.
Howard B. Thompson - 1936 (2), 1937, 1938 (2), 1939
Herman D. Faulkner - 1937

Richardson Park--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Paul A. Morgan - 1935 (2)

Harrington--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Arlie T. Jacobs - 1932, 1935 (2)

Mahons--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Irvin S. Lynch - 1928 (2)

Odessa--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Clayton Vogt - 1910
Joseph Pierson - 1935

Barker's Landing--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
S. C. Wells - 1884
Magnolia--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
G. W. Hudson - 1875

Indian River--Ships over 20 Tons

Ships with identified builder (Master Carpenter):
Joseph Burk - 1886

Delmar--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
Leo Barker - 1935

Cranston Heights--Ships under 20 Tons

Ships with identified builder (Master Carpenter):
J. Milton Latta - 1940
Victor S. Ereckson - 1937

Townsend --Ships under 20 Tons

Ships with identified builder (Master Carpenter):
C. N. Burrows - 1938
Appendix B:
Excerpts from the United States Census of Manufactures, 1850-1880

1850
Murderkill Hundred--Kent County

Samuel Lorchard, Shipbuilder: $600 invested; raw materials--50,000 feet white oak worth $840, 5000 feet white pine worth $125, 3000 spikes and bolts worth $150; 6 employees w/$125 monthly wages; products--2 vessels (schooners) of 60 tons each worth $4000.

Asa Allen, Blacksmith: $150 invested; raw materials--15,000# iron worth $600, 150 bushels bituminous coal with $40; 2 employees w/$42 monthly wages; products--2000 spikes “For Vessels” worth $140, “Ship Smithing” and “Hull Rigging” worth $200, cultivators worth $300, and other articles worth $600.

Ferdinand Hollingworth, Saw Mill: $2800 invested; raw materials--logs worth $3750, 150 cords wood worth $300; used steam power; 4 employees w/$71 monthly wages; products--200,000 feet ship timber worth $3600, 200,000 feet frame stuff worth $3000.

Wm. G. McIlraine, Saw Mill: $3000 invested, raw materials--logs worth $3000; used water power, 1 employee w/25 monthly wages; products--140,000 feet “ship timber” worth $2520, 140,000 feet frame stuff worth $1960.

John Lank, Shipbuilder: raw materials--42,000 feet white oak worth $935, 5000 feet white pine worth $135, 5 tons iron worth $300; 6 employees w/$150 monthly wages; products--2 vessels (sloops) worth $3000.

1st Division of New Castle County (Rockland and duPont in this area)

Jonathan Zebly, Shipbuilder: $10,000 invested; raw materials--50,000 feet white oak worth $1200, 20,000 feet white pine worth $400, 3 tons iron worth $240, sundries worth $180; 8 employees w/$288 monthly wages; products--3 vessels (schooners) worth $8000, ship repairs worth $2000.

Pencader Hundred-New Castle County

D. McConaughey, Saw Mill: $3000 invested; raw materials--250,000 feet lumber (sounds more like a product to me); used water power; 10 employees w/$200 monthly wages; products--“ship timber” worth $4500.
Wilmington-New Castle County

Harlan and Hollingsworth, Machinists: $60,000 invested; raw materials--1000 tons iron worth $60,000, lumber worth $1500, sundries worth $28,500; used steam power; 180 employees w/$5000 monthly wages; products--"Machinery of all kinds and Iron Boats" worth $175,000.

Thomas Young, Shipbuilder: $8000 invested; raw materials--150,000 feet oak worth $4500, 35,000 feet pine worth $1050, sundries worth $9000; 20 employees w/$720 monthly wages; products--4 new vessels worth $16,600, 6 rebuilt vessels worth $6600, "U.S. Buyes [buoys?]" worth $500, ship repairs worth $1850.

E. & G. Moore, Shipbuilder: $11,000 invested; raw materials--250,000 feet lumber worth $7200, 8 tons iron worth $480, copper worth $600; 25 employees w/$900 monthly wages; products--2 vessels of 528 tons each worth $18,000, other work worth $2500.

W. & A. Thatcher, Shipbuilder: $25,000 invested; raw materials--250,000 feet oak worth $4000, 75,000 feet pine worth $1500, iron worth $6000; 50 employees w/$1800 monthly wages; products--4 sailing vessels worth $16,000, 2 steamers worth $20,000, other work worth $12,000.

J. & J.A. Harris, Shipbuilder: $15,000 invested; raw materials--100,000 oak worth $2200, 20000 feet pine worth $460, iron worth $1000; 20 employees w/$560 monthly wages; products--one "large" vessel worth $8000, other work worth $5000.

