

## HISTORIC AMERICAN ENGINEERING RECORD

DRY DOCK ENGINE WORKS  
(Detroit Shipbuilding Company)  
(Electromaster, Inc.)  
(Detroit Edison Company)  
(Globe Trading Company)

HAER No. MI-330

Location: 1801 Atwater Street, Detroit, Wayne County, Michigan

Date of Construction: 1892-1919

Fabricator: (for machine shop) Berlin Iron Bridge Company

Present Owner: City of Detroit

Present Use: Closed

Significance: The Dry Dock Engine Works is significant, first of all, because of its role in manufacturing and repairing marine steam engines and boilers for Great Lakes freighters and passenger vessels from 1867 until the mid-1920s. Secondly, it is significant as a showcase of the evolution of American factory construction methods of the late nineteenth and early twentieth centuries. The six extant buildings that make up the Dry Dock Engine Works complex were erected between 1892 and 1919. The first of these, a machine shop, was designed and built by the Berlin Iron Bridge Company of East Berlin, Connecticut, and is an early example of an industrial structure entirely supported by a steel frame with brick curtain walls. The remaining five buildings (a foundry, an industrial loft building, an addition to the machine shop, a chipping room, and a shipping and receiving space) were built between 1902 and 1919 and show the evolution of steel-frame construction as riveted connections became welded, solid webs gave way to lattice webs, and builders began to use reinforced concrete.

Historian: Thomas A. Klug, August 2002

Project Information: The Detroit Dry Dock Engine Works Recording Project is part of the Historic American Engineering Record (HAER), a long-range program that documents and interprets

historically significant engineering, industrial, and maritime sites, structures and vessels throughout the United States. HAER is a program within the National Park Service, U.S. Department of the Interior. This project was co-sponsored by the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER), under the general direction of E. Blaine Cliver, and by the MotorCities Automobile National Heritage Area (ANHA), Constance Bodurow, AICP, Executive Director, and Arthur F. Mullen, Revitalization Programs Manager.

The summer field team was under the direction of Richard O'Connor (HAER Historian) and Thomas M. Behrens (HAER Architect). The recording team included Erin E. Ammer, Field Supervisor (Tulane University, New Orleans, Louisiana), Architects Michelle K. Bowman (University of Detroit Mercy, Detroit, Michigan), Jessica Schulte (University of Detroit Mercy, Detroit, Michigan), Danail Stoykov (U.S./Icomos, Sofia, Bulgaria), Historians Laura Janssen (Hollywood, California), Thomas Klug (Marygrove College, Associate Professor of History, Detroit, Michigan) and Rebecca A. Howell (University of Virginia, Charlottesville, Virginia). Large format photography was done by Jet Lowe, HAER Photographer.

## Chronology

1866	Dry Dock Engine Works formed by William Cowie, Edward Jones, and Robert Donaldson; capitalized at \$35,000. Plant located at Orleans and Atwater Streets, opposite the dry docks of Campbell & Owen (later the Detroit Dry Dock Co.)
1880-1882	Henry Ford works at the Dry Dock Engine Works picking up the machinists' trade.
1883	Dry Dock Engine Works acquires the neighboring boiler shop of Desotell & Hutton.
1892	Senator James McMillan assumes presidency of the Dry Dock Engine Works. The Berlin Iron Bridge Company designs and erects a new steel-framed machine shop and a new boiler shop for the Dry Dock Engine Works.
1897	State of Michigan factory inspectors visit Dry Dock Engine Works. Employment at the engine-building plant is 75; 60 at the boiler shop.
1899	Dry Dock Engine Works becomes part of the Detroit Shipbuilding Company, while the latter combines with twelve other Great Lakes shipbuilders to form the American Shipbuilding Company.
1902	Engine-building plant of the Detroit Shipbuilding Company erects a new foundry and an industrial loft building; combined cost, \$75,000.
1910s	Construction of machine shop addition, chipping room, and shipping and receiving building.
1924	The sidewheel steamers <i>Greater Detroit</i> and <i>Greater Buffalo</i> are the last ships to be outfitted with engines and boilers at the Orleans Street Plant of the Detroit Shipbuilding Company.
1929	Detroit Shipbuilding Company ends its corporate existence. Electromaster, Inc., a stove manufacturer, occupies the former engine plant.
1935	Detroit Edison Company acquires ownership of the former engine plant. From the 1950s until the mid-1960s, it uses the plant as a "reconditioning and appliance shop."
1966	Earliest evidence that the Globe Trading Company, a wholesale dealer in machinery and mill supplies, is occupying the former engine plant.
1981	Globe Trading Company purchases the plant from Detroit Edison for \$81,000.

## Introduction

Along with stoves, railway freight cars, heating appliances, pharmaceuticals, and tobacco products, shipbuilding constituted one of the well-established industries of Detroit, Michigan, before the rise of automobile manufacturing in the early 1900s. Geographically, much of the city's early industrial base was spread out along the Detroit riverfront. In particular, the riverfront located east of the downtown core was a vital center of shipbuilding activity. The district not only supported several dry docks, but also it was home to a number of manufacturers of marine steam engines. At the site of the Dry Dock Engine Works (later absorbed into the Detroit Shipbuilding Company), marine steam engines were built for sixty years, from the mid-1860s through the mid-1920s. The focus of this study is on the complex of six connected buildings that were erected between 1892 and 1919 by the Dry Dock Engine Works/Detroit Shipbuilding Company.

## Part I: Historical Overview: The Detroit Context of Great Lakes Shipbuilding, Engine Building, and the Dry Dock Engine Works

“The modern great ship building industry,” wrote Detroit historian Clarence Burton, “goes back in its roots” to the middle of the nineteenth century.<sup>1</sup> While sailing vessels at the time dominated the Great Lakes, major steps had already been taken to apply steam power to water transportation. The first steamboat on the Great Lakes was the *Ontario*, launched in 1817. The following year the *Walk-in-the-Water* went into service as the first passenger steamer on the upper lakes. By 1833, eleven steamers delivered passengers and cargo on Lakes Erie, Huron, and Michigan. A decade later more than sixty-five steam vessels operated on the same waters.<sup>2</sup>

The construction of steamships in Detroit began in 1827 with the *Argo*. In 1833 came the *Michigan*, which featured passenger cabins on the main deck. Additional vessels followed, including the launching in 1848 of the *Mayflower*, a 1,354-ton passenger ship owned by the Michigan Central Railroad.<sup>3</sup> By the time the Civil War ended, a total of sixty-eight steam vessels had been built at Detroit, including twenty-two during the war years of 1861-65.<sup>4</sup> Since Detroit businessmen owned fifty-two steamships in 1850, the Detroit Free Press expressed the need for the city to have its own dry dock

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<sup>1</sup> Clarence M. Burton and M. Agnes Burton, eds., History of Wayne County and the City of Detroit, Michigan (Chicago: S.J. Publishing Co., 1930), II: 1332. Important information on Great Lakes ships can be found in the Great Lakes Vessel Index that is maintained by the Historical Collections of the Great Lakes, Bowling Green State University, Bowling Green, Ohio (<http://www.bgsu.edu/colleges/library/hcgl/vessel.html>). Unfortunately, little or no information is provided in the index about the engines or boilers that powered steam vessels.

<sup>2</sup> Mark L. Thompson, Queen of the Lakes (Detroit: Wayne State University Press, 1994), 15, 18.

<sup>3</sup> Burton, History of Wayne County, 1332; Thompson, Queen of the Lakes, 16-20. More recent research indicates that *Argo* was built in 1829. See Gordon P. Bugbee, “Stars on the River,” Steamboat Bill LVIII (Winter 2001), 257.

<sup>4</sup> Silas Farmer, The History of Detroit and Michigan or the Metropolis Illustrated: A Chronological Cyclopaedia of the Past and Present (Detroit: Silas Farmer & Co., 1889; second edition), 1: 914.

facilities rather than have vessels set in at Buffalo for major repairs.<sup>5</sup> By 1852, several dry docks were in operation in Detroit. That same year, the partnership of Campbell, Wolverton and Company opened a vessel repair yard on the east riverfront at the foot of Orleans Street. This site was the ancestor to a succession of shipbuilding firms: Campbell & Owen, the Detroit Dry Dock Company, and the Detroit Shipbuilding Company.<sup>6</sup>

Campbell & Owen built a 260' dry dock at Orleans Street in 1860 and added another 300' dry dock several years later. Improved facilities, together with John Owen's interests in a line of steamers plying the waters of Lake Erie, generated increased business for the shipyard. In 1867 it constructed its first steamship, the *R.N. Rice*, by utilizing the standard subcontracting methods of the day. "As was common in these days," observed Gordon Bugbee, "several contractors were brought together at the shipyard to produce the *Rice*. Captain John Oades modelled her and superintended her construction. A Mr. Ellinwood did the carpentry work; and William Wright & Company decorated the cabin. A fine engine for the *Rice* came from the famous Fletcher firm in New Jersey."<sup>7</sup>

In some form the "extensive subcontracting networks" that Thomas Heinrich has described for mid-nineteenth century shipbuilding in Philadelphia also prevailed in Detroit:

Typically, a shipowner signed three different contracts to build a wood steamer: the first with a shipyard for the hull, the second with the ropemaker for the rig, and the third with an engine builder for the engine and boilers. These firms, in turn, issued subcontracts to smaller craft shops that supplied specialty items, such as bolts, castings, spats, sails, and anchors....The building of a single wooden steamship usually involved twenty to thirty firms.<sup>8</sup>

Common to both cities during the age of wooden steamship construction was a proprietary form of capitalism characterized by limited amounts of fixed capital invested in manufacturing operations and reliance on autonomous skilled craftsmen. In order to avoid large overhead costs in the face of fluctuating market conditions, shipbuilders naturally subcontracted with independent specialty producers that inhabited the urban industrial environment. Shipbuilding, therefore, was a rather decentralized industry for much of the nineteenth century, and only toward the end of it were many elements of the construction of ships concentrated in large shipbuilding corporations.

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<sup>5</sup> Entry for Detroit Free Press, May 16, 1850, in Gordon P. Bugbee, "Notes on the History of the Detroit Dry Dock Company" (unpublished typescript manuscript, July 1980, available at the offices of the City of Detroit, Historic Designation Advisory Board), 8.

<sup>6</sup> Burton, History of Wayne County, 1332; Gordon P. Bugbee, "A Short Historical Sketch of the Detroit Dry Dock Company," Telescope 15 (April 1966): 78-80; Richard J. Wright, Freshwater Whales: A History of the American Shipbuilding Company and Its Predecessors (Kent State University Press, 1969), 94.

<sup>7</sup> Bugbee, "A Short Historical Sketch of the Detroit Dry Dock Company," 80; entry for Detroit Free Press, June 24, 1864, in Bugbee, "Notes on the History of the Detroit Dry Dock Company," 25.

<sup>8</sup> Thomas R. Heinrich, Ships for the Seven Seas: Philadelphia Shipbuilding in the Age of Industrial Capitalism (Baltimore: The Johns Hopkins University Press, 1997), 22-23, 65.

Central to the operation of steamships were boilers and propelling engines. Frequently, machinery builders in other cities sold such equipment to Detroit shipbuilders, particularly in the early years of the industry.<sup>9</sup> By the early 1850s, however, Detroit's own growing network of machine shops and foundries offered shipbuilders the alternative of a local supplier base. According to Bugbee, the manufacture of an engine for the steamer *Pearl* in 1851 by the partnership of Harmon DeGraff and Silas Kendrick marked "the start of a regular building of marine engines in Detroit."<sup>10</sup> The DeGraff & Kendrick Iron Works was located at Larned and Fourth Street on the west side of the downtown. In 1854 it was acquired by a group of investors and renamed the Detroit Locomotive Works. Despite its new name, the firm advertised itself in 1862 as a manufacturer of engines and boilers, millwork, and stationary engines for milling and mining. It also undertook repairs of steamboats. Directors and officers included John Owen (president), Thomas S. Christie (secretary and treasurer), Louis Cass, Jr., and the successful merchant, Christian H. Buhl. The Mayor of Detroit from 1860 to 1862, Buhl acquired a controlling interest in the firm in 1864. In 1880 the firm was incorporated as the Buhl Iron Works, with Christian Buhl as president. An advertisement in 1884 showed that the company continued to make low and high pressure engines for boats, rolling mills, and saw mills; boilers; and general iron and brass castings.<sup>11</sup>

Another marine engine builder—Johnston, Wayne & Company—stood at Woodbridge and Brush on the east side of the downtown.<sup>12</sup> It was organized in 1851. Three years later it became the Fulton Iron and Engine Works. The company continued to make steam engines into the 1880s, including "blast, threshing, rolling, mining and mill engines," but it appears to have dropped marine work.<sup>13</sup>

Three other marine engine firms appeared between 1863 and 1866: Cowie, Hodge & Company, the Frontier Iron Works, and the Dry Dock Engine Works. Two things are noticeable about the firms. The first is the close connection between leading figures of these companies. Samuel F. Hodge was employed as foreman of the blacksmith shop of DeGraff & Kendrick, and for four years he remained at the factory after its acquisition by the Detroit Locomotive Works. In 1863 he joined in organizing the engine- and machinery-building firm of Cowie, Hodge & Company with business partners William Cowie, William Barclay, and Thomas S. Christie. Christie had been a director as well as

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<sup>9</sup> See references in the Detroit Free Press in 1848-50 to the Fletcher, Harrison, & Co. of Hoboken, New Jersey; the Phoenix Foundry, Secor's Foundry, the Allaire Works, and the Buffalo Steam Works, all in New York; and the Cuyahoga Furnace in Ohio. Bugbee, "Notes on the History of the Detroit Dry Dock Company," 5-8. The engine for the *Mayflower* came from the West Point Foundry at Cold Spring, New York. See "Navigation on Lakes Erie and Ontario" Marine Review 28 (December 17, 1903): 21.

<sup>10</sup> Bugbee, "Notes on the History of the Detroit Dry Dock Company," 9.

<sup>11</sup> Entry for Detroit Free Press, March 7, 1862, in Bugbee, "Notes on the History of the Detroit Dry Dock Company," 22; "Christian H. Buhl," in Farmer, History of Detroit and Michigan, 2: 1043-44; City Directory of Detroit (1884), 95. All city directories cited in this report are available at the Burton Historical Collection, Detroit Public Library, Detroit, Michigan. Among the steam vessels that had engines or boilers built by DeGraff & Kendrick or the Detroit Locomotive Works were the *Pearl* (1851), *Ruby* (1851), *Forest City* (1852), *May Queen* (1853), *Lion* (1855), and *Webb* (1856). See Bugbee, "Notes on the History of the Detroit Dry Dock Company," 9, 11, 13 and 16.

<sup>12</sup> Engines from this site went into the *Dart* (1853), *Ottawa* (1853), and *Minnie* (1857). See Bugbee, "Notes on the History of the Detroit Dry Dock Company," 11, 12, 16.

<sup>13</sup> Farmer, History of Detroit and Michigan, 1: 807.

secretary and treasurer of the Detroit Locomotive Works. Christie parted from the Hodge firm in 1870, and two years later he joined with Harmon DeGraff in forming a company that incorporated in 1885 as the Frontier Iron and Brass Works. Among other things, the firm produced marine engines. As for William Cowie, he left Hodge in 1865. A year later he joined with Edward D. Jones and Robert Donaldson in forming the Dry Dock Engine Works.<sup>14</sup>

The second outstanding feature of these three firms was their geographic concentration along the east riverfront of Detroit. The Samuel Hodge enterprise was located at Rivard and Atwater.<sup>15</sup> The Frontier Iron and Brass Works was established at the corner of Chene and Atwater. The Dry Dock Engine Works stood between these two facilities, at the northeast corner of the intersection of Orleans and Atwater, opposite the Campbell & Owen shipyard. The deployment of these engine-building factories along the east riverfront during the 1860s was representative of the early phase of the “deconcentration” of Detroit industry. For much of the nineteenth century, the downtown core of Detroit featured an array of residences, public buildings, retail stores, craft shops, and small industrial companies. In the 1860s, according to Olivier Zunz, heavy industrial activities began to move beyond the central city to undeveloped areas along the riverfront. By 1880, “the riverfront had become a long industrial strip.”<sup>16</sup>

The Dry Dock Engine Works was incorporated in November 1866, with a capitalization of \$35,000. The incorporators were William Cowie (president and treasurer), Robert Donaldson, and Edward Jones.<sup>17</sup> Donaldson, who had worked for William Barclay, one of the partners in the first Hodge firm, became shop superintendent.<sup>18</sup> Little is known of Edward Jones, but he perhaps played some role in deciding upon the precise location of the works across from the Campbell & Owen dry docks. In October 1866, Jones acquired two lots on the north side of Atwater Street, midway between Orleans and Dequindre. The following January, Jones sold them to the

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<sup>14</sup> “Samuel F. Hodge” in Farmer, History of Detroit and Michigan, 2: 1192-93; “Samuel F. Hodge” in J.B. Mansfield, History of the Great Lakes (Chicago: J.H. Beers, 1899), 282; “Frontier Iron Works” in Commerce, Manufactures and Resources of Detroit, Michigan (Detroit: Commerce Publishing Co., 1885), 90-91; “Frontier Iron and Brass Works” in James J. Mitchell, Detroit in History and Commerce (Detroit: Rogers & Thorpe, 1891), 136-37; “Frontier Iron Works” in Detroit of Today: The City of the Strait (Detroit: Phoenix Publishing Co., ca. 1893), 228; City Directory of Detroit (1884), 1346. In 1899, the Northern Engineering Works, a manufacturer of cranes and hoists, acquired the Frontier Iron and Brass Works. See “George A. True” in Albert Nelson Marquis, ed., The Book of Detroiters (Chicago: A.N. Marquis & Co., 1914), 493.

<sup>15</sup> The Hodge Company made significant plant investments in 1876. It incorporated in 1883 as Samuel F. Hodge & Company and undertook an extensive plant modernization program in the mid-1890s, by which time it was also known as the Riverside Iron Works. In 1902, the Rivard Street property was purchased by the Great Lakes Engineering Works, which also acquired shipyard facilities in Ecorse and St. Clair, Michigan, and Ashtabula, Ohio. See Mansfield, History of the Great Lakes, 1: 282-83; Burton, History of Wayne County, 2: 1333; “Another Lake Shipyard,” Marine Review 27 (January 8, 1903), 22-23; “A Fine Ship Yard,” 28 (October 8, 1903), 22.

<sup>16</sup> Olivier Zunz, The Changing Face of Inequality: Urbanization, Industrial Development, and Immigrants in Detroit, 1880-1920 (Chicago: University of Chicago Press, 1982), 29-30. See also Charles K. Hyde, “The Near East Riverfront: Its History and Historic Resources.” Report prepared for the City of Detroit, Community and Economic Development Department, August, 1982, 3-5.

<sup>17</sup> See list of incorporated companies in City Directory of Detroit (1876-77), 35.

<sup>18</sup> Wright, Freshwater Whales, 108-9.

