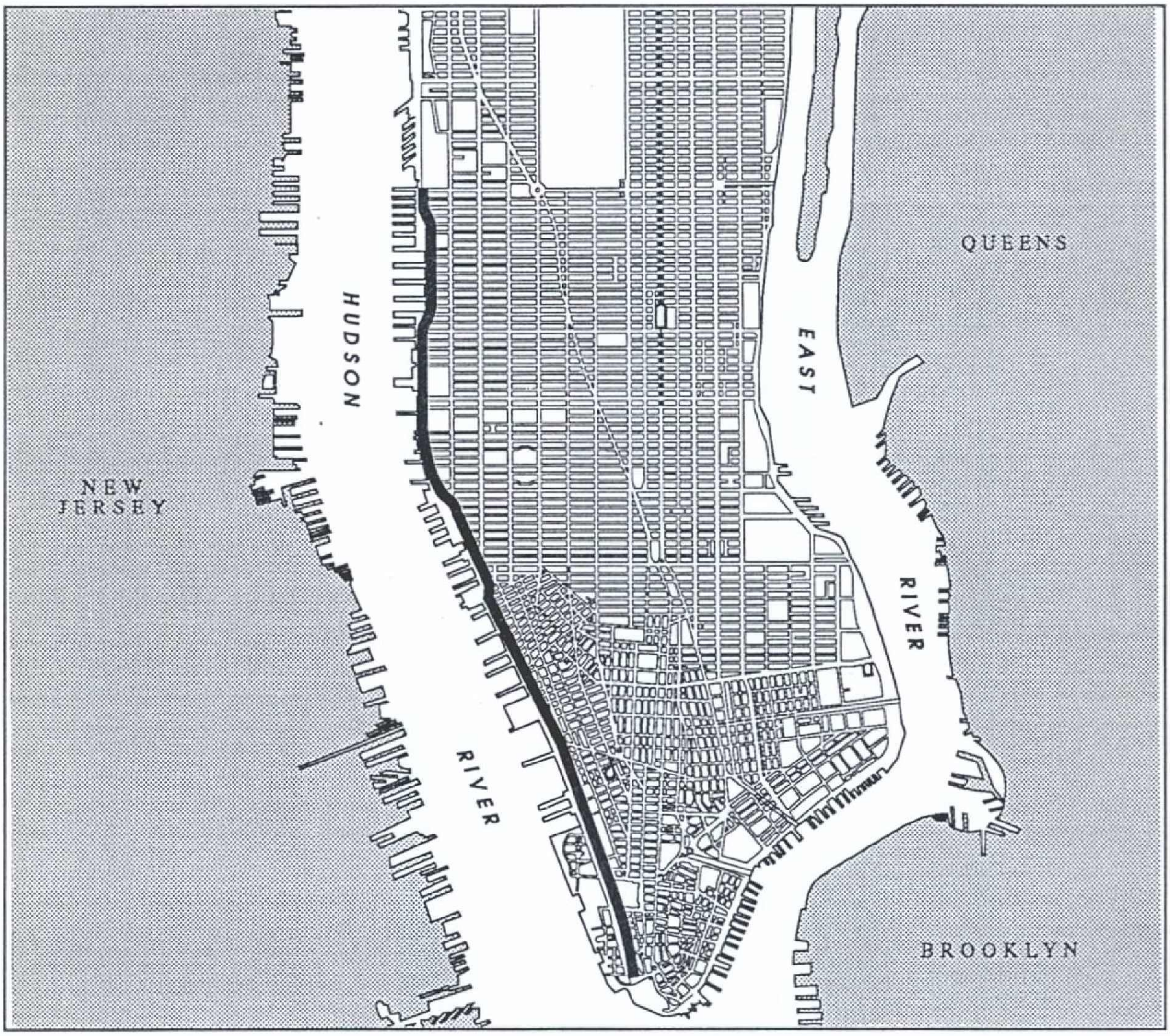
ROUTE 9A

RECONSTRUCTION PROJECT



DRAFT

CONTEXTUAL STUDY

SEQR

MANUFACTURING

May 1993

ROUTE 9A RECONSTRUCTION PROJECT
NEW YORK, NEW YORK

DRAFT CONTEXTUAL STUDY

MANUFACTURING HISTORIC CONTEXT

Prepared for:

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I. INTRODUCTION

This historic context study (B2.7) addresses potential archaeological resources associated with the history of manufacturing on the west side of Manhattan. It meets the Secretary of the Interior's Guidelines for Preservation Planning (48FR190:44717-44720) and follows direction received from the New York State Department of Transportation (NYSDOT). The present study owes much to previous studies completed by Hartgen Archeological Associates in cooperation with Historical Perspectives (1990a, 1990b, 1990c, 1990d, 1990e).