Baltimore Hundred--Sussex County

Peter R. Wapley, Saw Mill: $1000 invested; raw materials--400 pine logs worth $300, 500 trees worth $600; used water power; 1 employee w/$20 monthly wages; products--60,000 feet boards worth $600, 100,000 feet vessel timber worth $1000.

1860

1st Division of New Castle County-New Castle County

George Churchman, Saw Mill: $5000 invested; raw materials--83,400 cubic feet logs worth $12,500; used water power driving a shear and 2 saws; 13 employees w/$299 monthly wages; products--1,000,000 feet ship planks worth $20,000.
Dover Hundred-Kent County

William A. Shakespeare, Saw Mill: $5000 invested; raw materials—1000 logs worth $5000; used steam power; 8 employees w/ $200 monthly wages; products—500,000 feet ship lumber worth $15000.

Duck Creek Hundred-Kent County

D.J. Murphy, Saw Mill; $5000 invested; raw materials—800 oak logs worth $1600; used water power; 4 employees w/ $88 monthly wages; products—250,000 feet ship timber worth $5000, other work worth $1000.

Phineas Coverdale, Saw Mill: $5000 invested; raw materials—1300 oak logs worth $1700; used steam power; 3 employees w/ $60 monthly wages; products—400,000 feet ship timber worth $9000.

Murderkill Hundred-Kent County

John Kersey, Saw Mill: $7000 invested; raw materials—1200 logs worth $6000; used steam power; 7 employees w/ $200 monthly wages; products—600,000 feet ship timber worth $18,000, carriage stuff worth $2000.

Brandywine Hundred-New Castle County

W. & A. Thatcher, Shipbuilding: $15,000 invested; raw materials—40,000 feet oak and pine worth $8000, 3000# iron worth $1200, naval stores worth $500; 8 employees w/ $200 monthly wages; products—vessel building and repairing worth $14,000.

Wilmington-New Castle County

Thomas Clowards, "Car & Steam Boat Furnishings and Upholstery": $3000 invested; raw materials—1000 yds ticking worth $125, 500 yds plush worth $1000, 1500# curled hair worth $450, 1000 yds muslin worth $100, misc. worth $50; 4 male employees w/ $160 monthly wages, 1 female employee w/ $10 monthly wages; products—"Manufactures for cars and steam boats with wood materials furnished by ???????" worth $4650.

J. & J.A. Harris, Shipbuilder: $25,000 invested; raw materials—100,000 white oak worth $30,000, 20,000 feet other worth $5000, 10,000 feet white pine worth $2500, 20 tons iron worth $1200, naval stores
worth $400; 20 employees w/$900 monthly wages; products--1 new vessel worth $15,000, old work and repairs worth $40250.

J.M. Poole & Company, Machinist: $50,000 invested; raw materials--150 tons castings and 10 tons wrought worth $10,000, fuel worth $125, bituminous coal worth $500; 30 employees w/$900 monthly wages; products--steam engines and mill work of various kinds worth $30,500.

Woolman & Sullivan, Shipsmiths: $2500 invested; raw materials--iron, steel, and fuel worth $1000; 8 forges; 6 employees w/$100 monthly wages; products--ship work worth $3200.

Pusey and Jones Company, Steam Engine Builder and Machinist: $45,000 invested; raw materials--400 tons castings worth $25,000, 1200 tons bar iron worth $7200, 150 tons plate iron worth $12,000, 65,000 feet lumber worth $2275, 350 tons bituminous coal worth $1400, misc. worth $14,200; used 30 HP of steam power; 120 employees w/$2275 monthly wages; products--"Steam Boats, Steam Engines & Mill Work, Generally" worth $120,000.

*** The Next Six Firms Were Sequentially Listed in the Census ***

E. & C. Moore, Shipbuilders: $33,500 invested; raw materials--300,000 feet oak and pine worth $7500, 50,000# iron worth $2000, 3000# oakum worth $180, paints and oils worth $340, misc. worth $10,000; under power--"Horse Power Marine Railway"; 20 employees w/$800 monthly wages; products--2 new schooners worth $30,000, repairs to old vessels worth $5000.

Thomas Walters, "Steam Saw Mill Manufacturers of Ship Timber, etc.": $35,000 invested; raw materials--2,000,000 feet white oak and pine worth $50,000; 100 HP of steam power; 20 employees w/$700 monthly wages; products--2,000,000 feet white oak and pine lumber worth $70,000.