Dry Dock Engine Works at \$1,300 per lot. Five months later the company purchased an adjacent lot for \$3,500.<sup>19</sup> Between 1871 and 1878, the Dry Dock Engine Works obtained three lots fronting Guoin Street that lay immediately behind the first three. All that remained was to fill out the block by acquiring the four corner lots. In 1880, Addison Munger sold to the company lots 1 and 10 that lay along Orleans Street at a price of \$5,500 a piece. Lot 5, at the corner of Dequindre and Guoin streets, came into the possession of the company in 1889 at a cost of \$4,000. The last parcel, lot 6, was substantially more expensive. Located at the northwest corner of Dequindre and Atwater streets, the property included the two-story Dry Dock Hotel, an establishment that first appeared in city directories in 1883. Peter and Anna Marie Klintwort had purchased the lot in 1867. During the 1880s they leased the Dry Dock Hotel to several hotel operators. In May 1892, Anna Marie Klintwort sold the lot to the Dry Dock Engine Works for \$11,000.<sup>20</sup>

Marine engine builders such as the Dry Dock Engine Works survived as business enterprises by making and selling a range of products and services. “Most firms did not limit their work to shipbuilding but also produced nonmarine items,” notes Heinrich. “Machine shops that supplied shipbuilders, for example, usually built stationary steam engines for factories and coal mines.”<sup>21</sup> What was true of Philadelphia’s engine builders was also true of those in Detroit. The Frontier Iron Works, for instance, manufactured not only marine steam engines, but also special machinery for reducing, drying, and separating ores and clays. It likewise produced lines of pulleys, brass castings, fly wheels, lubricators, hydrants, valves, and Weber’s patented lawn furniture. Its most celebrated product was the Frontier water heater and purifier that it sold to breweries, laundries, and dye works.<sup>22</sup> The Samuel F. Hodge & Company made mining machinery as well as marine engines.<sup>23</sup>

In the City Directory for 1869-70, the Dry Dock Engine Works advertised itself as a manufacturer of marine, stationary, and portable condensing and noncondensing steam engines. It also offered mill gearing and mining machinery, a variety of brass and iron castings, and blacksmithing of all kinds. “Particular attention is given to steamboat repairs and ship work,” it noted.<sup>24</sup> By the late 1870s, the company added propeller wheels to its product mix.<sup>25</sup> Around 1883, it acquired the boiler shop of Desotell & Hutton, which was located east of the engine works between Dequindre and St. Aubin streets. The firm was about as old as the Engine Works. It first appeared in the City Directory in 1866-67, and it built the boiler for the *Dove* in 1868.<sup>26</sup> In late 1883, fire

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<sup>19</sup> See transactions involving the Dequindre Farm, section 4, lots 7, 8, and 9, in Wayne County Register of Deeds, Tract Index, liber 539, tab 4.

<sup>20</sup> See transactions involving the Dequindre Farm, section 4, lots 1, 2, 3, 4, 5, 6, and 10; City Directory of Detroit (1883), 393; Wright, Freshwater Whales, 109.

<sup>21</sup> Heinrich, Ships for the Seven Seas, 18.

<sup>22</sup> Commerce, Manufactures and Resources of Detroit, Michigan, 90-91; Detroit in History and Commerce, 136-37; Detroit of Today, 228.

<sup>23</sup> Detroit of Today, 247.

<sup>24</sup> City Directory of Detroit (1869-70), 26.

<sup>25</sup> City Directory of Detroit (1878), 303.

<sup>26</sup> City Directory of Detroit (1866-67); entry for Detroit Free Press, March 15, 1868, in Bugbee, “Notes on the History of the Detroit Dry Dock Company,” 21.

guttled the recently acquired boiler shop of the Dry Dock Engine Works.<sup>27</sup> A great deal of the machinery was lost, but the framework of the building remained standing. The company eventually regained its boiler making capacity. Between 1887 and 1891 it fulfilled forty contracts to manufacture and/or install boilers in steamships.<sup>28</sup>

The main product of the Dry Dock Engine Works was the marine propelling engine.<sup>29</sup> Its first contract was in 1867 to build a horizontal engine for the *Schlegelmilch*. The company built thirty-three engines between 1867 and 1879. About a third of them were low-pressure engines, and twenty were high pressure. The early 1880s were an especially busy time for the company, coinciding as it did with the advent of the compound engine on the Great Lakes. The compound engine normally featured two cylinders: “a high-pressure cylinder received steam directly from the boilers, and a second, low-pressure cylinder received spent steam from the first cylinder and used it as a power source.”<sup>30</sup> John Elder of Glasgow invented a practical compound marine engine in the mid-1850s. During the 1860s it was adopted throughout the British shipbuilding industry.<sup>31</sup> A compound engine was first installed on an American steamship in 1871 at the William Cramp shipyard in Philadelphia. The Dry Dock Engine Works built its first compound engine in 1880 for the *Thomas W. Palmer*. It turned out nine of them in 1882 and seven more the following year. Over the period 1880-86 the company constructed forty-one engines. Of these, twenty-six were compound engines and only eleven were of the low or high-pressure variety.

The mid-1880s were an extremely difficult time for ship and engine builders. When the economy regained momentum in 1887, the Dry Dock Engine Works was prepared for the next technological advance: the triple expansion steam engine. The engine was also of British origins. During the 1870s, A.C. Kirk of the Glasgow firm of R. Napier & Company experimented with recycling spent steam from the high-pressure cylinder to a pair of intermediate and low-pressure cylinders (hence the frequent reference to it as a “double compound engine”). The problem was that a triple expansion engine required high-pressure steam, which meant that boilers had to be found that could handle over 125 pounds per square inch of pressure. According to Holmes, the solution came with “improvements made in the manufacture of mild steel [which permitted] the application of this material to the construction of marine boilers.” Improvements also took place in the tools and machinery used for riveting boilers. By the end of the decade, manufacturers were able to make boilers that could withstand pressures of 150 to 170 pounds per square inch.<sup>32</sup>

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<sup>27</sup> Entry for Detroit *Free Press*, November 22, 1883, in correspondence of Gordon P. Bugbee to William M. Worden, “Historical background of Detroit Dry Dock Company,” August 13, 1980, in a file at the City of Detroit, Historic Designation Advisory Board.

<sup>28</sup> Detroit Dry Dock Company, *Around the Lakes* (Detroit: Detroit Dry Dock Company, n.d., but ca. 1894), 44-45.

<sup>29</sup> The figures on engine output by the Dry Dock Engine Works in this and subsequent paragraphs are based on two tables in Detroit Dry Dock Company, *Around the Lakes*, 42-45.

<sup>30</sup> Heinrich, *Ships for the Seven Seas*, 53.

<sup>31</sup> Heinrich, *Ships for the Seven Seas*, 53; Charles E. Hyde, “The Modern Marine Engine,” *Cassier’s Magazine* 123 (August 1897): 441; George C.V. Holmes, *Marine Engines and Boilers* (London: Chapman and Hall, 1889), 71.

<sup>32</sup> Holmes, *Marine Engines and Boilers*, 90

Success came with the engine installed in 1881 in the ocean-going steamer, the *City of Aberdeen*.<sup>33</sup> By 1885, the triple expansion engine became the standard for new ships in the Royal Navy.<sup>34</sup> The Cramp shipyard experimented in 1885 with a triple expansion engine for the yacht *Peerless*. Real gains at Cramp were made in 1886-87 after the U.S. Navy provided it with hull and engine drawings from the British for the construction of the cruiser *USS Baltimore*, including a British-designed triple expansion engine.<sup>35</sup> According to Mansfield, the first such engine on the Great Lakes was built by Samuel F. Hodge & Company and placed in the *Roumania* on October 2, 1886.<sup>36</sup>

The workhorse of merchant fleets and navies, the triple expansion engine “became the standard means of propulsion until steam turbines made their debut just before World War II.”<sup>37</sup> If “the economy of the compound engine over the low pressure boiler was 55%,” wrote Bruce Bowlus, “this efficiency increased another 24% with the use of the triple expansion engine.”<sup>38</sup> According to Holmes, studies in the late 1880s demonstrated that triple expansion engines using 145 pounds of pressure consumed 25 percent less coal than ordinary compound engines. Sometimes the figure was as high as a 33 percent saving in the consumption of coal.<sup>39</sup> Steamships were vast coal platforms. The ability to generate high steam pressures translated into more efficient marine engines and a relative decline in the amount of coal that ships needed to carry below deck. For naval vessels, this made for a combination of heavier armor and guns and an extension in the range of warships between refueling stops. Improvements in fuel consumption allowed commercial vessels to dedicate a greater amount of space to passengers and cargo.<sup>40</sup> On the Great Lakes, more efficient engine technology made it possible for shipping companies to reap profits from vessels of ever-greater size and speed.

The Dry Dock Engine Works produced four triple expansion engines in 1887 and nine more in 1888. In the latter year it made only one compound engine, but compound engines regained the lead in 1889-90 when ten were built compared to only five of the triple expansion variety. Overall the firm constructed thirty-seven engines in the period 1887-1891. Of these, sixteen were compound, while twenty-one were triple expansion

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<sup>33</sup> Holmes, *Marine Engines and Boilers*, 90-92; Hyde, “The Modern Marine Engine,” 453-55.

<sup>34</sup> Richard Sennett and Henry J. Oram, *The Marine Steam Engine: A Treatise for Engineering Students, Young Engineers, and Officers of the Royal Navy and Mercantile Marine* (London: Longmans, Green and Co., 1898), 14.

<sup>35</sup> Heinrich, *Ships for the Seven Seas*, 103.

<sup>36</sup> Mansfield, *History of the Great Lakes*, 1: 283.

<sup>37</sup> Thompson, *Queen of the Lakes*, 41.

<sup>38</sup> Bruce Bowlus, “Bold Experiments: The Evolution of the Great Lakes Ore Carrier,” *Michigan Historical Review* 22 (Spring 1996): 14.

<sup>39</sup> Holmes, *Marine Engines and Boilers*, 93. Commenting on the progress in economizing on fuel, Sir Henry White observed, “the best direct-acting engines in screw steamships of 1859, with 20 to 25 lbs. of pressure, required from 3 ¾ to 5 lbs. of coal per indicated horse-power per hour. In the mercantile marine, about twenty years later, this had been reduced to about 2 lbs. as an average with compound engines. At present it is about 1.5 lbs. for ocean-going steamships with triple and quadruple-expansion engines.” See “Ships and Ships’ Engines,” *Marine Review* 28 (December 10, 1903): 30.

<sup>40</sup> As Henry M. West put it, “Under the pressure of modern competition, which has attacked the ship-owning community as severely as any other industry, there has been a constant and urgent demand to increase the *paying load* of cargo steamers.” “The Problem of Steamship Design,” *Cassier’s Magazine* 12 (August 1897): 323.

engines. The last years for which figures are available (1892, 1893, and part of 1894) saw the Dry Dock Engine Works turn out eighteen engines, of which five were compound and eleven were triple expansion engines.<sup>41</sup>

In summary, over the period 1867-1894, the Dry Dock Engine Works built a total of 129 propelling steam engines. The categories of engines and numbers built were as follows:

Low pressure engines	13
High pressure engines	29
Compound engines	47
Triple expansion engines	32
Other	8

(By comparison, the nearby Samuel F. Hodge & Company turned out 125 engines between 1884 and 1899.)<sup>42</sup> In addition, the Dry Dock Engine Works produced 130 boilers between 1884 and 1894.

As a supplier of engines and boilers, the Dry Dock Engine Works came to have a special relationship with the Detroit Dry Dock Company. It sold its first engine to Campbell & Owen in 1868, a high-pressure device for the tug *Champion*. An engine-building enterprise could ill afford to link itself entirely to the fluctuating fortunes of a single shipbuilder. A sound business strategy required a firm to pursue multiple buyers. Thus, in the years 1867 to 1879, nearly three-quarters of the engines it built went to buyers other than the Detroit Dry Dock Company. The percentage fell to 49 percent in 1880-86, then 35 percent in 1887-91. But despite close business relations between the Dry Dock Engine Works and the Detroit Dry Dock Company, in 1892-94 the former sold 39 percent of its engines and 63 percent of its boilers to other shipbuilders.<sup>43</sup>

Nevertheless, by the 1890s the Dry Dock Engine Works and the Detroit Dry Dock Company were practically a single company in all but name. Central to this story of business consolidation was the network of family members and other allies surrounding James McMillan. A native of Hamilton, Ontario, James McMillan arrived in Detroit in the 1850s and obtained a position in the wholesale hardware firm owned by Christian Buhl and Charles DuCharme. He gained familiarity with the railroad industry from his position as purchasing agent for the Detroit & Milwaukee Railway Company. In 1864, he joined with John S. Newberry, a specialist in admiralty law, in organizing the Michigan Car Company. By the early 1890s, it had become the largest railway car

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<sup>41</sup> By the late 1880s the British had moved ahead with the development of the quadruple expansion marine engine. The first on the Great Lakes appeared in 1894 in the *Unique*, made by the Frontier Iron Works of Detroit, and the *Northwest*, by the Globe Iron Works of Cleveland. See "Navigation on Lakes Erie and Ontario," *Marine Review* (December 17, 1903), 22; "List of Vessels," in *Steamboat Bill* LVIII (Winter 2001): 297. On the quadruple expansion engine and its relatively limited appeal to shipbuilders and shipowners at the end of the 1890s, see Sennett and Oram, *The Marine Steam Engine*, 14; Holmes, *Marine Engines and Boilers*, 96-97; Hyde, "The Modern Marine Engine," 456-58. For another overview of steam engine progress, see James B. Stanwood, "Tendencies in Steam Engine Development," *Cassier's Magazine* 12 (1897): 211-15.

<sup>42</sup> Mansfield, *History of the Great Lakes*, 1:283.

<sup>43</sup> Detroit Dry Dock Company, *Around the Lakes*, 42-45.

manufacturer in the country. Officers of the company included James McMillan, president; Hugh McMillan, vice-president; and William C. McMillan, general manager. The McMillan group also controlled several smaller companies that supplied its sprawling west-side car-making complex with wheels, forgings, and springs. In addition, they had sizeable investments in railway car factories in St. Louis, Missouri, and London, Ontario. In 1892, the Michigan Car Company merged with the Peninsular Car Company, which was located on the east side of the city and owned by Frank Hecker, Charles Freer, and lumber baron Russell Alger (the U.S. Secretary of War in 1897-99). The final consolidation took place in 1899, when the Michigan-Peninsular Car Company joined with twelve other freight car manufacturers to form the St. Louis-based American Car & Foundry Company, which controlled two-thirds of the industry's output in the United States.<sup>44</sup>

The year 1892 also saw the Detroit Steam Radiator Company merge with the Michigan Radiator & Iron Manufacturing Company, the latter organized by James McMillan in 1888. Together with the Pierce Radiator Company of Buffalo, New York, the new enterprise became known as the American Radiator Company. By the late 1890s, the dozen or so plants of the Chicago-based firm controlled 75 to 80 percent of the steam radiator output in the United States.<sup>45</sup>

The McMillans and John Newberry had a long reach. They were significant investors in northern Michigan railroads. Their Detroit, Mackinac & Marquette Railroad, completed in 1879, opened up the eastern Upper Peninsula of Michigan. In Detroit they were involved in the Michigan State Telephone Company, the D.M. Ferry Seed Company, the Union Depot Company, real estate, and banks. McMillan managed the successful congressional campaign of John Newberry, who served one year in the House of Representatives (1879-81). The growing prominence of James McMillan as a man of business and politics catapulted him to the top of the Republican Party establishment in Michigan in 1886. He served in the United States Senate from 1889 until his death in 1902. As a senator McMillan helped bring increased federal support for Great Lakes shipping, and as chair of the District of Columbia Committee he played an important role in redesigning the city according to Pierre L'Enfant's original plan of 1792.<sup>46</sup>

The McMillan-Newberry alliance developed substantial interests in such Great Lakes passenger and freight companies as the Hamtramck Navigation Company, the Detroit Transportation Company, the Red Star Line, and the Detroit & Cleveland Steam Navigation Company (D & C). The latter was organized in 1850 and incorporated in 1868. Detroit businessman John Owen became the largest stockholder in the firm and served as its president for many years. Owen, therefore, was in a position in 1867 to have his other interest, the Campbell & Owen shipyard, build the *R.N. Rice* for the D & C. A

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<sup>44</sup> Farmer, [History of Detroit and Michigan](#), 1:803-6, 2: 1063-67; Zunz, [The Changing Face of Inequality](#), 212-13; Donald Finlay Davis, [Conspicuous Production: Automobiles and Elites in Detroit, 1899-1933](#) (Philadelphia: Temple University Press, 1988), 47-48. .

<sup>45</sup> Davis, [Conspicuous Production](#), 48.

<sup>46</sup> Davis, [Conspicuous Production](#), 48-49; Farmer, [History of Detroit and Michigan](#), 2: 1063-67; Charles Moore, "James McMillan, United States Senator from Michigan," in [Michigan Historical Collection](#) (Lansing, MI: Michigan Historical Commission, 1915), 39: 175-77; John C. Teaford, "McMillan, James," in <http://www.anb.org/articles/05/05/00513.html>, American National Biography Online, December 2001.

decade later, both firms were reorganized as the Detroit Dry Dock Company prepared to build a composite hull (that is, an iron-framed hull sheathed in wood) sidewheel steamship for the D & C. In 1877, James McMillan and John Newberry acquired shares in the passenger line. Around the same time, the Detroit Dry Dock Company purchased a shipyard in Wyandotte, the downriver community south of Detroit, where Frank and Joe Kirby had constructed several iron-hulled vessels beginning in 1872. The expanded Detroit Dry Dock Company now combined wood shipbuilding and repair at its Orleans Street yard in Detroit with iron shipbuilding in Wyandotte, where Frank Kirby took charge. The office of president remained in the hands of John Owen.<sup>47</sup>

The *City of Detroit*, launched at the Wyandotte yard in 1878, marked the start of an intimate business relationship between the Detroit Dry Dock Company and the Detroit & Cleveland Navigation Company that lasted for decades. Moreover, it represented the first of thirteen sidewheel passenger steamers that naval architect Frank Kirby designed for the D & C line between the late 1870s and the mid-1920s.<sup>48</sup> While James McMillan at this point did not yet own shares in the Detroit Dry Dock Company, his various shipping interests nevertheless placed orders with it for vessels. The first, in 1879, was the iron passenger steamer, *Grace McMillan* (later renamed the *Idlewild*). Over the next eight years the McMillan group contracted for a series of wood hull freighters. In the meantime, the D & C ordered passenger ships (the *City of Cleveland II* in 1880 and the *City of Mackinac* in 1883) that opened a new service for the company from Detroit through Lake Huron to the Upper Peninsula. The service, opened in 1882, conveniently connected the region's population centers in the south with the McMillan-Newberry developments in northern Michigan. The wooden ferries *Algolah* (1881) and *St. Ignace* (1888) were built to operate year round at the Straits of Mackinac on behalf of the railroad interests of McMillan and Newberry. Both vessels were designed by Frank Kirby, built by the Detroit Dry Dock Company, and equipped with compound engines supplied by the Dry Dock Engine Works.<sup>49</sup>

James McMillan expanded his hold over shipping and shipbuilding during the 1880s. The death of John Owen in 1892 opened the Detroit & Cleveland Navigation Company to a wholesale takeover by the McMillans. As for the related Detroit Dry Dock Company, by 1890 James McMillan had become the second largest stockholder as well as its president. Frank Kirby and Alexander McVittie, both business allies of the McMillans, also owned numerous shares. In the mid-1890s, James McMillan owned the company along with his brother Hugh, several other family members, plus McVittie and Kirby.<sup>50</sup>

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<sup>47</sup> Farmer, History of Detroit and Michigan, 1: 910; 2: 1064-68; Wright, Freshwater Whales, 98-100; Bugbee, "A Short Historical Sketch of the Detroit Dry Dock Company," 82; Gordon P. Bugbee, "Frank E. Kirby: A Biographical Sketch," Steamboat Bill LIV (Spring 1997): 7. John Owen was born near Toronto, Ontario, in 1809 and came to Detroit in 1818. See Farmer, The History of Detroit and Michigan, 2: 1067.