Twenty-seven potential resources were identified by previous research as relating to the manufacturing historic context. One of these resources, a glass works (Site 128), is the subject of a separate context study (B2.7.9). Another site, Site 110, was eliminated from this study because it was found not to conform to the manufacturing historic context. Site 110 was identified by Hartgen Archeological Associates and Historical Perspectives (1990c) as "brick buildings, auto repair, glass studio, kiln, lumber." Map research indicated that the brick buildings, built circa 1902, were originally owned by the American Power Co. (Bromley and Bromley 1902:II:17). By 1911, one of the buildings served as a hotel and by 1922 the other structures were occupied by a glass studio and a garage.

The remaining 25 manufacturing sites were organized into eight classes.

Soap Works/Piano Factory (B2.7.1)	1
Ice Industry/Malt House (B2.7.2)	1
Pottery (B2.7.3)	1
Paint/Varnish/Chemical Works (B2.7.4)	5
Metal Working (B2.7.5)	8
Piano (B2.7.6)	3
Carpet (B2.7.7)	3
Cooperage and Carton (B2.7.8)	3

LBA revised this system in only one significant way. Prior research incorrectly assigned a property labeled "Salamander Works" to the Metal Working class. Salamander Works was at one time the largest clay manufacturer in New Jersey and the Salamander Works plant in Woodbridge, New Jersey, produced fire brick, sewer and water pipes, and various specialty products (Clayton 1882:554; Ries et al. 1904:324). An office and depot of Salamander Works was located at the foot of Bethune Street in New York City (Clayton 1882). Therefore, this property has been combined with the former Pottery class to produce a clay-working group, which encompasses brick as well as pottery manufacture. Table I.1 provides an outline of the manufacturing property classes discussed in this report and brief descriptive information for the specific properties considered in each class; the locations of these resources are shown in Figure I.1. More detailed depictions of the locations of the resources and their spatial relationships to the proposed construction corridor are expressed in the overlays, which have been separately attached.

TABLE I.1

B2.7 MANUFACTURING PROPERTIES

Site No.	Resource	Dates	Location
SOAP WORKS			
134	David S. Brown & Co. Soap Works	c. 1896-1910	Between W. 51st and W. 52nd Sts.
ICE INDUSTRY			
130	Hygiene Ice Co. Plant	c. 1911-1920s	Between W. 49th and W. 50th Sts. at 12th Ave.
CLAY WORKS			
54	Salamander Works	c. 1879-1902	Between Bank and Bethune Sts., near Pier 49
370	Wm. D. Stewart & Co. Pottery; Manhattan Pottery	c. 1859-1902	Between W. 18th and W. 19th Sts.; opposite Pier 59
PAINT/VARNISH/CHEMICAL WORKS			
286	Chemical Works	c. 1879-1885	Between Bank and Bethune Sts.; opposite Pier 49
307	Marchand & Co. Chemical Works	c. 1885-1902	Between Pier 51 and Gansevoort Sts.; opposite Horatio St.
299	C. Brooks & Co. Varnish Factory	c. 1879-1902	Between W. 12th and Jane Sts.
56	Brooks Varnish-Extension	c. 1885-1902	Between W. 12th and Jane Sts.
310	Paint Works	c. 1879-1885	Between Horatio and Gansevoort Sts.
METAL WORKS			
291	John Innes and Son; John Innes' Son Rapid Iron Works	c. 1863-1902	Between Bank and Bethune Sts.
288-290, 292	J. Leonard Manhattan Rolling Mill	c. 1866-1902	Between Bank and Bethune Sts.
499	New York Lead Works; New York Smelting and Refining Co.	c. 1866-1896	Between Horatio and Jane Sts.; opposite Pier 51
309	Tin Works; Monitor Tin Plate Works; Eagle Wrought Iron Works	c. 1879-1902	Between Horatio and Gansevoort Sts.

TABLE I.1 - Continued

Site No.	Resource	Dates	Location
PIANO INDUSTRY			
460	Piano Factory/Autopiano Co.	c. 1902-1920	Between W. 49th and W. 50th Sts., east of 12th Ave.
134	Autopiano Co., Standard Pneumatic Action Co., and Auto-Pneumatic Action Co.	c. 1911-1930	Between W. 51st and W. 52nd Sts., east side of 12th Ave.
479	Milton Piano Co. Building	c. 1909-1925	Between W. 54th and W. 55th Sts; opposite Pier 95
480	Piano Co. facility adjacent to Milton Piano Co. building	c. 1902-1922	Between W. 54th and W. 55th Sts.; opposite Pier 95
CARPET INDUSTRY			
119	Pickers Building for E.S. Higgins Carpet Factory; Manufacturers Real Estate Co.	c. 1855-1930	Between W. 43rd and W. 44th Sts.
120	Storehouse for E.S. Higgins Carpet Factory; Manufacturers Real Estate Co.	c. 1855-1930	Between W. 43rd and W. 44th Sts.
121	E.S. Higgins & Co.; Manufacturers Real Estate Co.	c. 1879-1930	Between W. 43rd and W. 44th Sts.
COOPERAGE AND CARTON MAKING			
381	Box Factory	c. 1902-1913	Between W. 20th and W. 21st Sts.; opposite Pier 60
465	Cooperage	c. 1902-1930	Between W. 50th and W. 51st Sts at Pier 90
94	Cooperage associated with "Bradish Johnson Storehouse"	c. 1859-1902	Between W. 15th and W. 16th Sts. at Pier 54
MALT INDUSTRY			
130	Malt House	c. 1859-1913	Between W. 49th and W. 50th Sts. at 12th Ave.