Baldwin & Harris, Ship Smith: $2500 invested; raw materials--61.5 tons iron worth $4000, bituminous coal worth $300; steam power running a single trip hammer; 6 employees w/$280 monthly wages; products--134,000# ship work worth $10,725.

Kirkman & Co., Shipbuilders: $20,000 invested; raw materials--250,000 feet white oak worth $7500, 8 tons iron worth $480, misc. worth $1000; 12 HP of steam power; 20 employees w/$780 monthly wages; products--3 new vessels worth $21,000, repairs worth $1200.

Wm. O. Griffenburg, Mast and Spar Manufacturer: $1000 invested; raw materials--pine logs worth $2000; 3 employees w/ $100 monthly wages; products--masts and spars of various kinds and sizes worth $4176.
Anthony Winn, Block Manufacturer: $500 invested; raw materials--3 tons lignum vita [sic] worth $120, 2500 feet ash worth $75, iron and brass bushings worth $500; 2 employees w/$35 monthly wages; products--"Blocks of Various Sizes and Kinds" worth $1500.

Wm. & A. Thatcher, Shipbuilders: $50,000 invested; raw materials--300,000 feet lumber worth $16,000, 30 tons iron worth $2000, naval stores worth $800, misc. worth $700; 6 HP of steam power used for sawing; 40 employees w/$1400 monthly wages; products--1 steam tug and 1 steam frey? [frug?] lt. boat worth $20,000, repairs on old vessels worth $28,200.

Weaver & Femenick, Sailmaker: $1000 invested; raw materials--15,000 yds canvas worth $950, rope, etc. worth $180; 3 employees w/$150 monthly wages; products--17 sets? sails worth $4250, repairs worth $2280.

Harlan & Hollingsworth, "Iron Steam Vessel, Steam Engine & Boiler, and Railroad Car Manufacturer": $250,000 invested; raw materials--600 tons iron castings worth $40,000, 1000 tons puddled iron plate worth $60,000, 200 tons boiler plate worth $25,000, 400 tons wrought iron worth $24,000, 600,000 feet lumber and timber worth $130,000, misc. and 1000 tons anthracite and bituminous coal worth $33,500; 70 HP in 3 steam engines; 600 employees w/$18,000 monthly wages; products--12 steam vessels worth $400,000, steam engines and boilers worth $50,000, railroad cars of various kinds worth $100,000.

Broadkiln Hundred--Sussex County

*** The Next Four Firms Were Sequentially Listed in the Census ***

R. Paynter, Saw Mill: $2000 invested; raw materials--100,000 feet logs worth $1000; used water power; 1 employee w/$20 monthly wages; products--100,000 feet ship timbers.

Noah Magee, Shipbuilder: $5000 invested; raw materials--75,000 feet lumber worth $1800, 5 tons iron worth $350; 7 employees w/$39 monthly wages; products--1 schooner worth $9000.

Samuel Martin, Shipbuilder: $5000 invested; raw materials--100,000 lumber worth $2300, 5 tons iron worth $350; 6 employees w/$39 monthly wages; products--1 schooner worth $9000.

Wm. G. Prettyman, Shipbuilder: $6000 invested; raw materials--80,000 lumber worth $2000, 5 tons iron worth $350; 7 employees w/$39 monthly wages; products--1 schooner worth $9000.
Appendix B

Morgan & Narding, Saw Mill: $10,000 invested; raw materials--120,000 feet logs worth $1200; 20 HP steam power; 4 employees w/$100 monthly wages; products--120,000 feet ship timber worth $2400.

Cedar Creek Hundred--Sussex County

P. F. Causey, Saw and Flour Mill: $3000 invested; raw materials--50,000 feet log worth $580, used water power, 1 employee w/$25 monthly wages; products--50,000 feet ship timber worth $1000.

C.S. Watson, Saw Mill: $2000 invested; raw materials--50,000 feet log worth $580, used water power, 1 employee w/$25 monthly wages; products--50,000 feet ship timber worth $1000.

Wm. V. Coulter, Saw and Flour Mill: $3000 invested; raw materials--100,000 feet log worth $1000, used water power, 1 employee w/$25 monthly wages; products--100,000 feet ship timber worth $2000.

James N. Deputy, Shipbuilder: $8000 invested; raw materials--200,000 feet lumber worth $4000, 10 tons iron worth $750; 20 employees w/$39 monthly wages; products--2 schooners worth $18,000.

Wm. A. Scribner, Shipbuilder: $4000 invested; raw materials--100,000 feet lumber worth $4000, 5 tons iron worth $375; 10 employees w/$39 monthly wages; products--1 schooners worth $9,000.