<sup>48</sup> See Gordon Bugbee, "Frank E. Kirby," 7, "A Short Historical Sketch of the Detroit Dry Dock Company," 8, and The Lake Erie Sidewheel Steamers of Frank E. Kirby (Detroit: Great Lakes Model Shipbuilders Guild, 1955), 8-9.

<sup>49</sup> Bugbee, "Frank E. Kirby," 7, 9; Detroit Dry Dock Company, Around the Lakes, 20, 43; Wright, Freshwater Whales, 100.

<sup>50</sup> Wayne E. Rook, "The Automobile Age in the Making of Detroit, 1880-1900," (M.A. thesis, Wayne State University, 1964), 15. See also the appendix to Rook's study, "Detroit Industries of 1880-1901: List

Through Frank Kirby another firm entered the mix: the Detroit Sheet Metal and Brass Works. It began in 1883 as the Dry Dock Sheet Metal Works and was housed in a two-story brick building located at the northeast corner of Orleans and Guoin streets. According to the city directory for 1884, Alfred Rentz was the superintendent of the works. “Steamboat work” was one of its specialties. The company incorporated in 1885 as the Detroit Sheet Metal and Brass Works. Frank Kirby became a leading stockholder and president, while Rentz remained superintendent. Neil McMillan, no relation to James McMillan, became secretary and treasurer of the firm. By the mid-1890s, Kirby shared ownership of the firm with Hugh, Gilbert, and Harold McMillan. The company’s products were as varied as ever. The firm won heating, ventilation, and plumbing contracts on downtown Detroit projects, including the steel-framed Chamber of Commerce building. It made brass tables and easels, Worthington steam pumps and condensers, Foster pressure regulators, and Metropolitan injectors. It also handled sheet metal and copper work on buildings and ships. The enterprise was absorbed by the Detroit Dry Dock Company in 1899.<sup>51</sup>

Frank Kirby was also the avenue through which the McMillans gained control of the Dry Dock Engine Works. In 1880 practically all shares in the company were still owned by Cowie, Donaldson, and Jones. By 1884, however, Frank Kirby had acquired 1,700 shares in the firm, making him the single largest stockholder. Toward the end of the decade the Detroit Dry Dock Company possessed virtually all the stock of the Dry Dock Engine Works, and John Owen had replaced Cowie as president. By 1892 James McMillan was president of the firm, his brother Hugh was vice-president, his nephew Gilbert secretary, and Alexander McVittie treasurer and general manager. With the exceptions of Kirby and McVittie, the firm was entirely McMillan-owned by the mid-1890s. James McMillan soon stepped down as an officer, although he continued as majority stockholder. Hugh McMillan emerged as the new president, McVittie as vice-president and manager, and Gilbert McMillan as secretary and treasurer. Frank Kirby became consulting engineer to the firm, and Charles B. Calder was hired as superintendent of the works.<sup>52</sup>

The tendency of the age was for the concentration of business. In shipbuilding the tendency resulted in the integration of hull construction with engine building. In 1890, American shipbuilders spent \$2,913,856 on engines and boilers. The figure increased only slightly in 1900 to \$3,082,977. Yet, shipbuilders launched a much larger number and tonnage of vessels in 1900 than in 1890. According to the United States

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of Stockholders,” based on his research into corporation records at the State Archives of Michigan. In 1867, the Scottish-born McVittie moved from London, Ontario, to Detroit, where he hired on as a bookkeeper at at Campbell & Owen. In 1872, he rose to the position of secretary and manager following the formation of the Detroit Dry Dock Company. See entry for “Alexander McVittie” in Robert B. Ross and George B. Catlin, Landmarks of Wayne County and Detroit (Detroit: The Evening News Association, 1898), 768-69.

<sup>51</sup> Commerce, Manufacturers, and Resources of Detroit, Michigan, 88; City Directories of Detroit (1883), 109, 393, (1886), 493, (1892), 403; Roock, “The Automobile Age in the Making of Detroit,” 17 and appendix; see transactions involving the Dequindre Farm, block 7, lots 9-10, in Wayne County Register of Deeds, Tract Index, liber 539.

<sup>52</sup> City Directories of Detroit (1886), 492, (1889), 491, (1890), 433, (1892), 425, (1895), 490; Roock, “The Automobile Age in the Making of Detroit,” 16 and appendix; Wright, Freshwater Whales, 108-10.

Census Office, the relatively lower expenditure on engines and boilers in 1900 indicated that the plants of shipbuilders “had been sufficiently increased to enable a large proportion of them to manufacture the machinery and boiler equipment of the vessels built, without recourse to specialists in these lines of manufacturing.”<sup>53</sup> The virtual integration of the Dry Dock Engine Works with the Detroit Dry Dock Company matched this integrating trend in the industry. Subcontracting, however, did not come to a complete end, even in the area of engine building. While the Dry Dock Engine Works of the mid-1890s was a rather complete operation with a machine shop, pattern shop, foundry, and forge, the company might look elsewhere for critical engine components. On March 8, 1895, for example, Frank Kirby wrote to the Wheeler Condenser & Engine Company in New York, asking for a price quote on improved surface condensers, along with air and circulating pumps, suitable for triple expansion engines of 2,000 horsepower.<sup>54</sup>

The year 1899 saw the formation of the American Shipbuilding Company, the Great Lakes shipbuilding trust with central offices in Cleveland, Ohio. Incorporated on March 16 under New Jersey law, the new entity originally had the holdings of seven shipbuilding companies, including the properties of the Detroit Dry Dock Company and its subsidiaries that were valued at \$1,428,000. Alexander McVittie served on the executive committee of the new corporation, while Gilbert McMillan represented the interests of his family on the board of directors. At the end of March, in an effort to properly organize the Detroit operations, the McMillans combined the Dry Dock Engine Works, the Detroit Sheet Metal and Brass Works, and the Detroit Dry Dock Company to form the Detroit Shipbuilding Company. Alexander McVittie held the positions of president and general manager, while William C. McMillan (son of the senator) served as vice-president.<sup>55</sup>

The City Directory of Detroit for 1899 identified the five principal assets of the Detroit Shipbuilding Company:<sup>56</sup>

- (1) Engine Works at Orleans and Atwater (with a boiler shop at Dequindre and Atwater)
- (2) Sheet Metal and Brass Department at Orleans and Guoin

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<sup>53</sup> Alexander R. Smith, “Shipbuilding,” in United States Census Office, Twelfth Census of the United States Taken in the Year 1900: Manufacturers. Census Report Volume 10, Part IV: 225 (Washington, D.C.: United States Census Office, 1902).

<sup>54</sup> Frank Kirby to Wheeler Condenser & Engine Company, March 8, 1895, in Frank Kirby Letterbook, April 5, 1891 to June 26, 1896, Frank E. Kirby Papers, Burton Historical Collection, Detroit Public Library, Detroit, Michigan.

<sup>55</sup> Wright, Freshwater Whales, 135-41; City Directory of Detroit (1899), 504; Roock, “The Automobile Age in the Making of Detroit,” 18. Of the nine individuals listed as stockholders in the Detroit Shipbuilding Company, seven were members of the McMillan family. The exceptions, again, were Frank Kirby and Alexander McVittie. See Articles of Incorporation of Detroit Shipbuilding Company [March 1, 1899], Articles of Incorporation/Bylaws file, Detroit Shipbuilding Company Papers, Wright Marine Collection, Historical Collections of the Great Lakes, Jerome Library, Bowling Green State University, Bowling Green, Ohio [hereafter, HCGL].

<sup>56</sup> City Directory of Detroit (1899), 504.

- (3) dry dock facilities at the foot of Orleans Street (and site of the main offices of the company)
- (4) dry dock facilities at the foot of Clark Street
- (5) Metal Yard Department in Wyandotte

With a force of 1,337 workers when operating at full capacity, the Detroit Shipbuilding Company was the fourth largest employer of labor in the Detroit area in 1900.<sup>57</sup> The only available employment figures specifically pertaining to the Engine Works date from 1897. That year the Dry Dock Engine Works reported a full-time force of 125 employees in the engine-building plant and another 140 in the boiler shop; however, only 75 and 60 workers, respectively, were under hire at the time of inspection by the state of Michigan. With the economic depression of the 1890s still lingering, only half of the facility's potential labor force was employed.<sup>58</sup>

Little is known directly about the adult (and presumably white) males who labored at the Engine Works.<sup>59</sup> However, fifty-three of the company's employees were captured in a photograph taken in the early 1880s when a young Henry Ford worked there picking up the machinists' trade.<sup>60</sup> The workers were arranged in four rows before a two-story brick building. Hanging over the entrance behind them was a makeshift wooden sign inscribed with the handwritten words, "Dry Dock Engine Works." Ford's tenure at the Dry Dock Engine Works between the fall of 1880 and the late summer of 1882 serves as a reminder that in the early 1880s it was steam power and steam engines that fascinated the future automobile pioneer. Ford testified to this many years later when he recalled the period following his employment at the Dry Dock Engine Works: "I had the idea of making some kind of a light steam car that would take the place of horses—more especially, however, as a tractor to attend to the excessively hard labour of

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<sup>57</sup> At the time of inspection by the State of Michigan's Bureau of Labor and Industrial Statistics, only 775 workers were actually employed at the Detroit Shipbuilding Company. See Table 23, "Detroit and Detroit Area Firms with 500 or more Workers" in Thomas A. Klug, "Roots of the Open Shop: Employers, Trade Unions, and Craft Labor Markets in Detroit, 1859-1907," (Ph.D. dissertation, Wayne State University, 1993), 165-66.

<sup>58</sup> State of Michigan, Bureau of Labor and Industrial Statistics, Fifteenth Annual Report (Lansing, MI: Robert Smith Printing Co., 1898), 41. The Detroit Dry Dock Company reported a capacity of 300 employees at its Detroit yard, with 100 on hand at the time of inspection. The Detroit Sheet Metal and Brass Works gave figures of 325 (capacity) and 30 (actual employment).

<sup>59</sup> African-Americans represented only 1.43 percent of Detroit's population of 285,000 in 1900. Their presence was negligible in manufacturing occupations. Only 10 percent of African-Americans active in the labor force held jobs in the manufacturing sector, and these were chiefly construction jobs for men and dressmaking for women. They were practically non-existent in Detroit's factories until the World War I era, and even then very few employers hired them. See Klug, "Roots of the Open Shop," 136-37. The most thorough examination of Detroit's African-Americans before World War I is David Katzman, Before the Ghetto: Black Detroit in the Nineteenth Century (Urbana, IL: University of Illinois Press, 1973).

<sup>60</sup> The photograph appears in Sidney Olson, Young Henry Ford: A Picture History of the First Forty Years (Detroit: Wayne State University, 1997; second edition), 29. Ford stands in the fourth row, the fifth person from the right. The period of his employment at the Dry Dock Engine Works is also covered in Allan Nevins and Frank Ernest Hill, Ford: The Times, the Man, the Company (New York: Charles Scribners Sons, 1954), 84-86. Ford briefly hints at his "apprenticeship" at the Engine Works in My Life and Work (Garden City, NY: Garden City Publishing Co., 1922), 24.

ploughing. It occurred to me, as I remember somewhat vaguely, that precisely the same idea might be applied to a carriage or a wagon on the road.”<sup>61</sup>

It appears that on one or more occasions the young Ford was noticed by Frank Kirby, the ship designer and engineer, and a pair of anecdotes about these encounters have passed down through time.<sup>62</sup> Another Ford anecdote, again told many years later, casts a bit of light on relations between workers and their supervisors at the Dry Dock Engine Works. As Ford recalled,

I had cleaned up and was sitting down, enjoying a minute’s rest as only the man who has earned it can enjoy rest, when John Donaldson, the foreman, came through. He looked at me and grinned at my attitude of careless relaxation. Some of the men had been lazing just as I was, had sprung to attention and tensity as they saw the ‘boss’ approach.

“That’s right,’ he said to me. ‘Make no pretense because I am the boss. Sit there and smile at me. I’d rather you’d do that than make a bluff at working just because the boss is passing.’”<sup>63</sup>

A survey conducted in 1890 by the State of Michigan of the nearby marine engine firm of Samuel F. Hodge & Company provides a reasonable basis upon which to make inferences about the characteristics of the workforce of the Dry Dock Engine Works.<sup>64</sup> The Hodge workforce consisted of 104 individuals. Of these, 63 percent were skilled workers such as machinists (41), molders and coremakers (17), blacksmiths (4), and patternmakers (4). The average wage for most of them was \$15.00 per week. Laborers (21) and helpers (7) represented 27 percent of the labor force, and their pay was half that of the skilled workers. Nearly two-thirds of the workers (generally men in their 30s and older) were married. The oldest employee was a 65-year old laborer born in Ireland, married, and with three children to support. The youngest were a pair of 17-year old, native-born, “machine hands.” Fully 93 percent of the labor force was either foreign-born or foreign stock (that is, native-born with at least one foreign-born parent). Seventy employees (or 67 percent) were foreign born. The largest number came from Germany (19) and Canada (18). Twenty-four had been born in England, Scotland, or Ireland. Ten workers came from Poland as part of the “new” immigration from eastern and southern Europe at the end of the nineteenth century. All but one of the Polish-born workers were laborers, which reflected the occupational concentration of this group of immigrants in American industry. Among the native-born workers of foreign stock, three-quarters came from Canada, England, Scotland, or Ireland.

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<sup>61</sup> Ford, *My Life and Work*, 25.

<sup>62</sup> The anecdotes are told in Nevins and Hill, *Ford*, 85, and Olson, *Young Henry Ford*, 30. In the 1920s, Ford had Kirby’s name inscribed on the lintel of his automobile company’s Engineering Laboratory Building in Dearborn, along with such scientists and inventors as Galileo, Newton, and Edison.

<sup>63</sup> Nevins and Hill, *Ford*, 85-86.

<sup>64</sup> State of Michigan, Bureau of Labor and Industrial Statistics, *Eighth Annual Report* (1891), 72-77. Also included in the state’s report (pages 84-87) were ninety-five workers employed at the Detroit Sheet Metal and Brass Works.

Detroit-area shipbuilders, like those in other locales, battled with assertive and organized workers. During the 1880s, ship-carpenters offered the greatest resistance to employers, and on occasion employers recruited workers or strikebreakers from Scotland, Canada, or Maine. Companies did not have much better luck with riveters. In the midst of a dispute during the summer of 1897 with workers at the Wyandotte yard of the Detroit Dry Dock Company, Frank Kirby posted the following notice:

To all workmen, including riveters:

The habit of losing time, especially on Mondays, will not be permitted hereafter. The timekeeper is instructed to report any one not here on regular working hours. Any workman employed in this yard who cannot work steadily each whole working day need not work at all.

The response of management to the riveter problem was the pneumatic riveting machines. Around 1896 the machines began to appear in the Great Lakes shipyards; the Chicago Pneumatic Tool Company supplied most. They vastly increased output and lowered the costs of riveting. One additional advantage of riveting machines, according to Wright, “was that unskilled labor could be trained to operate them in a short period of time. This would reduce labor expenses and almost eliminate one large managerial headache.”<sup>65</sup>

Frank Kirby took the lead in bringing pneumatic riveting to the Detroit Dry Dock Company.<sup>66</sup> The pneumatic-power revolution also came to the Dry Dock Engine Works. In early 1900, for example, Charles Calder, the general superintendent, noted the installation of an air compressor on the back of the boiler shop.<sup>67</sup> Of great concern to Calder at the time was the trouble the Detroit Shipbuilding Company and employers elsewhere were having with the iron molders’ and machinists’ unions.<sup>68</sup> During the summer of 1901 the nationwide machinists’ strike enveloped the Detroit Shipbuilding Company. Thirty machinists at the Engine Works downed their tools, but fifteen commuters from Windsor, Ontario, remained at work. Trade unionists futilely sought the assistance of federal customs officers and a pair of immigrant inspectors in keeping out the strikebreaking commuters. The machinists’ union, therefore, mounted its own defense of the border by stationing some of its members at the Detroit River ferry docks in a bid to turn back the Canadians. To evade the union lookouts, however, the “Windsor boys” took to crossing the river by rowboat. On the evening of June 6, the striking machinists replied by crossing into Canadian territory and smashing the rowboat. “It looks as if the union men wanted to get back to their old jobs,” Calder noted wryly in his journal.<sup>69</sup>

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<sup>65</sup> Wright, *Freshwater Whales*, 13-15, 101-2, 106-8; Thomas A. Klug, “The Detroit Labor Movement and the United States-Canada Border, 1885-1930,” *Mid-America* 80 (Fall 1998): 212-14.

<sup>66</sup> Wright, *Freshwater Whales*, 14.

<sup>67</sup> Entry for March 9, 1900, Daily Journal of C.B. Calder, HCGL.

<sup>68</sup> Entries for January 23-24, March 7, 8, 10, 28 and 29, 1900, Daily Journal of C.B. Calder, HCGL.

<sup>69</sup> Klug, “The Detroit Labor Movement and the United States-Canada Border,” 232; entry for June 7, 1901, Daily Journal of C.B. Calder, HCGL.

The 1901 strike gravely weakened the machinists' union in Detroit. Nor did the iron molders and other skilled workers fare much better in these years. For most of the next four decades, Detroit enjoyed the reputation as one of the leading "open shop" cities in the country. Due to the determination of employers and developments in manufacturing technology related to the burgeoning automobile industry, the city offered an environment where trade unions had enormous difficulty remaining effective.<sup>70</sup>

Although the Detroit Shipbuilding Company played its part in the war against organized labor that helped pave the way for the concentration of the automobile industry in Detroit, the company itself does not appear to have been involved in the new industry. In early 1900, an engineer for Buick & Sherwood Manufacturing Company, a successful producer of bathroom plumbing fixtures and an early participant in the nascent automobile industry, visited the Detroit Shipbuilding Company. According to C.B. Calder, he asked "if we could advise him in regard to the best mill for boring out gasoline engine cylinders they are going in the business to make 20 engines a day." As Calder recalled, "we advised his going to the Westinghouse people."<sup>71</sup> There is no evidence that the company used its foundry or machining capacity to diversify by expanding into the auto industry. None of the local city directories during the 1900s and 1910s, for example, listed the Detroit Shipbuilding Company as a supplier of castings, engines, machine shop products, or automobile parts.<sup>72</sup>

Annual surveys by the State of Michigan provide some measure of employment levels at the Detroit Shipbuilding Company during the first two decades of the century. Some of the figures for these years are presented in Table 1. Unfortunately, it is not possible to separate employment at the Engine Works from the other operations of the company.

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<sup>70</sup> Klug, "Roots of the Open Shop," chapters 12-19.

<sup>71</sup> Entry for February 28, 1900, Daily Journal of C.B. Calder, HCGL. Calder identified the engineer from Buick & Sherwood as W.S. Murray. For more on the business career of David Buick, see George S. May, A Most Unique Machine: The Michigan Origins of the American Automobile Industry (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1975), 195-202.

<sup>72</sup> See the classified sections for the city directories of Detroit, 1900-1920.

Table 1  
 Employment at Detroit Shipbuilding Company  
 At Time of State Inspection, 1906-1919

<u>Inspection Year</u>	<u>Employment at the Detroit Shipbuilding Company</u>		
	<u>Detroit</u>	<u>Wyandotte</u>	<u>Total</u>
1906	597	826	1,423
1909	534	263	797
1910	224	191	415
1919	3,010	4,013	7,023

Source: State of Michigan, Bureau of Labor and Industrial Statistics, Twenty-Fourth Annual Report (1907), 161, 187; State of Michigan, Department of Labor, First Annual Report (1910), 155, 183; Department of Labor, Second Annual Report (1911), 248, 277; Department of Labor, Thirty-Seventh Annual Report (1920), 244, 289.

A regular pattern set in over these years: steel hulls built in Wyandotte were brought up the Detroit River to Orleans Street, where vessels underwent work on their superstructures and received their engines and boilers. A total of 151 ships were built at Wyandotte between 1900 and 1920. Half of them were constructed in 1917-1919, many as part of the government’s mobilization of Great Lakes shipbuilders during World War I. Reflecting the wartime swelling of employment, the Detroit Shipbuilding Company engaged some 7,000 workers in 1919. After the war the American Shipbuilding Company phased out the Wyandotte facility as part of a cost-cutting move. The last vessel (the *James Davidson*) was launched from there on October 9, 1920.<sup>73</sup>

The Orleans Street operations of the Detroit Shipbuilding Company, including the Engine Works, remained open for several more years. In 1923, the American Shipbuilding Company erected the steel hulls for a pair of identical sidewheel passenger ships at Lorain, Ohio, for the Detroit & Cleveland Navigation Company. Named the *Greater Detroit* and *Greater Buffalo*, the 518’ long steamers were the last ones designed by Frank Kirby. At the time they were largest passenger steamers ever built on the Great

<sup>73</sup> Chaput, “Michigan Shipbuilding Cities,” 335-39; Rev. Edward J. Dowling, S.J., The “Lakers” of World War I (Detroit: University of Detroit Press, 1967); Wright, Freshwater Whales, 177-201. A total of 448 Great Lakes steel ships were built for war purposes. See Edward N. Hurley, The Bridge to France (Philadelphia: J.B. Lippincott Company, 1927), facing page 50.

Lakes. The following year they were towed to Orleans Street, which is where their Scotch marine type boilers, three-cylinder compound inclined engines, and feathering wheels were installed.<sup>74</sup>

After nearly seventy-five years of activity, ship- and engine-building operations at the foot of Orleans Street ceased after work concluded on the *Greater Detroit* and *Greater Buffalo*. The corporate existence of the Detroit Shipbuilding Company expired on March 30, 1929. Before its departure the company sold the property on which the Engine Works stood to Biddle Avenue Realty, which in turn conveyed it to James S. Holden. Huron Farms Company acquired the property at the end of 1932, agreeing that they would use no part of the property for shipbuilding for ten years. Three years later, Huron Farms Company sold the site to the Detroit Edison Company. There is no evidence as to how the plant was used between 1925 and 1929. However, photographs taken in the late 1920s and early 1930s clearly show the words “Cabinet Shop” painted boldly on the Atwater façade overlooking the former dry dock.<sup>75</sup> It is not known just how this signage related to the occupant of the building: Electromaster, Inc., a small stove manufacturer organized in 1929 by Warren Noble, Richard Marshall, and Edward Gushee. Electromaster last appeared in a city directory in 1941—the last one published for Detroit until the 1950s.<sup>76</sup>

Detroit Edison owned the Engine Works site from 1935 until 1981. In 1948, the company made drawings of a pair of structures on the site of the former boiler shop, and in 1952 drawings were prepared of the former engine-building plant, so it is likely that the company occupied these facilities by those dates.<sup>77</sup> City directories in 1957 and 1963 indicate Detroit Edison using the engine-building plant as a “reconditioning and appliance shop.” In 1981, it sold the property to the Globe Trading Company for \$81,000. A wholesale dealer in machinery and “mill supplies,” Globe Trading first appeared at the site in the city directory in 1968. However, a photograph taken in the summer of 1966 reveals a “Globe Trading Company” sign prominently displayed on the Orleans Street façade at the southwest corner of the building. At present, the building is unoccupied and owned by the City of Detroit.<sup>78</sup>

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<sup>74</sup> Wright, Freshwater Whales, 205-6; Bugbee, “Frank E. Kirby,” 14; “Builds Lake Liner,” Marine Review 54 (September 1924): 376-79; Frank E. Kirby and Herbert C. Sadler, “The Design of Passenger Vessels for the Great Lakes,” Transactions of the Society of Naval Architects and Marine Engineers (1925), in Steamboat Bill LIV (Spring 1997): 32-44.

<sup>75</sup> See photographs in Philip P. Mason, Rumrunning and the Roaring Twenties: Prohibition on the Michigan-Ontario Waterway (Detroit: Wayne State University Press), on pages 115, 128, and 130, which also show the use of former Dry Dock No. 2 by officials involved in the enforcement of the prohibition laws. In addition, see the pair of aerial photographs of the Engine Works site taken on May 13, 1931, and submitted as part of this report.

<sup>76</sup> Oxtoby, Robison & Hull to Detroit Edison Company, October 9, 1941, Deeds File: St. Aubin Farm Indentures and Correspondence, 1908-1941, Detroit Shipbuilding Company Papers, Wright Marine Collection, HCGL; transactions involving the Dequindre Farm, section 4, in Wayne County Register of Deeds, Tract Index, liber 539; City Directories of Detroit (1930-31), 2739, (1937), 2268, (1941), 2170.

<sup>77</sup> See Landmarks Design Services, Inc., Ex-10, 7-21-80, based on information taken from drawings dated 11-23-48 and 9-13-49, drawn by the Detroit Edison Company; and Landmark Design Services, Inc., Ex-5, 7-21-80, based on information taken from drawing dated 5-12-52, drawn by the Detroit Edison Company.

<sup>78</sup> Transactions involving the Dequindre Farm, section 4, in Wayne County Register of Deeds, Tract Index, liber 539; City Directories of Detroit (1957), 20, (1963), 18, (1968), 16, (1970), 16, 359; Jennifer Dixon,

## Part II: Site and Buildings of the Dry Dock Engine Works

### The Site and Buildings, Pre-1892

The Dry Dock Engine Works produced marine steam engines at the corner of Atwater and Orleans Streets as early as 1867. However, not until the mid-1880s is there firm documentary evidence as to the types of buildings that the company maintained at the site. Not one of these early buildings has survived. They were replaced by six newer structures (the ones that stand today) built between the years 1892 and 1919.

A series of Sanborn insurance maps of Detroit for 1884, 1897, and 1922 constitutes one of the most important sets of documents on the ship- and engine-building operations that took place in the vicinity of Atwater and Orleans.<sup>79</sup> The Sanborn map for 1884 reveals the Detroit Dry Dock Company's operations south of Atwater; the two-story Dry Dock Sheet Metal Works at the corner of Orleans and Guoin; and a combined two-story boiler shop and one-story blacksmith shop of the Dry Dock Engine Works located mid-way between Dequindre and St. Aubin Streets. A contemporary sketch in Silas Farmer's History of Detroit and Michigan also offers a sweeping view of the dry docks. The rectangular boiler shop is plainly visible in the upper right-hand corner of the drawing.<sup>80</sup>

Some of the brick structures of the Dry Dock Engine Works that fronted Atwater Street are also visible in the background of the drawing in Farmer, and the Sanborn map for 1884 identifies their functions. Starting at the corner of Orleans Street, a two-story brick building stretched nearly two-thirds of the way across the block. The first floor contained a machine shop, while the second floor was used for patternmaking and storage.<sup>81</sup> To the east of it was a one-story square building that held the company's forge. At the corner of Dequindre, and quite prominent in the Farmer sketch, was the two-story,

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"Globe's Last Stand," Detroit Free Press (November 12, 2002), C1, 3. The black and white photograph of the "Globe Building" taken by Wayne Roock is dated July, 1966, and is in the possession of the author of this report.

<sup>79</sup> Insurance Maps of Detroit, Michigan (New York: Sanborn Map & Publishing Co., 1884), volume 2, plate 62; Insurance Maps of Detroit, Michigan (New York: Sanborn-Perris Map Co., 1897), volume 4, plate 43-44; Insurance Maps of Detroit, Michigan (New York: Sanborn Publishing Co., 1922), volume 4, plates 49-50.

<sup>80</sup> Silas Farmer, History of Detroit and Michigan, 912. Internal evidence indicates that the drawing captured the scene around 1884. Shown nearing completion is the wooden package freight steamer, *W.A. Haskell*, which was built by the Detroit Dry Dock Company in 1884. Also sketched are several ships in for repair: the sidewheeler *City of Detroit* (built by the Detroit Dry Dock Company in 1878) and the *G.W. Adams* (1875). In the foreground are the *John Owen* (1874) and *W.J. Averill* (1884). For dates of ship construction, see Detroit Dry Dock Company, Around the Lakes, 5, 7, 19, 42-45. Facing this drawing in Farmer's history, on page 913, is a sketch of the Detroit Dry Dock Company's iron shipyard in Wyandotte.

<sup>81</sup> The triple expansion engine of the steamer *Marigold*, built in 1891 and published in Around the Lakes (p. 166), probably was taken in this early machine shop. As for the photograph of the compound engine of the *John J. Hill*, a wooden steamer built in 1892, it is difficult to determine whether the surrounding building is the old machine shop of the Dry Dock Engine Works, or the new one that started up in the spring of 1892. See Around the Lakes, 169.

brick Dry Dock Hotel. The facades of these three buildings are also captured in a photograph taken in the early 1890s when Dry Dock No. 2 to the south was under construction.<sup>82</sup>

Not revealed in any photograph or sketch at this time were the buildings behind the Atwater frontage. For example, a one-story machine shop of frame construction extended north from the main machine shop. Within its space was a boiler room; its 65' high brick chimney is also visible in the above-mentioned photograph. A two-story square structure, connected to the main machine shop at its northwest corner, served as an office building. Set apart from the other buildings was the company's foundry, a rectangular structure located along Guoin Street. To it were attached structures used to house cupolas and core ovens. Other stand-alone buildings included a one-story frame structure used for storing iron; a two-story frame building in the middle of the block used for the cleaning of castings; and a combined pattern shop and storage building located at the corner of Orleans and Guoin. Six residences or former residences, mostly one-story and of frame construction, occupied the area along Dequindre Street north of the Dry Dock Hotel.

For the Dry Dock Engine Works, the manufacturing operations essential to building marine engines were in place by 1884. The company had its own pattern-making shop. It maintained facilities needed to make iron and brass castings, such as a foundry, cupolas, core ovens, and a space for cleaning castings. The company could also make the necessary forgings for such moving parts of a steam engine as piston rods, cross-heads, connecting rods, valve links and stems, and crank shafts.<sup>83</sup> The space dedicated as a "machine shop" was used for two purposes: to turn castings and forgings into workable engine components, and for the actual erection of engines. To all this the company had added a facility to build marine boilers.

These basic functions of the Dry Dock Engine Works remained in place when the next Sanborn map came out in 1897. However, the company's facilities had been significantly overhauled at the beginning of the 1890s. This was at a time when the McMillan interests had acquired control of assorted shipbuilding operations in the vicinity of Orleans Streets. "By an expenditure equal to about one-third the original investment represented in the plant of the Detroit Dry Dock Company...the capacity of the different works was doubled in 1892, and the plant as a whole is now among the finest in the entire country," claimed the company.<sup>84</sup> The Sanborn map reveals not only the McMillans' investment in plant modernization that occurred early in the decade, but also the growing integration of production among three nominally independent companies: the Detroit Dry Dock Company, the Dry Dock Engine Works, and the Detroit Sheet Metal & Brass Works.

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<sup>82</sup> Photograph, Detroit Dry Dock Company, Historical Collections of the Great Lakes, Bowling Green State University, Bowling Green, Ohio 43403. Photograph is in field records.

<sup>83</sup> On the identification of the forgings used in marine steam engines, see R.W. Davenport, "Steel for Marine Engine Forgings and Shafting," *Cassier's Magazine* 12 (August 1897): 513.

<sup>84</sup> Detroit Dry Dock Company, *Around the Lakes*, 88.

## Dry Dock, Machine Shop, and Boiler Shop, 1892

In 1892 the Detroit Dry Dock Company opened a new dry dock at the foot of Orleans Street in order to accommodate the growing size of Great Lakes vessels that might set in for rebuilding or repair. Known as Dry Dock No. 2, it measured 378' in length, at the time making it the second longest dry dock on the Great Lakes. It was 91' wide at the top and 55' wide at the floor. The depth was 20.5' from the water line to the floor of the dock, and 16.5' of water covered the keel blocks. A steel caisson gate, made at the company's shipyard in Wyandotte, was 79.5' long. It had five 30" valves for flooding the dock, an operation that took about twenty minutes. A pair of centrifugal pumps, driven by two Westinghouse compound steam engines, each of which was powered by three oil-fired boilers, could empty the water in the dock in about one and a half hours. Nearby the company added "a pair of steel shear legs for hoisting boilers, engines, spars, etc, from and into boats." Each stood 100' in height and could lift 100 tons.<sup>85</sup>

Hefty investments were also made in two new structures built for the Dry Dock Engine Works: a machine shop and a boiler shop. Each of these was designed and built by the Berlin Iron Bridge Company of East Berlin, Connecticut.<sup>86</sup> Each also featured skeleton construction made with *steel* columns, beams, and girders and non-load-bearing masonry curtain walls.<sup>87</sup> The Dry Dock Engine Works took out a building permit for its

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<sup>85</sup> Detroit Dry Dock Company, *Around the Lakes*, 114-15. The remnants of Dry Dock No. 2 are still visible today. During the shipbuilding era, and just to the east of No. 2, was Dry Dock No. 1. It measured 245' in length, 48' in width, and it had only half the depth of No. 2. The company also had a pair of dry docks at the foot of Clark Street in Detroit, about a mile southwest of Orleans Street.

<sup>86</sup> On the Berlin Iron Bridge Company's role as the designer and builder of these structures, see its advertisement in Detroit Dry Dock Company, *Around the Lakes*, 241. See also photographs and text pertaining to these buildings in The Berlin Iron Bridge Co., *The Berlin Iron Bridge Co. Engineers, Architects, and Builders in Iron and Steel* (Hartford, CT: Case, Lockwood & Brainard, n.d., but circa 1894), 18, 52, and 54. "The boiler shop measured 180 feet long, 70 feet wide, and 50 feet in height. The main building, which is about 45 feet in width, is lighted by an immense skylight, and by continuous windows with heavy frames around the outward portions of the sides of the shop just under the roof. In this main building, a 20-ton electric crane is fitted to an overhead system of tracks, so as to operate over the full length and width of the floor space....An L shaped addition to this main shop, 30 by 80 feet, contains part of the machinery, while in the old boiler shop, which adjoins the structure, the blacksmiths' fires and some small machines are located." Detroit Dry Dock Company, *Around the Lakes*, 90.

<sup>87</sup> Contemporary sources are not consistent as to whether iron or steel was the metal used in the new machine and boiler shops of the Dry Dock Engine Works. To begin with, the building permit for the machine shop indicated only a one-story *brick* shop. More information was provided by the Detroit Dry Dock Company's publication, *Around the Lakes*, which noted that the construction of the machine shop was of "*steel* and brick" (p. 86). As for the other structure, a trade journal reported, "a contract has just been let with the Berlin Iron Bridge Company of East, Berlin, Conn., for a new boiler shop to be built of *steel* and brick of the latest and most approved type...." See *Marine Review* 5 (January 28, 1892): 5. However, a subsequent article commented on the machine and boiler shops, "with their massive structural *iron* frames." See "A Great Shipbuilding and Dry Dock Plant," *Marine Review* 6 (November 3, 1892), 13, which is identical to the statement in Detroit Dry Dock Company, *Around the Lakes*, 89. The Berlin Company's own publication, *The Berlin Iron Bridge Co.*, noted that it worked in iron and steel. However, the use of steel was not mentioned with the firm's work at any of the companies mentioned in the publication. "The entire frame work of the building is of *iron*," it remarked about the boiler shop (p. 18) and the machine shop (p. 54) of the Dry Dock Engine Works. Not until 1922 did a Sanborn insurance map

new machine shop on December 26, 1891.<sup>88</sup> The building was situated at the northeast corner of Atwater and Orleans Streets. The south end of it was built over the western half of the existing machine shop, which left the remaining portion of the older structure functioning as a bolt cutting shop on the first floor and a pattern shop on the second. Construction continued on the new machine shop through the winter and early spring of 1892, and engine-building operations commenced there on April 26.<sup>89</sup> The year “1892” is indicated in wrought-iron numbers just below the roof overlooking Atwater Street. Still visible on the south façade is painted lettering that reads: “*Detroit Shipbuilding Company. Machine Shop. Established 1862.*”<sup>90</sup>

The last decades of the nineteenth century saw the designing and building of industrial plants emerge as a scientific discipline. “A modern manufacturing building constructed of iron and brick is as much a scientific creation as an iron railroad or highway bridge,” noted the Berlin Iron Bridge Company in the mid-1890s. “In the past few years, modern shop practice has advanced by rapid strides, so that plants built within the last few years can turn out work and make a fair profit, where shops which were built according to old ideas could not even make a living.” Intense business competition necessitated a relentless quest to eliminate waste and reduce costs, and it spurred engineers and managers to dramatically improve efficiency in the design, construction, and, most importantly, the operation of factories.<sup>91</sup>

The new machine shop of the Dry Dock Engine Works featured many of the latest advances in factory design and construction. Some of these, such as metal roof trusses and the roof monitor, went back to the mid-nineteenth century.<sup>92</sup> Three important

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detail the framing material, at which time it indicated *steel*. Some clarification of terminology comes from Sennett and Oram. They referred to the “inclusive sense” of the term iron “to comprise cast-iron, wrought-iron, and steel; which, though differing so greatly in qualities, are but different forms of the same material.” Richard Sennett and Henry J. Oram, *The Marine Engine: A Treatise for Engineering Students, Young Engineers, and Officers of the Royal Navy and Mercantile Marine* (London: Longmans, Green & Co., 1898), 450. Bearing this in mind, it appears that buildings described in the late-nineteenth-century as iron framed might be made of iron *or* steel. However, a building described as steel framed was precisely that: steel.