H.D. Deputy, Shipbuilder: $4000 invested; raw materials--100,000 feet lumber worth $4000, 5 tons iron worth $375; 10 employees w/$39 monthly wages; products--1 schooners worth $9,000.

1870

Kenton Hundred--Kent County

Henry H. Pennell, Steam Saw Mill: $1000 invested; 1-10HP steam engine running 2 high pressure saws; 4 male employees over 16 years old; $2000 annual pay; operated 12 months; raw materials--logs worth $5000; products--ship planks worth $10,000.

Mispillion Hundred--Kent County

Thomas R. Adkins, Saw Mill: $1200 invested; 2 steam engines developing 28HP running 2 high pressure saws and 1 plane; 3 male employees over 16 years old; $450 annual pay; operated 6 months; raw materials--8000 feet white oak logs worth $4800; products--100,000 vessel lumber worth $9500.
William Sheddake, Jr., Saw Mill: $15000 invested; 1 steam engine developing 26HP running 1 saw and 1 plane; 4 male employees over 16 years old; $720 annual pay; operated 9 months; raw materials--5000 feet white oak logs worth $3000; products--70,000 vessel lumber worth $6300.

Wilmington Subdivision Number 1

Pusey and Jones Company, Machinery and Shipbuilding: raw materials--100 tons boiler iron worth $13,000, 50,000# brass and copper worth $17,500, 1000 tons coal worth $5,000, 200,000 feet lumber worth $7000, 200 tons bar iron worth $16,000, 250 tons plate iron worth $21,000, other unspecified materials brings the total expended to $177,500; 1 steam engine developing 30 HP and running 39 lathes, 10 planers, 8 punches, 9 drills, and 4 shears

Machinery Division: $75,000 invested; 75 male employees over 16 years old; $35,000 annual pay; operated 12 months; products--1 fourdinier paper machine, 1 steam saw mill, 8 stationary engines, 23 boilers, 6 marine boilers worth $84,000, and repairs worth $50,000.

Shipbuilding Division: $175,000 invested; 200 male employees over 16 years old; $100,000 annual pay; operated 12 months; products--5 iron steamboats with machinery worth $300,000, repairs worth $56,000.

"Steamers built-Iron Steamer "Rosa" Side Wheel Steamer - running on Savannah River; do no name Exported to Peru - screw steamer shipped in Pieces; do do for Export to Bolivia - Side Wheel Steamer shipped in pieces; do "Tambo" Exploration Steamer - Side Wheel Steamer Built for Republic of Peru; do "Amazona" Merchant Steamer Side Wheel Running on River Amazon; Also Exported 6 Stationary Boilers to West Indies and 1 Marine Boiler to South American Port.

James Bradford, House, Ship, and Sign Painter: $5000 invested; 4 paint mills; 15 males over 16 years old; $10,000 annual wages; operated 12 months; raw materials--"Lead, Oil, Turp., Colors, etc." worth $10,000; products--"House, Ship and Sign Painting" worth $25,000.

Wilmington Subdivision Number 25

Harlan & Hollingsworth, Cars, Iron Ships, Steam Engines, and Boilers: $500,000 invested; steam engines developing 110 HP and running lathes, planers, slotters, punches, shears, and rollers; 800 male employees over 16 years old and 50 children; $450,000 annual wages; operated 12 months; raw materials--lumber worth $100,000, iron worth $250,000, castings worth $50,000, coal worth $6500,
Appendix B

hardware worth $12,000, sundries worth $100,000; products--50 cars worth $200,000, 6 ships worth $600,000, 20 steam engines and boiler work worth $100,000, sundries worth $100,000.

Ship Division: $200,000 invested; steam engines developing 30 HP and running 30 machines; 500 males over 16 years old and 25 children; $250,000 annual wages; operated 12 months; raw materials--iron worth $225,000, castings worth $30,000, lumber worth $50,000, castings worth $5000, sundries worth $25,000; products--6 vessels worth $600,000 with a gross tonnage of 5500.

Machinery Division: 150 males over 16 years old and 15 children; $100,000 annual wages; operated 12 months; raw materials--total worth of $98,500; products--8 marine engines worth $100,000, 12 stationary engines worth $20,000, 30 boilers worth $80,000, misc. worth $30,000.

Thos. Dreire & Son, "Small Boat Building": $500 invested; hand labor, no machines; 2 males over 16 years old; $2100 annual wages; operated 12 months; raw materials--5000 feet lumber worth $250, 4 tons iron worth $350, 25# copper worth $125, 10# brass worth $30; products--22 boats worth $1500, jobbing worth $110.