<sup>88</sup> Building Permit #2066, December 26, 1891, Detroit Archives, Building and Safety Department, Fire Marshall Building Permits, 1890-1901, volume 5-8, microfilm reel 2, Burton Historical Collection, Detroit Public Library.

<sup>89</sup> “We started our new main shop this morning...” Frank E. Kirby to W.L. Mahon, April 26, 1892, Frank Kirby Letterbook, April 5, 1891 to June 26, 1896, Frank E. Kirby Papers, Burton Historical Collection, Detroit Public Library, Detroit, Michigan.

<sup>90</sup> The “1892” sign appears in the earliest photograph of the building in Detroit Dry Dock Company, *Around the Lakes*, 87. The earliest photograph to reveal the painted lettering is “Detroit Shipbuilding Co. life rafts dept.,” July 10, 1912, Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection, <http://memory.loc.gov/ammem/detroit/dethome.html>, Digital ID det 4a26732. The founding date of 1862 refers one of the predecessor firms of the Detroit Shipbuilding Company.

<sup>91</sup> Berlin Iron Bridge Company, *The Berlin Iron Bridge Co.*, 3. On the revolution in industrial building design and construction at the end of the nineteenth century, see the analysis of “engineered factories” in Betsy Hunter Bradley, *The Works: The Industrial Architecture of the United States* (New York: Oxford University Press, 1999), chapters 4-8. Also see Daniel Nelson, *Managers and Workers: Origins of the New Factory System in the United States, 1880-1920* (Madison, WI: University of Wisconsin Press, 1975), chapters 2-3; and Lindy Biggs, *The Rational Factory: Architecture, Technology, and Work in America’s Age of Mass Production* (Baltimore, MD: The Johns Hopkins University Press, 1996), chapters 1-2.

<sup>92</sup> Bradley, *The Works*, 181, 189.

elements of the modernized factory featured in the machine shop of the Dry Dock Engine Works first appeared during the decade of the 1880s: electric-drive machinery, the electric-powered traveling crane, and iron/steel framing with riveted connections and exterior curtain walls.

First applied to factories in 1884, electric drive was, according to Daniel Nelson, “probably the single most important stimulus to change in the layout and operation of the large factory.” By eliminating or at least greatly reducing the amount of complicated millwork (with its attendant shafts, gears, pulleys, and belting) required to power machines in a factory, electrical generators and motors made it possible to vastly extend the length and scale of industrial buildings. “Upper walls and roofs became more important than ever as sources for natural light and ventilation once headroom was cleared of millwork,” notes Betsy Hunter Bradley. “Consequently, much wider structures became feasible.” Electric drive also helped bring about a break with existing industrial traditions by freeing engineers and managers to arrange machinery and work in accordance with efficient plant layout and materials handling considerations rather than with the needs of millwork in mind.<sup>93</sup>

The hallmark of the modern machine shop, erecting shop, foundry, and forge was a tall and wide bay served at all points by a traveling crane. The traveling crane was a complicated piece of machinery. It consisted of a parallel set of elevated tracks supported by girders; a bridge that moved longitudinally along the rails; an operator’s cage that was attached to the bridge; a trolley that moved transversely across the bridge; and a hoisting apparatus attached to the trolley. Unlike British or French shops, traveling cranes were not common in American factories until the last quarter of the nineteenth century, possibly due to the obstacles presented by overhead millwork. Instead, stationary jib cranes were most commonly used in the United States. By the time he wrote his treatise on cranes in the early 1880s, however, the engineer Henry Towne insisted that the “power traveling crane constitutes the most perfect and complete apparatus for handling heavy loads, and is to be preferred to all other types of cranes, wherever the construction of the building and other surrounding conditions admit of its use.”<sup>94</sup>

Early traveling cranes were powered by hand, by compressed air, or by line shafting attached to a steam engine. In 1888, the E.P. Allis Works in Milwaukee experimented with the first electric-powered crane; by 1890 they were available from several manufacturers. “No machine builder of the present time with anything like advanced ideas,” observed the Berlin Iron Bridge Company, “would think of constructing a foundry or machine shop in which it was proposed to handle large work, without making provision for a traveling crane.” Writing almost ten years later, Edward Sanborn argued, “in no feature of machine shop practice has there been greater progress during this [past] decade than in the provision of crane facilities.” According to a writer for Engineering Magazine, “the advent of the electric-driven traveling crane revolutionized

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<sup>93</sup> Nelson, Managers and Workers, 21-22; Bradley, The Works, 95-98.

<sup>94</sup> Bradley, The Works, 98-100; Henry R. Towne, A Treatise on Cranes (Stamford, CT: E.S. Dodge Printing Co., 1883), 158. Some years later, H.D. Hess offered a thorough and technical analysis of various types of cranes in Machine Design: Hoists, Derricks, Cranes (Philadelphia: J.B. Lippincott Co., 1912), esp. pages 285-343 on overhead electric traveling cranes.

shop construction for heavy work...For all shops handling pieces of as little as five hundred pounds' weight even, the traveling crane is needed and, where the work reaches into ordinary steam-engine proportions, this agent is indispensable."<sup>95</sup>

The electric traveling crane found its ideal home in the production shed, or "mill building." A rectangular building of varying length, the production shed evolved over the second half of the nineteenth century "as a means of framing, lighting, and ventilating a single-story structure of considerable width." Typical sheds had tall and wide central bays served by jib and traveling cranes, gabled roofs supported by trusses, and roof monitors. Narrower adjacent bays (also known as galleries or lean-tos) of one or more levels provided space for millwork and machinery. "It was not unusual for them to have galleries on one side only," writes Bradley.<sup>96</sup>

The full potential of the production shed as an enclosed site for heavy manufacturing—a tall, wide, well-lighted and ventilated space, unimpeded by millwork or interior columns, yet possessing sufficient strength to contend with the forces of wind and the movements of traveling cranes and other machinery—awaited the transformation of its framing system. The critical development in building design, according to Carl Condit, was "the reduction of the exterior wall to a mere curtain or envelop that is supported throughout by the interior framing and nowhere supports itself or any part of the building load."<sup>97</sup> In the construction of office buildings, the decisive steps occurred in Chicago during the 1880s. This was the place where architects and engineers employed wrought iron (and even steel) columns and girders to support curtain walls of terra cotta, stone, brick, and glass; developed methods of diagonal bracing to enable the metal frame to resist lateral wind forces; and used riveting to achieve rigid connections among sections of the frame. Altogether, according to Condit, this "completed the most radical transformation in the structural art since the development of the Gothic system of construction in the twelfth century."<sup>98</sup>

William Le Baron Jenny's nine-story Home Insurance Building, constructed in Chicago in 1884-85, was the "first extensive application of internal skeleton and the curtain wall to a high office building," and as such signified "the decisive step in the creation of the framing that made the modern skyscraper possible..."<sup>99</sup> Cast iron and built-up wrought iron box columns, along with wrought iron beams, were used up to the sixth floor; Bessemer steel girders and beams were used on the upper levels. This marked the first use of steel in the framing of a building. However, the frame

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<sup>95</sup> Bradley, *The Works*, 100; George L. Clark, "Cranes for Machine Shops," *Cassier's Magazine* 23 (1902): 93-117; Berlin Iron Bridge Company, *The Berlin Iron Bridge Co.*, 3; Edward H. Sanborn, "A Decade of Machine Shop Progress: From 1890 to 1900," *Cassier's Magazine* 23 (March 1903): 669; *Engineering News* (1896), quoted in Bradley, 98. According to Sanborn (669), "electricity...furnishes an ideal method of driving cranes, and the necessary installation of an electric plant for operating cranes has no doubt greatly furthered the adoption of electric power for other purposes."

<sup>96</sup> Bradley, *The Works*, 38-40, 101.

<sup>97</sup> Carl W. Condit, *The Chicago School of Architecture: A History of Commercial and Public Building in the Chicago Area, 1875-1925* (Chicago: University of Chicago Press, 1964), 80.

<sup>98</sup> Condit, *The Chicago School of Architecture*, 79; Linton E. Grinter, *Theory of Modern Steel Structures*. Volume 1: *Statically Determinate Structures* (New York: The Macmillan Company, 1936), 17.

<sup>99</sup> Carl W. Condit, *American Building: Materials and Techniques from the First Colonial Settlements to the Present* (Chicago: University of Chicago Press, 1968), 123-24.

connections in the structure were bolted, not riveted; there was no wind bracing; and the granite base carried some of the load of the building.<sup>100</sup> The ten-story (second) Rand McNally Building, erected in Chicago in 1889-90 upon the designs of Daniel Burnham and John Root, was the first office building to be entirely supported on an all-steel frame.<sup>101</sup> In New York City, the twenty-story American Surety Building appeared in 1894-96 as that city's first wind-braced and riveted steel-framed high-rise.<sup>102</sup> In Detroit, the years 1894-95 for the first time saw the construction of similar Chicago-style skyscrapers: the Union Trust Building and the Chamber of Commerce Building. The latter still remains at the northeast corner of Griswold and State streets.<sup>103</sup>

The emergence of the frame-supported building with curtain walls depended in large measure on the substitution of structural iron and steel for wood, masonry, and cast iron columns and beams. During the 1840s, wrought (or rolled) iron was first used for beams in the construction of buildings. American manufacturers began to roll I-beams by the 1870s. Over the next decades, columns and beams composed of wrought iron plates, channels, and angles offered alternatives to frames made of brittle cast iron or combustible wood. Wrought iron had greater tensile strength than cast iron; wrought iron connections could be made strong by riveting, whereas cast iron connections could only be pinned or bolted. At the same time builders began to devise ways of having structural frames carry the weight of floors and roofs. This meant less reliance on walls, particularly thick masonry piers, to support building loads. As a result, it became possible to reduce the thickness of enclosing walls, thereby opening much more of the interior to useable floor space. By reducing and eventually eliminating masonry piers, a much larger wall area also became available for windows, thereby increasing the amount of natural light and air admitted into the interior of a building.<sup>104</sup>

Taller and wider buildings became possible as architects and engineers moved toward frame-supported structures with non-load-bearing walls. Fabricated structural steel shapes that came onto the market during the 1880s advanced these tendencies. As a framing material, steel shared many of the properties of wrought iron. Indeed, according to Bradley, "there was little difference in the detailing of structural frames as steel replaced iron during the 1890s." Both metals enjoyed similar strength in dealing with the forces of tension and compression; unlike wood, neither would shrink nor rot; their connections could be riveted; and framing sections could be put up quickly. In addition, both metals were vulnerable to fire to the extent that prolonged exposure to extreme temperatures would cause them to soften, warp, and lose their ability to carry a load. Builders, therefore, devised various methods to insulate structural iron and steel from the

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<sup>100</sup> Condit, The Chicago School of Architecture, 83-85.

<sup>101</sup> Condit, The Chicago School of Architecture, 99-101.

<sup>102</sup> Condit, The Chicago School of Architecture, 119.

<sup>103</sup> W. Hawkins Ferry, The Buildings of Detroit: A History (Detroit: Wayne State University Press, 1968; revised edition, 1980), 136. Completed in 1892, the machine and boiler shops of the Dry Dock Engine Works may very well represent the first structures built in Detroit with riveted steel frames and non-load-bearing curtain walls.

<sup>104</sup> Bradley, The Works, 138-45; Irving Engel, Structural Steel in Architecture and Building Technology (Englewood Cliffs, NJ: Prentice Hall, 1988), 4-7; Peter Knowles, Design of Structural Steelwork (Glasgow: Surrey University Press, 1987; second edition), 1-3; Charles G. Salmon and John E. Johnson, Steel Structures: Design and Behavior (New York: Harper & Row Publishers, 1980, second edition), 4.

effects of fire. At least in metalworking establishments, where there was not an abundance of combustible material, interior columns were usually left exposed. Steel, of course, held some intrinsic advantages over wrought iron. Steel, for example, was a highly ductile and elastic material, which enabled it to resist fracture and return to its original shape after loads were removed. The relative costs of iron and steel helped owners and builders determine which of the two metals to use, and the issue was decided during the 1890s as manufacturers moved toward the mass production of steel.<sup>105</sup>

By the mid-1890s steel had become an ideal and economical framing material for production sheds that required considerable width, strength, and light and ventilation. It supported high walls and long spans exposed to wind pressure and the movement of overhead cranes. Reduced to the function of merely enclosing a structure rather than supporting it, thin side walls admitted great quantities of natural light. Steel also opened up large areas of the interior to productive use, particularly wide crane bays cleared of obstructing columns. The potential strength and economy of a rigid steel frame was realized when portable pneumatic riveting machines came into general use after 1890. According to Charles Hyde, this allowed riveting to be done at the job site rather than in the erection shop of the steel fabricator.<sup>106</sup>

The riveted and steel-framed industrial building was still in its experimental phase at the time of the construction of the machine and boiler shops of the Dry Dock Engine Works. Taking the lead in this innovation, according to Bradley, were the “bridge shops;” that is, firms that fabricated structural iron and steel shapes for the construction of bridges. Among such firms was the Berlin Iron Bridge Company of East Berlin, Connecticut. Founded in 1868 as the Corrugated Metal Company, the firm produced roofing material, fire doors, shutters, and roof trusses. Later it went into the manufacture of highway bridges and, in 1878, it purchased the rights to the parabolic truss patented by William Douglas. Over the next two decades the company erected hundreds of bridges, including its famed lenticular truss bridges, with most concentrated in the Northeastern United States. In 1883 it changed its name to the Berlin Iron Bridge Company. By the end of the decade it had become one of the largest structural fabricators in New England. The 400 workers at its East Berlin plant produced an assortment of girders, beams, and other components for bridges. “Giant shearing machines were used to cut bar stock, plate, angle-iron, rod, I-beams and other rolled forms to the length needed. Drill presses made the larger holes, such as those for the pins in bridge construction. Certain pieces had to fit together so precisely that, once they were made up, the ends were finished off by huge milling machines.”<sup>107</sup>

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<sup>105</sup> Bradley, *The Works*, 138-45; Engel, *Structural Steel in Architecture and Building Technology*, 2-4; Knowles, *Design of Structural Steelwork*, 3-9; Arne Petter Eggen and Bjorn Normann Sandaker, *Steel, Structure, and Architecture* (New York: Watson-Guptill Publications, 1995), 34-35.

<sup>106</sup> Bradley, *The Works*, 146-49; “The Advantages Claimed for Brick and Steel Factory Buildings,” *Iron Age* 56 (December 19, 1895): 1272-73; Charles K. Hyde, *Historic Highway Bridges of Michigan* (Detroit: Wayne State University Press, 1993), 64.

<sup>107</sup> Bradley, *The Works*, 149; Victor C. Darnell, *Directory of American Bridge-Building Companies, 1840-1900* (Washington, D.C.: Society for Industrial Archeology, Occasional Publication No. 4, 1984), 3; “Berlin Iron Bridge Company,” <http://www.past-inc.org/bibco/>, <http://www.past-inc.org/bibco/history.htm>, and <http://www.past-inc.org/bibco/plant.htm>.

From its base in bridgework the Berlin Iron Bridge Company moved into the design and construction of iron and steel-framed industrial buildings. It is not clear when the firm began building factories, although by the time it constructed its own new plant in 1890-91 it already had some experience along this line.<sup>108</sup> By the mid-1890s the company had “furnished work of different classes” to some 170 manufacturers. “We are prepared to furnish when desired, complete plans of entire plants,” it noted, “and also to furnish an engineer or an architect to superintend the construction of the work complete.” In its employ were “a large number of Civil Engineers, Mechanical Engineers, and Architects, skilled in the different branches of engineering.” Its wide range of projects included foundries, rolling mills, machine shops, paper mills, forge shops, puddling mills, powerhouses, boiler shops, gas and electric light stations, and electric railway plants. Some of this work was for the shipbuilding and marine engine-building industries. The Berlin Iron Bridge Company designed and built a boiler and blacksmith shop for the William Cramp & Sons shipyard in Philadelphia, a foundry for the S. F. Hodge Company in Detroit, and a machine shop and boiler shop for the Newport News Shipbuilding and Dry Dock Company in Newport News, Virginia. The machine and boiler shops that it built in 1892 for the Dry Dock Engine Works in Detroit involved a designer and builder on the cutting edge of factory architecture and engineering.<sup>109</sup>

The contract for a machine shop that the Berlin Iron Bridge Company had with the Dry Dock Engine Works “was for the building complete in every way, shape and manner, including the foundations.”<sup>110</sup> The industrial production shed that emerged in 1892 was actually a combination of two kinds of shops. One was for the machining of castings and forgings that were made in the company’s foundry and forge or purchased from suppliers. The second was a spacious erecting bay where workers put together heavy metal components to make finished marine steam engines. Overall, the building measured 200’ long and 66’ wide. The height of the building from the foundation to the top of the wall on the west façade was 48’, whereas the distance to the top of the roof monitor was 58’.<sup>111</sup>

Internally, the engine-erecting bay was 37’ wide and it ran the entire length of the building. Without any structural impediments in its way, it rose 45’ from the ground

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<sup>108</sup> “The Plant of the Berlin Iron Bridge Co. at East Berlin, Conn.,” Engineering News 26 (October 3, 1891): 316.

<sup>109</sup> Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 4-21, 28-35, 50-55, 68-69; advertisement of the Berlin Iron Bridge Company, showing sketch of the foundry of the S.F. Hodge & Co., in Marine Review 20 (August 10, 1899): 26. See also the descriptions of Berlin’s work on the plants of the George W. Stafford Mfg. Company and the Granger Foundry & Machine Company, both of Providence, Rhode Island, in “The Advantages Claimed for Brick and Steel Factory Buildings,” Iron Age 56 (December 19, 1895): 1272-73.

<sup>110</sup> Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 54.

<sup>111</sup> The nearby marine-engine builder, The Samuel F. Hodge & Co., added a new brick and steel machine shop in 1894. It measured 84’ x 150’. Although not as long as the machine shop of the Dry Dock Engine Works, it was wider. This allowed the central bay that was served by a 25-ton electric crane to be flanked with lean-tos on both sides. See Mansfield, History of the Great Lakes, 2: 283. Mansfield does not indicate the builder of the machine shop. The Berlin Iron Bridge Company constructed a new foundry for the Hodge firm in 1894, and one would think that it also was involved in the erection of the machine shop. However, Berlin’s own publication, which dates from around the mid-1890s, refers only to its job on the Hodge foundry. The Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 69.

floor to the lower chord of the roof trusses. On the east side of the erecting bay, and separated from it by a row of interior columns, was a lean-to that measured 27' in width and also extended the full length of the building. The ground floor was a continuation of the floor of the erecting shop, with two floors above it. The builder noted that the overall structure was "somewhat peculiar," in that a lean-to flanked only one side of the erecting bay. The explanation for not adding a second lean-to was that it was "necessary to adapt the building to the land which it was to occupy."<sup>112</sup> In order to accommodate an additional lean-to, the Dry Dock Engine Works would have had to eliminate a portion of its foundry, which was something it probably was not prepared to do in the early 1890s.

The second gallery floor in the lean-to was used as a pattern storage loft; however, it could be "readily equipped with machinery when additional work requires it."<sup>113</sup> No doubt this latter option would not have been an ideal use of the space since two rows of trusses supporting the roof over the lean-to, along with their diagonal members, intersected with the floor of the second gallery. Moreover, during the summer the build up of heat at this level would have made it a difficult area within which to work, despite the presence of roof vents. Clearly the most feasible use of the space was for storage.

The first gallery floor was devoted to light machinery and bench work. According to the company, "there are three small planers and seven small lathes of various sizes, two shapers, three vertical drills and a bench 75 feet long for vice work."<sup>114</sup> A photograph taken from the south end of the first gallery floor, looking northwards, was published in Around the Lakes.<sup>115</sup> Benches were located on the right of the photograph, next to the windows on the east side of the building. Belts and shafting were attached to several machines, including a lathe near the railing on the left. Halfway along the gallery a platform projected out from the floor and into the erecting bay. Its function was to allow the overhead traveling crane to move heavy machinery in and out of the first gallery.<sup>116</sup> An elevator afforded access to the first and second galleries from the ground floor.<sup>117</sup> According to the Sanborn map for 1897, the original elevator was located about 75' from the north end of the building. By the time of the Sanborn map of 1922, it had moved to its present location some 40' from the south end of the building.

The main shop—the erecting bay—was dedicated to the construction of steam engines and the operation of heavy machinery. Photographic evidence indicates that the north end of the bay was reserved for the erection of engines. "The space devoted to this purpose admits of four of the largest triple expansion engines being put up at one time," noted the company.<sup>118</sup> At the other end of the floor was the heavy machinery, most of which came from Bement, Miles & Co., of Philadelphia. Among the "big tools" was "a planer capable of planing 72" square in the clear; a 48" double head planer; 120" lathe, 24'

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<sup>112</sup> Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 54.

<sup>113</sup> Dry Dock Engine Works, Around the Lakes, 89.

<sup>114</sup> Dry Dock Engine Works, Around the Lakes, 88-89.

<sup>115</sup> Detroit Dry Dock Company, Around the Lakes, 95. Several of the photos in this publication, as well as an interior illustration, were also published in Berlin Iron Bridge Company, The Berlin Iron Bridge Co.

<sup>116</sup> Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 52. The platform is visible in the photograph and illustration of the interior of the Engine Works published in Detroit Dry Dock Company, Around the Lakes, 97-98. The platform no longer exists.

<sup>117</sup> Detroit Dry Dock Company, Around the Lakes, 88.

<sup>118</sup> Detroit Dry Dock Company, Around the Lakes, 88. See the photograph in Around the Lakes, 97.

between centers; wall planer, capacity 14' x 20'; a 96" lathe; 30" stroke slotting machine; 18" stroke slotting machine; 36" lathe; 48" lathe; 60" boring mill; two radial drills and a vertical suspension drill."<sup>119</sup>

The photograph of the erecting bay in Around the Lakes shows two or three engines at some point in their construction. Workers stand on top of the engine closest to the camera and on its surrounding scaffolding, a view that demonstrates quite well the relative scale of humans and the enormous machine they created.<sup>120</sup> Another photograph captured the erecting bay in 1913 as workers labored on the engine for the steamer *Seeandbee*.<sup>121</sup> The engine was far from complete, and in the foreground several workers prepared large engine components for installation. On the right side of the photograph stood a worker beneath the hook of the overhead electric traveling crane. The crane was the dominant feature of the erecting bay. It was the means by which workers brought heavy parts on the erecting bay floor, or even in the galleries, to the site where the engines were built.

The erecting bay originally was fitted with a 20-ton Shaw electric crane. It ran the full length of the building and had a span of 37'. The distance from the ground floor to the crane hook was 36'.<sup>122</sup> The photograph and illustration of the interior the machine shop published in Around the Lakes show the crane at the north end of the erecting bay, suspended from the heavy crane rails.<sup>123</sup> Several stationary jib cranes stood on the east side of the erecting bay. At some point after 1907 the original overhead crane was replaced with a new one that the Detroit Edison Company referred to in a 1953 drawing as a 40-ton crane.<sup>124</sup> An inscription stamped onto the side of the trolley identifies the manufacturer as the Northern Engineering Works, the crane- and hoist-building firm in Detroit that was located at the corner of Chene and Atwater, just several blocks to the east of the Engine Works. The inscription also cites a patent number (847,849) and the date of March 19, 1907. The records of the United States Patent Office indicate that George A. True, the president of the Northern Engineering Works, applied for a patent on June 30, 1906, for a "trolley for traveling cranes." True's patent had as its object an "invention to obtain a construction which may readily be adapted to the use of motors of different size and power; further, to provide a simple means for housing the gearing, and, further, to obtain a simple and inexpensive construction."<sup>125</sup> Until fairly recently, this overhead traveling crane was the only machine in the complex to survive that linked the

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<sup>119</sup> Detroit Dry Dock Company, Around the Lakes, 88-89. Three of these machines were featured in Around the Lakes (p. 96): 14' x 20' wall planer, 120" lathe, and a 30" slotting machine.

<sup>120</sup> Detroit Dry Dock Company, Around the Lakes, 97. Curiously, an artist's illustration (page 98) prepared from the same photograph removes all of the workers from the engine and the erecting bay floor. What looks like a manager (by the style of hat and clothing) is the only person remaining on the floor.

<sup>121</sup> "Str. No. 190, main engine in shop, 3 cyln. compound-inclined type," Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection, <http://memory.loc.gov/ammem/detroit/dethome.html>, Digital ID det 4a26744.

<sup>122</sup> Detroit Dry Dock Company, Around the Lakes, 88-89.

<sup>123</sup> Detroit Dry Dock Company, Around the Lakes, 97-98.

<sup>124</sup> Third Floor Plan, Landmarks Design Services, Inc., Ex-4, based on information taken from drawing dated 5-14-53, drawn by the Detroit Edison Company.

<sup>125</sup> Patent No. 847,849 (March 19, 1907), United States Patent and Trademark Office, <http://www.uspto.gov>.

facility to its days as a builder of marine steam engines.<sup>126</sup> Presently, however, the crane rests broken and twisted on the floor of the erecting bay.

Workers built marine steam engines at fixed locations on the floor of the erecting bay. The overhead crane brought engine parts to these workstations. The Sanborn map for 1897 suggests that various engine components likely came into the building by means of railway. Tracks at the northwest corner of the building were connected to the external railroad network. This perhaps explains why this particular entrance filled a bay that was 17' wide, whereas the other dozen bays on the west side of the building were only 15' across.<sup>127</sup> Castings and forgings produced on-site probably entered the building by means of a wide doorway on the east side of the lean-to. The photograph and illustration of the machine shop in Around the Lakes show what appears to be a track coming through this doorway.<sup>128</sup> The Sanborn map does not indicate any internal tracks for the Engine Works complex, but it would not have been surprising if they existed and linked the foundry to the cleaning room (the former one-story frame machine shop) located in the middle of the complex and, in turn, to the new machine shop.

It is not readily clear how finished engines were removed from the erecting bay and transferred to the riverfront south of Atwater for installation on waiting vessels or shipment to other locations. "One of the greatest features of these works for economy and rapid handling of material of all kinds," the Detroit Dry Dock Company claimed, "is the close connection established between the dry docks and ship yards and the engine and boiler shops." Specifically, "railway tracks run into the yards and buildings, connecting the different departments with the river front and docks...."<sup>129</sup> While the Sanborn map for 1897 shows several tracks reaching the dry dock area, including one directly from the boiler shop, not a single track appeared to connect the machine shop to the riverfront.<sup>130</sup> Moreover, the photograph of the south and west sides of the machine shop show no evidence of railway tracks running along Orleans Street or crossing Atwater.<sup>131</sup>

The west side of the erecting bay originally had two large doorways. The one at the northwest corner of the building was about 17' wide. A second doorway was located in the middle of the thirteen bays. It fit the entire bay—about 15' in width. It was still visible in a photograph taken of the machine shop in 1912.<sup>132</sup> At some later date this doorway was eliminated and filled in with brick and windows. The original doors for

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<sup>126</sup> For an example of a Northern Engineering overhead electric traveling crane in operation, see the photograph published in George Clark, "Cranes for Machine Shops," Cassier's Magazine 23 (1902): 116.

<sup>127</sup> Today, the entrance at the northwest corner of the building rises almost to the lintels of the second tier windows. Originally, however, the opening was shorter, barely rising to the level of the wall ties located between the first and second tier windows. See photograph in Detroit Dry Dock Company, Around the Lakes, 87.

<sup>128</sup> Detroit Dry Dock Company, Around the Lakes, 97-98.

<sup>129</sup> Detroit Dry Dock Company, Around the Lakes, 89.

<sup>130</sup> See photograph of the track and railway car entering the rear of the boiler shop, in Detroit Dry Dock Company, Around the Lakes, 92.

<sup>131</sup> Detroit Dry Dock Company, Around the Lakes, 87.

<sup>132</sup> "Detroit Shipbuilding Co. life rafts dept.," July 10, 1912, Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection, <http://memory.loc.gov/ammem/detroit/dethome.html>, Digital ID det 4a26732.

each of these openings were similar to those used on the boiler shop: sliding doors with midsections filled with multiple panes of glass.<sup>133</sup>

The Berlin Iron Bridge Company designed the machine shop of the Dry Dock Engine Works for the purpose of assembling large marine steam engines. This primary function of the building, in turn, determined how the Berlin Iron Bridge Company approached the structural framing, lighting and ventilating, and powering of the building.

A framework of steel columns, girders, and beams supported the roof, floors, walls, and overhead traveling crane of the machine shop. Structural members were made by riveting together some basic steel shapes, such as L-shapes, Z-shapes, and flat plates. Generally, the steel used was 3/8" in thickness. The exterior columns were spaced on centers roughly 15' apart. The bases of the columns consisted of several angles and plates that were riveted and then anchored (probably by bolts) to the limestone caps in the foundation.<sup>134</sup> Column shafts measured roughly 13" x 8". They were built by riveting together four L-shaped lengths to a flat plate to form I-beams. As a matter of design the builder placed the brick wall in between the exterior columns "on account of the severe climate in this latitude."<sup>135</sup> This resulted in the exposure of one of the flanges of each column to the outdoors, since the brick wall ran flush up against the web of the I-beam and the outer flange was not covered with unnecessary masonry pilasters. Normally the brick filler obscured the web of the I-beam from view. However, an addition to the east side of the machine shop more than twenty years later caused the removal of the original brick wall. This exposed all the surfaces of the once exterior columns on the east side of the building, revealing the use of solid webbing on the first level and lattice webbing for the columns on the second and third levels. Very likely a similar pattern was employed on the columns on the three other sides of the structure.

Two parallel rows of heavy interior columns supported the crane girders that flanked the erecting bay. They probably were connected to the foundation by bolts. Originally the surface of the ground floor was made of wood planks.<sup>136</sup> At some point after 1922 the flooring was changed to a concrete slab; the concrete was even poured over the bottom plates of the columns. The row of crane columns along the west side of the machine shop abutted the exterior columns. The other row was located on the opposite side of the erecting bay. These latter columns did triple duty by supporting the

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<sup>133</sup> For the doors of the boiler shop, see the photograph in Detroit Dry Dock Company, *Around the Lakes*, 93.

<sup>134</sup> On the bolting of column bases to foundation capstones, see "The Advantages Claimed for Brick and Steel Factory Buildings," 1272, and George A. Hool and W.S. Kinne, *Steel and Timber Structures* (New York: McGraw-Hill Book Company, Inc., 1942; second edition), 53-54.

<sup>135</sup> Berlin Iron Bridge Company, *The Berlin Iron Bridge Co.*, 50.

<sup>136</sup> According to Hool and Kinne, "for a machine shop or factory where the workmen are standing continually, the wearing surface should be wood or asphalt." See *Steel and Timber Structures*, 80. That the original surface of the ground floor of the machine shop was made of wood is indicated by the interior photograph and sketch in *Around the Lakes*, 97-98; a 1913 photograph, "Str. No. 190, main engine in shop, 3 cyln. compound-inclined type," Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection, <http://memory.loc.gov/ammem/detroit/dethome.html>, Digital ID det 4a26744; and a notation on the Sanborn map of 1922. As a point of comparison, the main floor of the Granger Foundry & Machine Company of Providence, Rhode Island, also designed by the Berlin Iron Bridge Company, consisted of "5 inches of tar concrete, on top of which is laid hemlock plank, and this covered with jointed maple." See "The Advantages Claimed for Brick and Steel Factory Buildings," 1273.

crane girder, the beams and girders holding up the floors of the first and second galleries, and the chord of the roof truss that separates the erecting bay from the lean-to. Crane columns were spaced on centers approximately 15' apart. They were about 16" x 10" in size, and they were made by riveting four Z-shaped angles to plates. To contend with the movement of the crane, the columns were braced diagonally every other bay with three-sectioned tension rods that were screwed together and then bolted to the columns. Diagonal cross-bracing extended the full height of the crane columns. The columns were also braced horizontally: on the east side by plate girders at the level of the first gallery floor, and on the west side by lattice girders located between the first and second story windows. Both sets of girders were divided into sections that were riveted to the crane columns.

A framework of beams and girders supported the wood floors of the first and second galleries. The beams and girders below the first gallery floor were closely packed together. They were also very heavy structural members. All were in the form of I-beams, made by riveting L-shaped angles to plates. The girders ran transversely (east-west) and were supported on each end by the crane columns and the exterior columns. They were fully in contact with the ceiling above. The plates of the girders were 31" wide. The plates of the beams were almost 21" wide. Beams ran longitudinally (north-south) and were riveted to the plates of the girders.

The I-shaped beams and girders that carried the second gallery floor were light in comparison with those used on the floor below. For example, the girders had lattice webs. The girders were connected to the exterior columns and, by means of plates or diagonal braces, to the crane column and crane girder. The heavy crane girder supported one end of the second gallery floor. Three rows of beams also supported it. While the beams were in contact with the floor above, there was a gap of a couple of inches between the top of the girders and the ceiling.

Crane girders were built up from simple shapes, flat plates, and L-shaped angles. Vertical stiffeners were set at regular intervals. The bottom flange of the girder was connected to column heads by rivets. Crane rails were attached to the top flange by means of rivets and bolts.<sup>137</sup>

The roof of the machine shop was supported by a series of twelve steel trusses, each nearly 15' from the neighboring one. The design of the trusses was a variation of the Warren truss that was first patented in England in 1848 for use in bridge construction. According to Condit, the popularity of the Warren truss grew in the United States after 1860, "the steel Warren truss began to appear in rapidly growing numbers in the last decade of the century, and continued a vigorous life throughout the twentieth." A "true" Warren truss had "no posts, or vertical members, and alternate diagonals sloped in opposite directions." It was rather simple and economical in construction, as evidenced by equilateral triangles. Primary truss members were equal in length, making it possible to quickly fabricate and erect the structural frame. Due to the addition of vertical posts, however, the trusses in the machine shop represented a typical modification of the

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<sup>137</sup> On crane girders and rails, see Hool and Kinne, Steel and Timber Structures, 56-58.

Warren truss. The “stretching” of the trusses meant that they also deviated from the ideal Warren truss because the triangles were not equal in size.<sup>138</sup>

The chords, diagonals, and posts of the roof trusses were made of L-shaped angles that were riveted to gusset plates of varying shapes and sizes. Rivets connected the end posts along the west wall of the building to the exterior columns. End posts and the lower chords were also connected to a lattice girder that ran above the third level windows. In every third bay the plane of the bottom chords was cross-braced to provide stability to the truss system and the building.<sup>139</sup>

The original roof of the machine shop probably was similar to the present one: 6” wide wood planks covered with a composition of felt and asphalt. Pediment walls with limestone caps rose above the roof on the north and south ends of the building. The sloping roof carried off water to a gutter and downspout system on the west side of the building; no doubt a similar arrangement was devised for the east side of the roof prior to the construction of an addition to the machine shop. The roof did not come into contact with the trusses. Rather, steel purlins that ran the length of the building transmitted the load of the roof to the upper chords of the truss system. The C-channel-shaped purlins intersected with, and were riveted to, the upper chords of the trusses at the panel points. The ends of the purlins also were connected to the exterior columns on the north and south sides of the building.

The steel frame supported the entire load of the building. There is *no* indication that the exterior walls carried any of the weight of the roof or floors.<sup>140</sup> On the contrary, the exterior columns of the frame supported or stabilized the 12” wide light-colored brick walls.<sup>141</sup> Numerous metal wall ties that are visible on the exterior facades above the first, second, and third level windows also provided stabilization, as did a common bonding pattern generally consisting of five or six rows of stretchers followed by a sixth or seventh row of headers. The metal wall ties intersected the crane and lattice wall girders on the interior of the structure. It is quite doubtful that the wall ties gave any support to the girders. Their support came entirely from connections to the crane columns. If anything, it would appear that the girders helped stabilize the wall.

The machine shop was designed with ventilation and lighting considerations in mind. A 13’ wide roof monitor extended 168’ along the length of the erecting bay, stopping one bay short of either end. It stood 5’ above the line of the roof. Although the ventilator is now covered with corrugated sheet metal, originally its sides *and* roof were “made of glass for lighting the interior of the building.”<sup>142</sup> The Sanborn map of 1897 also indicated the presence of roof openings over the lean-to that provided light and ventilation to this portion of the structure; five such openings are visible in the aerial photographs taken in 1931 (see Appendix).

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<sup>138</sup> Condit, American Building Art: the Nineteenth Century, 117-18.

<sup>139</sup> Concerning the truss system, “the function of diagonal bracing is largely to *square* the building during erection and to prevent the building from *twisting* under a diagonal wind.” See Grinter, Theory of Modern Steel Structures, 54-55.

<sup>140</sup> This is in contrast to Bradley, who wrote, “the brick curtain walls that enclosed the steel frame (and left it exposed on the interior) were detailed as load-bearing walls.” The Works, 146.

<sup>141</sup> That the brick of the machine shop was originally light colored (probably brown) is evident from the exterior photograph in Around the Lakes, 87.

<sup>142</sup> Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 54.