John Taylor, Pump and Block Manufacturer: $500 invested; 1 foot lathe and 1 hand drill; 2 males over 16 years old; $250 annual wages; operated 12 months; raw materials--2000 feet lumber worth $900, 2 tons iron worth $140, 300# brass worth $120, 2 tons lignum vitae worth $120; products--pumps and blocks worth $3000.

New Castle County--subdivision 26

E. & C. Moore, Shipbuilder: $50,000 invested; horse and hand power; 2 marine railways; 19 males over 16 years old and 1 child; $8426 annual wages; operated 12 months; raw materials--225,000 feet timber worth $9000, 40,000# iron worth $2000; products--1 schooner at 224 tons gross worth $14,500, repairs worth $12,000.

Amos Harris, Shipsmith: $5302 invested; 3 forges; 4 males over 16 years old; $2752 annual wages; operated 11 months; raw materials--28 tons iron worth $2403, 250# steel worth $39, 13 tons coal worth $89; products--4960# forgings worth $6144, repairs worth $1029.

Jackson & Sharp, Manufacturers of Cars, Vessels, Sash, Doors and Blinds: $250,000 invested ($10,000 in shipbuilding); steam power developing 65 HP (15 HP for shipbuilding); 50 woodworiking machines; 410 males over 16 years old and 18 children; $215,000 annual wages ($5,000 shipbuilding); operated 12
months; raw materials--$130,000 ($15,000 shipbuilding); products--150 cars worth $375,000, sash and door worth $47,000, ship repairs worth $15,000, sash and doors for vessels worth $3000.

**Cedar Creek Hundred--Sussex County**

James Richards, Saw Mill: $1000 invested; water power developing 20 HP; 1 saw; 1 males over 16 years old; $150 annual wages; operated 9 months; raw materials--wood, timber, and logs worth $500; products--70,000 feet of braces, framing, and ship plank worth $1500.

**1880**

**Wilmington**

Harlan & Hollingsworth, Iron Ships: $500,000 invested; 600 males over 16 years old and 200 children; $324,000 annual wages; $2.00/day for skilled labor; raw materials worth $336,000; products worth $800,000; 9 boilers with 10 engines producing 240 HP.

Pusey and Jones, Iron Ships: $250,000 invested; 375 males over 16 years old; $100,000 annual wages; $1.30/day for skilled labor; raw materials worth $130,000; products worth $240,000; 2 boilers with 1 engines producing 20 HP.

Jackson, Sharp and Company: $75,000 invested; 140 males over 16 years old; $58,085 annual wages; $2.00/day for skilled labor; raw materials worth $77,420; products worth $165,750; 6 boilers with 1 engines producing 50 HP.

John Willie, Sailmaker: $2000 invested; 2 males over 16 years old; $800 annual wages; $2.50/day for skilled labor; raw materials worth $1300; products worth $3000.

R.W. Birnie, Sailmaker: $1000 invested; 5 males over 16 years old; $3600 annual wages; $2.50/day for skilled labor; raw materials worth $5000; products worth $9500.

John Taylor, Block and Pump Maker: $5000 invested; 4 males over 16 years old; $2000 annual wages; $1.80/day for skilled labor; raw materials worth $3000; products worth $8000; 1 boilers with 1 engines producing 50 HP.
Enoch Moore Jr. (On Christina), Shipbuilder: $8000 invested; 40 males over 16 years old; $9000 annual wages; $2.25/day for skilled labor; raw materials worth $30,000; products worth $48,000; 1 boilers with 1 engines producing 35 HP.

Cedar Creek Hundred--Sussex County

William Scribner (On Mispillion), Shipbuilder: $15,000 invested; 25 males over 16 years old; $5000 annual wages; $1.50/day for skilled labor; operated 7 months; raw materials worth $9000; products worth $25,000; 1 boiler.

James W. Abbott (On Mispillion), Shipbuilder: $18,000 invested; 38 males over 16 years old; $6000 annual wages; $1.50/day for skilled labor; operated 12 months; raw materials worth $10,000; products worth $30,000; 1 boiler.

Thomas Carlisle (On Mispillion), Shipbuilder: $14,000 invested; 24 males over 16 years old; $5000 annual wages; $1.50/day for skilled labor; operated 9 months; raw materials worth $9000; products worth $23,000; 1 boiler.
Appendix C:
Finder's Guide to Historic Context Elements

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Geographic Zones: p. 6-7
Chronological Periods: p. 7
Known and Expected Property Types: p. 7-8, Chapters III, IV, V, VI
Criteria for Evaluating Existing or Expected Property Types: Chapters III, IV, V, VI
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