The exterior columns of the structure were “filled between with brick in order to add warmth to the building” during the cold months. However, noted the Berlin Iron Bridge Company, “as many windows are introduced in the outside wall as possible in order to give light in the interior of the building.”<sup>143</sup> Certainly in comparison with the existing structures of the Dry Dock Engine Works, the new machine shop was a very well-lighted space because curtain walls allowed for the extensive use of windows. Bradley points out, though, that by employing two standard-size windows per bay, the Berlin firm took a “relatively conservative approach to design.”<sup>144</sup> Despite the installation of seventy-four window units along the west façade, only about 37 percent of the total wall space was given over to glass or doors.<sup>145</sup> By contrast, the following year the company took an experimental leap by constructing a massive window wall for the machine shop of the Fuller Iron Works in Providence, Rhode Island. Indeed, the pattern of fenestration used on the machine shop of the Dry Dock Engine Works (1892) looked much more like the traditional kind used on Fuller’s older brick building, erected in 1869, than the steel and glass machine shop designed by the Berlin Company in 1893.<sup>146</sup>

The conservative fenestration and overall external appearance of the machine shop of the Dry Dock Engine Works may have had less to do with the designer than with the owner of the property. Concerning the “ordinary type of construction with heavy brick side walls” used on another job of the Berlin Iron Bridge Company, the author of an article in Iron Age noted, “many owners in contemplating extensions of their present buildings would like to maintain the same general outward appearance of the structures, while availing themselves of the saving and other advantages of steel in the construction of the interior.”<sup>147</sup> The revolution in steel framing and curtain walls at the end of the nineteenth century, in other words, did not necessarily result in dramatic changes to the outward appearance of a new structure, especially if a company already possessed buildings of the “ordinary type of construction.” The innovative engineering of the internal frame and outer walls went together with an exterior architecture that represented continuity with the past.<sup>148</sup>

The original windows and sills of the machine shop were replaced at some point between 1912-13 and 1932—undoubtedly when the Detroit Shipbuilding Company still

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<sup>143</sup> Berlin Iron Bridge Company, The Berlin Iron Bridge Co., 50 and 54.

<sup>144</sup> Bradley, The Works, 150.

<sup>145</sup> This figure was obtained by multiplying the number of windows originally on the west façade (74) by the dimensions of the windows now on the building, plus the size of the original door openings, to arrive at 3,542 square feet; then dividing the sum by the overall size of the wall (9,600 square feet). “At best,” Bradley writes, “the windows in a [traditional] brick multi-story building could constitute 30 to 35 percent of the wall area.” The Works, 162.

<sup>146</sup> Bradley, The Works, 150, and the photograph of the Fuller Iron Works in figure 6.12.

<sup>147</sup> “The Advantages Claimed for Brick and Steel Factory Buildings,” 1272. The reference was to the Stafford Manufacturing Company of Providence, Rhode Island. Obviously not all owners chose an “ordinary type of construction.” The Granger Foundry & Machine Company of the same city, for example, had the Berlin firm install an 8’ high continuous belt of sash around its brick and steel structure.

<sup>148</sup> Hence, the use of three rows of brick headers above the windows of the machine shop to create the impression of slightly rounded arches.

owned the facility.<sup>149</sup> It is not known what kind of material was used for the original window frames (possibly wood or metal) and sills (possibly wood or stone). Most windows were of the double-hung sash type.<sup>150</sup> On the west façade, the first-level windows had twenty panes in the upper sash over twenty panes in the lower sash. Second-level windows had sixteen-over-sixteen. The fixed windows at the upper level of the building had five rows of panes with four in each row. It seems that a similar pattern obtained for the windows on the other three facades.<sup>151</sup> The only deviation appears on the third-level windows of the south façade, where the builder installed only one twelve-over-twelve sash window per bay.

By 1913, the second- and third-level windows on the north façade were filled-in with brick. Within twenty years, all the remaining windows on the building were replaced, and new concrete sills were installed. The new metal-framed windows on the first and second levels had tilt openings in the lower panes rather than moveable sashes; third-level windows did not open. Opaque wire glass, commercially available since the 1880s, softened the light that entered the building.<sup>152</sup> On the west façade, first-level windows had six rows of panes, with four panes per row. Windows on the second level had five rows with four panes each. Third-level windows had three rows, each with four panes. The same pattern applied to windows on the south façade and the remaining first-level windows on the north. The third-level windows on the south side were significantly shortened in order to make them conform to the kind used on the west façade; the brick filler below the windowsill is still visible. Indeed, it appears that all the windows on the building were slightly shortened below the sills, as evident by one or two new courses of replacement brick. Window openings, however, remained 5' wide.<sup>153</sup>

Certainly in its origins, and perhaps for much of its history, daylight was the principal means of lighting the machine shop. Natural light from windows and roof monitors was a cheap and efficient means of lighting production sheds, especially wide crane-served bays or workbench areas in the galleries of lean-tos. This did not preclude the limited use of electrical lighting. The photograph of the first gallery floor published in [Around the Lakes](#) shows an incandescent light bulb dangling from a cord near the

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<sup>149</sup> Key to the dating of the windows are four photographs: an exterior photograph in [Around the Lakes](#) (p. 87), which showed the building as it looked in the early 1890s; an exterior photograph of the building in July 1912, "Detroit Shipbuilding Co. life rafts dept.," Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection, <http://memory.loc.gov/ammem/detroit/dethome.html>, Digital ID det 4a26732; an interior shot of the erecting bay taken in 1913, "Str. no. 190, main engine in shop, 3cyln. compound-inclined type," Library of Congress, Prints and Photographs Division, Detroit Publishing Company Collection, <http://memory.loc.gov/ammem/detroit/dethome.html>, Digital ID det 4a26744; and an exterior photograph, this one taken in 1932, published in Mason, [Rumrunning and the Roaring Twenties](#), 115.

<sup>150</sup> The presence of a tall ladder along the wall in the above-mentioned 1913 photograph of the interior of the erecting bay suggests that workers manually and individually opened and closed the first- and second-level windows.

<sup>151</sup> For the windows on the north and east facades, see the photographs and sketch in [Around the Lakes](#), 88, 94, 98.

<sup>152</sup> Bradley, [The Works](#), 163-64. The wire glass consisted of hexagonal wire shapes.

<sup>153</sup> Windows on the first, second, and third levels are, respectively, 10'-9", 8'-7", and 5'-4" in length.

railing.<sup>154</sup> At some later point in time, a regular system of electric lighting was added to the first gallery and to the ground floor of the lean-to. Along the length of the erecting bay, electric-light receptacles were attached to the lower ends of the vertical posts of the roof trusses.

From the start, electricity was present in the machine shop as a means of powering machinery and in providing some illumination to work spaces. According to Around the Lakes, an electric generator used “for the operation of cranes and the electric light plant” was located on the first gallery floor.<sup>155</sup> The Sanborn map for 1897, however, indicates that the generator and the steam engine that powered it were both located in a square, two-story, structure that stood along the southeast side of the lean-to. Very likely it was erected at the same time as the machine shop, although there is no mention of it by the Berlin Iron Bridge Company or in Around the Lakes. A 76’ high chimney rose from the north end of the powerhouse. The southeast corner of the 30’ x 30’ structure also contained a water closet for the needs of the workers. By 1922, when the building no longer was required to supply electrical power, much of the first floor was set aside as a washroom, and that remained its lasting function. After 1922, at least on the first floor, the brick filler wall that partially separated the powerhouse from the machine shop was removed. The connection between this space and the power needs of the building remains evident in the numerous boxes of circuit breakers that are attached to the outside wall of the washroom. The second floor of the former powerhouse is made of concrete and the space still has its original dimensions. Its roof has a skylight (now covered), and the only opening is by a doorway on its east side into the adjacent stock room.

No doubt machinery in the machine shop later on had individual electric motors. However, photographs in Around the Lakes from the early 1890s clearly show the existence of millwork. Running down the middle of the first gallery, and extending its entire length, was a line of shafting that was attached to the ceiling. Belts coming off it were connected either directly to machines positioned near the railing overlooking the erecting bay, or to subsidiary shafts that in turn drove machines. Similar shafting and millwork arrangements also existed on the ground floor to serve machines in the lean-to or the erecting bay. Shafts even were attached to the sturdy crane columns.<sup>156</sup>

In its original incarnation in 1892, the machine shop of the Dry Dock Engine Works represented both change and continuity. Its steel frame and roof trusses with riveted connections, brick curtain walls, the electric-powered overhead traveling crane and other machinery, the careful attention to lighting and ventilation as evident in numerous windows and the roof monitor—these bespoke the revolution in the physical setting of heavy manufacturing that began to come together in the United States at the end of the nineteenth century.<sup>157</sup> This revolution in factory design culminated in the early twentieth century in the modern automobile factories that emerged from the landscape of

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<sup>154</sup> Detroit Dry Dock Company, Around the Lakes, 95. A pair of light bulbs in the first floor gallery also appears in the interior photograph and sketch on pages 97-98.

<sup>155</sup> Detroit Dry Dock Company, Around the Lakes, 89.

<sup>156</sup> Detroit Dry Dock Company, Around the Lakes, 95, 97-98,

<sup>157</sup> Bradley, The Works, 99.

Detroit and Southeast Michigan.<sup>158</sup> The machine shop's continuity with the past, however, came through in the traditional pattern and style of windows used on the building, the use of millwork to power machinery in the galleries and on the main floor, and the roof monitor that stopped one bay short of each end. The production shed was itself the continuation of a strategy for organizing heavy manufacturing in an enclosed space. Yet, by adopting a steel frame and curtain walls the Berlin Iron Bridge Company was able to offer to the Dry Dock Engine Works a tall, wide, and well-lighted space that was unimpeded by millwork or columns and superbly suited to the work of a heavy-duty overhead traveling crane.

### **Foundry and Industrial Loft Building, 1902**

In 1902, the Detroit Shipbuilding Company constructed two new structures as part of its engine-building complex: a foundry and a three-story, multiple-use, industrial loft building. The combined price of the steel-framed structures was \$75,000. The new foundry was built along the east side of the block, opposite the boiler shop on the other side of Dequindre. The Sanborn map for 1897 shows that the land upon which it was erected previously had been used for foundry-related activities: the storage of sand, a shop for making flasks, and core ovens. A small portion of the old foundry was also taken by the new building. What remained of the old foundry along the north side of the block became a shop for the cleaning of castings. Adjoining the foundry to the south was the new industrial loft building. It stretched across Atwater Street, from the corner of Dequindre up to the wall of the machine shop. To make way for it, the company took down the old Dry Dock Hotel, blacksmith shop, bolt cutting and pattern shops, and the frame building used to clean castings. Since the machine shop fully extended along Orleans Street, the net result of the construction in 1902 was to surround the block on all four sides with industrial structures, leaving open a rectangular inner yard between the buildings.<sup>159</sup>

The Detroit Shipbuilding Company took out a building permit (#973) for its new foundry on August 18, 1902.<sup>160</sup> The building was substantially larger than the old foundry. It was 151' long and 75' wide. On the east side, facing Dequindre, it rose 50' from grade to the top of the wall—and 64' to the top of the roof monitor.<sup>161</sup> Designed as

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<sup>158</sup> Nelson, *Managers and Workers*, 23-23; Bradley, *The Works*, especially 255-58; Biggs, *The Rational Factory*, chapters 4-7; Charles K. Hyde, "'Dodge Main' and the Detroit Automobile Industry, 1910-1918," *Detroit in Perspective: A Journal of Regional History* 6 (Spring 1982): 1-21; and David A. Hounshell, *From the American System to Mass Production, 1800-1932* (Baltimore, MD: Johns Hopkins University Press, 1984), chapter 6.

<sup>159</sup> See description and map in "Enlargement of Detroit Shops," *Marine Review and Marine Record* 27 (January 1, 1903): 19. The yard would have been a perfect rectangle were it not for the presence of the square-shaped power plant (called an "engine house") that was attached to the machine shop.

<sup>160</sup> Landmarks Planning Inc., "The Engine Works: An Adaptive Re-Use Study of the Globe Trading Company, 1801 Atwater Street, in the East Riverfront Area of Detroit, Michigan" (Pittsburgh, PA, August 1980), 48.

<sup>161</sup> According to the Sanborn map for 1897, the old foundry was roughly 125' long, 45' wide, and 20' high.

a production shed, the foundry had a 46' wide main section and, on the west side, a narrower 26' wide lean-to. Crane girders in both sections indicate the presence of a pair of electric overhead traveling cranes. It is very likely that the Northern Engineering Works supplied the traveling cranes. C.B. Calder noted in his journal in December 1902 that the Northern Engineering Works hoisted into place the girder for the 40-ton crane.<sup>162</sup> The firm also equipped the foundry with jib cranes.<sup>163</sup>

Framed in steel and sheathed with non-load-bearing walls made of brick and glass, the foundry consisted of seven evenly divided, 21' wide bays. Exterior columns were embedded in the surrounding brick masonry. They were connected by a steel lattice to the interior columns on the perimeter of the building that supported the cranes. The cranes in both sections extended the full length of the foundry. In the lean-tos, I-beam-shaped girders and columns, rolled as single pieces, supported the overhead crane. Evidently it was a relatively light machine, unlike the crane in the main section of the foundry. The crane in the lean-to did not lift finished castings, and its maximum hoist was only about 15'. The crane in the main bay, on the other hand, required the support of heavy girders built out of riveted plates and L-shaped angles, much as in the machine shop. Shoring up the girders were weighty columns with shafts made of L-shaped angles and plates, riveted together to form C-channels. Strips of steel bar stock were riveted to the fronts and backs of these columns to form a lattice. The row of columns that divided the main section of the foundry from the lean-to combined both types of crane columns. Each column measured 1' x 3' in size. These particular columns held up the crane girders for both sections of the foundry, as well as one end of the roof truss system. Much like the lattice girders in the machine shop, sections of a Warren-style truss were riveted to the sides of the combination columns in order to provide horizontal bracing.

The roof truss system in the foundry blended Fink and Scissors designs. The method of constructing the trusses was similar to that employed in the machine shop. The difference, however, was that in the foundry the chords of the trusses were made up of *two* L-shaped pieces that were riveted together. The roof itself was a mixture of concrete and asbestos, poured into place, and covered with asphalt. Parapet walls along the north and south ends of the roof were capped with tiles. At one time about a dozen skylights pierced the roof of the lean-to, but these have since been filled-in with concrete. A 5' high steel roof monitor above the main section of the foundry allowed for light and ventilation. (It is now covered in corrugated sheet metal.) As with the machine shop, the monitor for the foundry stopped one bay short of each end. The W-shaped profile of the roof over the main bay—made possible by adding extra upward members to the trusses—measurably increased the vertical size of the industrial windows in the clerestory. These windows extended almost continuously along the east and west facades and admitted a substantial amount of light into the building. Clerestory window units had six rows of panes with five panes per row, and three steel-framed window units filled a single bay.

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<sup>162</sup> Entries for December 18 and December 23, 1902, Daily Journal of C.B. Calder, HCGL. In 1980, at the time of the study of the complex by Landmarks Planning Inc., an electric crane was still present in the building. See "The Engine Works," 49. ("An electric crane travels the length of the building.")

<sup>163</sup> See Northern Engineering Works, blueprint for "5-ton single I-beam overhead braced jib cranes," contract #1564-65, December 11, 1902, Frank E. Kirby Papers, scrapbook volume 3, untitled folder, Burton Historical Collection, Detroit Public Library, Detroit, Michigan.

Four panes in the upper portion of each window unit tilted open or closed. Windows also were installed on the north façade and above the door openings on the east side, although several of the latter have since been filled-in with brick. The wall along the east side of the foundry was substantially altered at the time of the construction of adjacent buildings. Yet, it is still possible to see where windows once filled the space between the crane girder and the roof of the lean-to.

There is little about the building today that immediately suggests that it once was a foundry. Fortunately, the map of the building in Marine Review and Marine Record published in early 1903 identifies the internal arrangement of the foundry.<sup>164</sup> In combination with a sketch of the interior of the foundry of the neighboring Samuel F. Hodge Co., and a photograph of the same published in 1897, it is possible to understand how the foundry of the Detroit Shipbuilding Company functioned as a productive unit.<sup>165</sup>

A number of critical activities in the foundry took place on the floor of the lean-to. The cupolas, partially surrounded by a brick wall, were located in about the middle of the lean-to. The core ovens were at the southwest corner of the foundry, just below the cupolas, in the area behind where subsequent owners of the building erected a loading ramp. The overhead crane facilitated work in the lean-to. The main floor was where molders and their helpers prepared sand molds for the large castings. The map in Marine Review indicated two sand pits just about in the middle of the main bay. Jib cranes and the overhead crane moved heavy flasks and finished castings around the workspace. After castings had hardened and were separated from the molds, they were probably transported to the cleaning room and then to the machine shop by means of the internal railway track that connected these structures on the north end of the complex.<sup>166</sup>

The productive life of the building as a foundry did not last long. The Detroit Shipbuilding Company prepared a map in early 1909 of its Orleans Street property, including the engine-building plant. The buildings of the latter functioned exactly as they did in 1902 when the foundry and loft building were constructed.<sup>167</sup> Dramatic changes occurred over the next decade, and these were revealed in a company map prepared in

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<sup>164</sup> The Sanborn map of 1897 pre-dated this foundry, and the next Sanborn map—the one published in 1922—identified the building as an “erecting shop.”

<sup>165</sup> The sketch of the S.F. Hodge & Co. foundry was published in The Berlin Iron Bridge Company, The Berlin Iron Bridge Co., and as an advertisement in Marine Review 20 (August 10, 1899): 26. The photograph is in Joseph R. Oldham, “Shipbuilding and Transportation on the Great American Lakes,” Cassier’s Magazine 12 (August 1897): 509. The caption below the photograph identified it as “the foundry of the Detroit Dry Dock Co., Detroit, Mich.” It was mistaken. The overhead crane, the iron or steel crane girders and columns, the metal horizontal bracing and Warren-style roof trusses, the window wall in the clerestory, the wide workspace featuring a pair of lean-tos flanking the central bay—all of these pointed to the steel-framed foundry that Berlin built for the Hodge firm in 1894, not of the old, 20’ high, narrow foundry of the Dry Dock Engine Works. Moreover, the structure in the photograph simply looks like the space featured in the sketch of the Hodge foundry.

<sup>166</sup> For an overview of foundries, see Bradley, The Works, 40-42.

<sup>167</sup> Map of the Orleans Street Plant of the Detroit Shipbuilding Company (February 13, 1909), Detroit Shipbuilding Company Papers, Box 5, Wright Marine Collection, HCGL. The map revealed the internal railway track that connected the foundry with the cleaning room and machine shop. It also showed a foundry flask yard at the northeast corner of Guoin and Dequindre Streets.

early 1919.<sup>168</sup> The engine-building plant was referred to as Building No. 17. The most significant change was that the former foundry was now labeled an “erecting shop.” A new line of internal tracks ran from the machine shop, through the corridor formed by the new structures that occupied the once open yard, into the erecting shop, and then linked up with the railway line that ran down Dequindre Street to Dry Dock No. 2. Tracks also extended the full length of the main bay of the erecting shop, and another set—located where a loading ramp was later constructed—connected the south end of the shop to the rail line on Dequindre. The Sanborn map for 1922 noted that the building had a concrete floor. The area in the lean-to that once was occupied by cupolas and core ovens was now subdivided into an office, a tool room, a locker room, and a water closet.

The Detroit Shipbuilding Company still had foundry needs, and these were met by two newer structures. The first was a brass foundry (Building No. 14) located south of Atwater Street and east of Dry Dock No. 1. The second was a massive iron foundry (Building No. 20) that was constructed north of the engine-building and boiler shops. In 1909, the company’s Sheet Metal & Brass Department operated out of a modest three-story structure located at the northeast corner of Guoin and Orleans Streets. Within a decade it was transformed into an iron foundry that was nearly 450’ long and 150’ wide.<sup>169</sup> It covered Dequindre Street. Indeed, in late 1917 and early 1918, the City of Detroit vacated Dequindre from the alley between Franklin and Guoin Streets to Atwater, effectively transferring the street to the Detroit Shipbuilding Company.<sup>170</sup>

Little information exists about the former foundry/erecting shop after the shipbuilding era. At some point between the 1920s and the 1950s, a subsequent occupant erected a steel-framed structure with a cinder-block wall that virtually separated the entire southern-most bay from the rest of the building. Within it a loading dock was built. The latter seemed well positioned to serve the adjacent industrial loft building, which was easily accessible through a weighted fire door. Above the loading dock a second-level balcony with concrete flooring was constructed; it also extended along the east side of the lean-to for about the length of three bays. A third-level balcony stretched across the south end of the building, although only a small portion of it remains at the southeast corner. While the precise function of these balconies is not known, they probably were used for storage.

The Detroit Shipbuilding Company took out permit #1060 for a three-story loft building on August 30, 1902.<sup>171</sup> As a form of industrial architecture going back to early nineteenth century textile mills, there were several objectives to the strategy of the multi-story industrial loft building. During the age of millwork, one purpose was to organize various manufacturing activities under a common roof in order to make efficient use of a

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<sup>168</sup> Map of the Orleans Street Plant of the Detroit Shipbuilding Company (January 8, 1919), Detroit Shipbuilding Company Papers, Box 5, Wright Marine Collection, HCGL.

<sup>169</sup> Additional details about the iron foundry located on the north side of Guoin Street were provided in the Sanborn map of 1922: iron construction, earthen floor, concrete slab roof, an electric traveling crane, and an annealing furnace. The foundry was captured in the aerial photographs taken in 1931, see Appendix.

<sup>170</sup> See Miscellaneous File: Detroit Common Council Proceedings, 1917-18, Detroit Shipbuilding Company Papers, Wright Marine Collection, HCGL.

<sup>171</sup> Landmarks Planning Inc., “The Engine Works: An Adaptive Re-Use Study of the Globe Trading Company, 1801 Atwater Street, in the East Riverfront Area of Detroit, Michigan” (Pittsburgh, PA, August 1980), 49.

power source (water or steam). A second goal was to maximize the amount of light reaching the interior of the building through the extensive use of windows along the length of the structure. A third was to maximize the amount of interior workspace by reducing the density of supporting columns. The engineering revolution that transformed the production shed—namely, electrification, steel framing, and curtain walls—also transformed the industrial loft into a design that was particularly relevant to the manufacturing needs of industry. Indeed, the multi-story industrial loft made of reinforced concrete became the archetype of the automobile factory during the first half of the twentieth century.<sup>172</sup>

In the previous structure that had fronted Atwater Street, the Dry Dock Engine Works already had begun moving toward the program of the industrial loft building. The structure built for the Detroit Shipbuilding Company in 1902 represented the culmination of the strategy of organizing various light manufacturing activities on multiple floors and under a single roof. The new three-story building was approximately 172' long and 50' wide. From grade to the top of the roof pediment was a distance of 55'. The functions housed in the building remained relatively constant throughout the shipbuilding era. As a functional carry over from the previous building, a blacksmith or forge shop occupied the eastern half of the first floor. Bolt-cutting machinery operated in the middle section, as it had in the earlier building. To the west of it was a narrow driveway that connected Atwater Street to the open yard at the rear of the building. A stockroom and a small superintendent's office filled the space up to the machine shop. A 140' long section of the second floor was used as a pattern shop—also a function of the space in the previous building. This left a small area next to the machine shop for use as a tool room. On the third floor, the eastern half was set aside for unspecified storage. The western half was used for drafting, the storage of blue prints, and office space for an engineer.<sup>173</sup>

The company drawing of 1909 referred generally to the loft building as a “smith shop, pattern shop, and joiner shop #1.” A similar drawing ten years later identified it as a “pattern shop, drawing office, and grating shop.”<sup>174</sup> In the Sanborn map of 1922, the east section of the first floor was identified as a blacksmith shop, while the west end was simply a stockroom. The middle of the first floor had become office space. On either side of it were two driveways that linked Atwater Street to the shipping and receiving space in the structure behind the building. The second floor was used as a pattern shop and as a stock room, and it was connected to the second-floor stock room of the adjacent building. The company used the third floor to store patterns (on the east end), as a drafting space (on west), and for offices.

Detroit Edison drawings of the 1950s are helpful in describing only the functions of the building on the first floor.<sup>175</sup> The 70' wide area on the east end was identified as “appliance repair.” Within it, “sanding” took place in a small room at the northwest

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<sup>172</sup> The industrial loft is discussed in Bradley, *The Works*, 29-38.

<sup>173</sup> “Enlargement of Detroit Shops,” *Marine Review and Marine Record* 27 (January 1, 1903): 19.

<sup>174</sup> Map of the Orleans Street Plant of the Detroit Shipbuilding Company (February 13, 1909), and map of the Orleans Street Plant of the Detroit Shipbuilding Company (January 8, 1919), Detroit Shipbuilding Company Papers, Box 5, Wright Marine Collection, HCGL.

<sup>175</sup> See Landmark Design Services, Inc., Ex-2, 7-21-80, based on information taken from drawing dated 5-20-55 of the Detroit Edison Company.

corner, while spraying and drying occurred in small rooms at the southeast corner. A 70' wide section around the middle of the first floor was reserved for five offices, as well as spaces for storage and telephone communications. The function of the remaining 28' wide west end was not identified, although facilities toward the rear were identified as showers and men *and* women's restrooms. The first-floor layout of the mid-1950s remains virtually intact today.

The industrial loft building was a steel-framed structure with brick curtain walls that maximized the amount of interior workspace. The supporting columns on the perimeter of the loft building were made of steel shapes and plates that were riveted together. They were spaced 14' apart, thus dividing the building longitudinally into twelve bays. Unlike the machine shop and foundry, however, the perimeter columns of the loft building were not engaged with, or encased in, the exterior wall. Rather, they stood fully within the structure. Two rows of interior columns spaced 15' apart also interrupted the internal work area. These 8.5" x 7" columns were made of four L-shapes riveted to lattice webs. Most significantly, interior columns were not present on the first floor. This left the first floor a spacious and unencumbered work area, and it allowed building occupants to rearrange masonry or wood partitions as they saw fit.

The absence of interior columns on the first floor was due to the fact that they were not true columns. Instead, they were vertical members of massive roof trusses that supported the second and third floors *from above*. The Fink-style truss system began in the loft area above the third floor. The heaviest structural members consisted of four L-shaped pieces riveted to plates to form I-beams; the lightest members were made by riveting two L-shapes. Large steel gusset plates brought all the members together in riveted connections. The columns on the perimeter of the structure supported the twelve trusses of the loft building. The vertical posts of the trusses that descended through the middle of the building, in turn, supported the 12" floor beams of the second and third floors that were made of wood. Therefore, unlike the truss systems of the machine shop and foundry, which carried only the roofs, the one designed for the loft building also helped carry the floors.

The steep gable roof of the loft building rested on eight purlins that were bolted to the upper chords of the trusses. The roof itself was made of wood planks covered with asphalt. Tiles covered the pediment walls at the gable ends, while gutters along the front and rear of the structure carried water off the roof. Although the building did not have a roof monitor, photographic evidence indicates that there were several skylights or vents clustered on the west side of the roof.<sup>176</sup>

Since the west façade abutted the machine shop, only three originally had exterior exposures. Of these, only the south and east facades remain easily visible. The discoloration of the brick, and numerous in-fills, makes it difficult to determine its original color. It is laid out in a common bond, with five or six rows of stretchers for every row of headers. Significant alterations have occurred on the south façade, particularly to the first level. Cartographic and physical evidence suggest that the third and seventh bays from the west end of the building had sliding doors that opened onto

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<sup>176</sup> See the aerial photographs accompanying this report, dated May 13, 1931; photograph dated April 20 1932, in Mason, Rumrunning and the Roaring Twenties, 115.

internal driveways that connected Atwater Street to the area behind the structure. By the early 1930s the driveway in the third bay no longer existed and the door had been replaced with brick and windows. At some point when the Globe Trading Company occupied the building, a simple wood door was inserted into the third bay. The driveway in the seventh bay continued to function in the early 1930s. Later on, it too was filled in brick and windows. A sliding door once filled the eleventh bay, although it is not clear as to the date of its installation. Like the other sliding doors, it also has been filled in.<sup>177</sup>

At the beginning, windows made up approximately 30 percent of the wall area of the south façade.<sup>178</sup> The paired double-hung windows at the third level had square openings; segmented arches topped those on the first and second levels. Windowsills are made of concrete. Extensive alterations have occurred to windows on the east façade where brick filler has covered up windows on all three levels. Most of the windows on the building are now covered with sheets of plywood.

### **Machine Shop Addition, Chipping Room, and Shipping & Receiving Room, 1910s**

Between 1909 and 1919, the Detroit Shipbuilding Company erected three additional buildings that enclosed the inner yard of its engine-building complex.<sup>179</sup> It is possible to precisely date the construction of only one of them. Their appearance perhaps coincided with the shipbuilding rush around World War I. With the conversion of the foundry to an erecting shop, by the end of the war the complex moved closer to specializing in the machining and assembling of marine engine components.

At some point after 1909 the Detroit Shipbuilding Company built a steel-frame addition adjacent to the lean-to of the machine shop. It was built on top of the west end of the old foundry, and it extended southwards to the wall of the powerhouse. The brick in-fill on the east side of the original machine shop was removed, thereby providing continuity between the two buildings. The rectangular-shaped addition was 122' long, 41' wide, and about 43' from the ground floor to the roof trusses. It was well provisioned with light. The building had a 4' high roof monitor with industrial-style tilt windows. The monitor was about 12' wide, and it stopped one bay short of the ends of the building. A 10' high window wall stretched just below the roofline on the east façade. The north side had a large steel-framed window wall, although the lower portion of it now is covered on the exterior with brick.

Structural steel columns were spaced on 15' centers, parallel with those in the original machine shop. The heavy columns on the east and west sides of the building

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<sup>177</sup> "Enlargement of Detroit Shops," *Marine Review and Marine Record* 27 (January 1, 1903): 19; Sanborn map, 1922; Mason, *Rumrunning and the Roaring Twenties*, 115; aerial photographs of May 13, 1931.

<sup>178</sup> This figure was obtained by multiplying the estimated number of window openings originally on the south façade (34) by the dimensions of the openings to arrive at 2,060 square feet; then dividing the sum by the approximate size of the south façade (6,800 square feet).

<sup>179</sup> The years 1909 and 1919 are terminal points marked by the pair of maps produced by the Detroit Shipbuilding Company.

were much like those in the original machine shop: four L-shapes riveted to solid plates. The thin upper reaches of the columns held up the Warren-style trusses that carried the roof made of wood planks covered with asphalt. The columns also supported an electric overhead traveling crane that ran the length of the building. Evidence of a crane can be seen in the large portion of the crane girder that survives along the east wall of the structure. The Sanborn map of 1922 also noted the presence of an “elec. traveling crane.” With its wide and tall crane bay, the machine shop addition augmented the engine-erecting capacity of the engine works. After 1922, however, the crane bay was eliminated by the insertion of a wood floor rising some 21’ above the ground floor. A new row of modest-size intermediate columns—made of C-channels welded to lattice webs—supported the floor beams, joists, and the floorboards.

What remained of the space on the north end of the block that formerly was occupied by the old foundry and, later, by a castings cleaning room, became the site of a new structure that housed an activity closely related to foundry work: chipping. This was the function of the building as identified in the Sanborn map of 1922. “Chipping is the first stage in finishing any casting,” notes an historian familiar with the manufacture of castings.

When castings cool and come out of the sand, they’re covered with masses of excrescences-- fins, gates, risers, scabs, etc. Chippers worked (by the 20<sup>th</sup> century) mostly using air hammers with chisel attachments (before then with cold chisels and hand power) to remove these surface imperfections and get castings ready for further finishing. In the case of some relatively crude castings, or ones where a fine surface finish was not required, chipping, followed by a bit of grinding, might be all that was required. Chipping was heavy, dirty, noisy work; classed as unskilled, low paid, entry-level, [and] dead-end....<sup>180</sup>

The 56’ wide and 80’ long chipping room was located between the machine shop addition to the west and the foundry to the east. A railway track on the north end of the building connected the three structures, although the fire doors at the entrance to chipping room no longer exist. The Sanborn map of 1922 identified the building as a steel-frame structure. The exterior columns on the east and west sides came from, and were shared with, the adjacent buildings. A substantial portion of the north wall consisted of industrial steel-framed windows that began 8’ from the ground and extended to the roof. Although visible from the inside, these windows are now covered on the exterior by a layer of concrete blocks. Of the six buildings that today make up the engine-works complex, the chipping room is the only one without a roof monitor, roof vents, or skylights. That was not always the case. The Sanborn map of 1922 indicated that in the middle of the structure a 4’ high, square, section rose from the roof. The aerial photographs of the site taken in 1931 confirm the existence of a roof monitor on top of the building (see Appendix).

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<sup>180</sup> Email communication of Howell J. Harris to Thomas A. Klug, August 21, 2002.

The chipping room had two sections that were divided by a masonry wall with steel columns embedded in it. It appears that the east section was built first. The south wall that opened onto the yard has door and window openings. The wall on the west side was evidently an exterior wall, for it, too, has traces of window openings. Most telling is that the Warren-style roof trusses had *riveted* plate connections. Enclosed later, the roof of the western portion of the chipping room was supported by lightweight Howe trusses with *welded* connections. The roof of the building slopes downward from west to east; inside heights go from 29' to 24'. The roof is made of wood planks covered by asphalt.

At the center of the engine works is a structure not visible from the exterior of the complex. This two-story steel-framed space was the last one to be built. Brick in-fill covered windows on all sides of the first floor, indicating that it was once an exterior space within the complex. Building permit #2269-A was issued on September 19, 1918, to “make alterations to reinforced concrete and brick factory building raising roof and enclosing courts, etc. at a cost of \$40,000.”<sup>181</sup>

According to the Sanborn map of 1922, the first floor of the structure was a shipping and receiving area that had access to Atwater Street by means of the driveways that ran through the ground level of the industrial loft building. The second story functioned as a stock room. The building was 56' wide and 72' long. In a structural sense, the hallway on the first floor that separated the chipping room from the shipping and receiving building belonged to the latter, as is apparent on the floor plan of the second level. The first story had a brick floor, and the riveted steel columns and beams were encased in concrete—a measure recommended for protecting steel members from potential fire damage. The floor of the second level was made of reinforced concrete and covered with wood planks. The riveted steel columns and rolled I-beams were not encased in concrete on the second level. An elevator at the northwest corner connected the stock room to the hallway below. A stairwell on the south side—which ran between the shipping and receiving and industrial loft buildings—linked the stockroom to the adjacent loft building. A doorway on the west side led from the stockroom to the first gallery floor of the machine shop.

The roof of the shipping and receiving building was made of reinforced concrete and was covered with asphalt. A roof monitor ran the full length of the second story. The monitor provided light to the second floor, as did the steel-framed windows on the east and north sides. The first floor was entirely enclosed by brick masonry walls and required artificial light for illumination.

## Conclusion

The manufacture of marine steam engines at Orleans and Atwater Streets had gone on for some fifty years when production peaked at the site around World War I. In less than a decade after the war, however, the Detroit Shipbuilding Company ceased all shipbuilding and engine-building operations. Although more than seventy-five years

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<sup>181</sup> Landmarks Planning Inc., “The Engine Works,” 49.

have passed since the last engine came out of the plant, the six buildings that make up the complex are a physical reminder of the age of steamships and steam power.<sup>182</sup> The steam engine was the hallmark of the industrial age. Its application to boats and ships transformed communications, transportation, and warfare throughout the world. In the case of the Great Lakes basin, steam engines revolutionized the business of transporting passengers and raw materials, notably iron ore. The United States' great leap into an industrial power at the end of the nineteenth century in no small measure rested on the conversion of iron ore into castings and useful iron or steel shapes. Getting the raw material from the Lake Superior region to iron and steel manufacturers located hundreds of miles to the south was the responsibility of ore freighters. Too often lost in the story of the steamship, however, is the variety of steam engines—low and high pressure, compound, triple and quadruple expansion—that made all of it possible. The engine plant of the Dry Dock Engine Works/Detroit Shipbuilding Company, therefore, is significant in terms of the role it and other such facilities played in powering America's ships from the early nineteenth to the middle of the twentieth century. In addition, and in the case of Detroit, the factory organization and metalworking skills associated with marine-engine production at the plant provided a general foundation for the growth of the automobile industry.

This study also has shown the important place of the buildings of the Dry Dock Engine Works in the evolution of factory design and construction. The buildings were designed for strength, light, ventilation, and economy in construction as well as maintenance. These factors no doubt explain why the facility—now commonly known as the Globe Trading Company Building—remained long in use after engine building ceased there in the mid-1920s. The machine shop that the Berlin Iron Bridge Company designed and erected in 1892 represented the culmination of ideas and techniques in factory architecture. Some, such as the production shed and roof monitor, went back to the middle of the century; others, such as the electric overhead traveling crane or the steel-framed structure with curtain walls, were innovations of the 1880s. The machine shop of the Dry Dock Engine Works is an early example of an industrial building that was entirely supported by a rigid steel frame and with exterior walls that functioned merely as a curtain. It may very well have been the first such structure in Detroit.

The production shed reappeared in the foundry (1902) and the machine shop addition (ca. 1910s) of the Detroit Shipbuilding Company. The alternative concept for organizing a workspace was the industrial loft building (1902). Both strategies—the production shed and the industrial loft building—were on hand in Detroit, therefore, when architects and owners had to decide what kinds of factories to build, and how to build them, for the manufacture of automobiles. By the time the two remaining structures (the chipping room and the shipping and receiving building) of the engine plant were built during the 1910s, the techniques that were so innovative in the machine shop of 1892 had become standard. However, the use of welding and reinforced concrete in these last, rather nondescript, buildings shows that advances in construction methods continued

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<sup>182</sup> For a nostalgic look back at the age of marine steam power, see David Plowden, End of an Era: The Last of the Great Lakes Steamboats (New York: W.W. Norton & Company, 1992). Plowden's narrative and photographs concern the *S.T. Crapo*, a 402' long vessel with a triple expansion engine that was launched in 1927 at the shipyard of the Great Lakes Engineering Works in River Rouge, Michigan.

at the engine plant to the very end. With construction spanning nearly twenty-five years, the engine complex of the Dry Dock Engine Works/Detroit Shipbuilding Company serves as a superb example of the range of decisions that architects, builders, and owners made in creating useable industrial space.

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