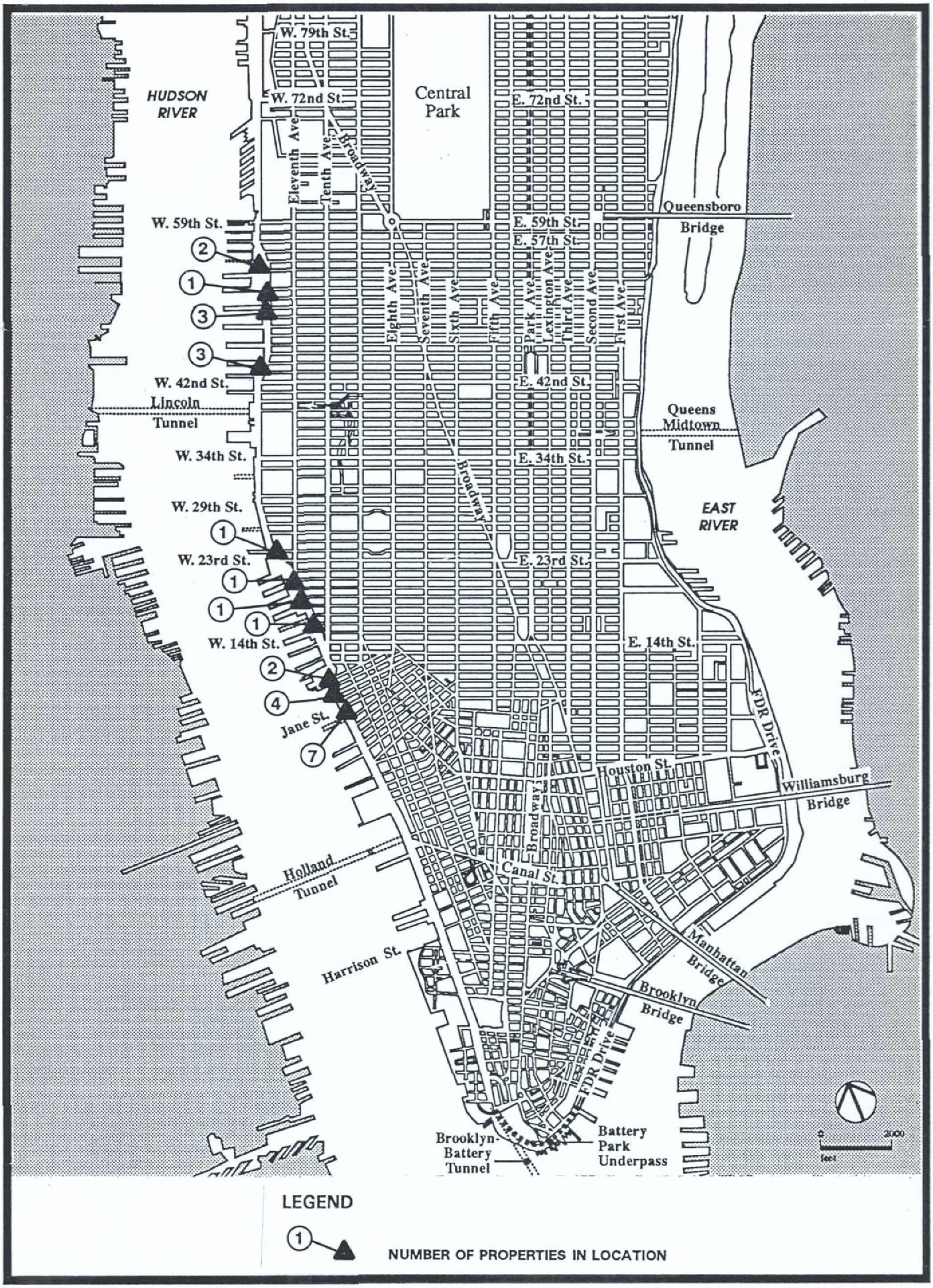


FIGURE I.1 Location of Manufacturing Properties

The one soap works discussed in the report was located in Block 1099, between West 51st and West 52nd Streets; it was subsequently occupied by manufacturers of player pianos and player-piano actions. The ice factory, which occupied an older malt house (Site 130), was located in Block 97, between West 49th and West 50th Streets. Two sites are related to clay works. The Salamander Works was located between Bank and Bethune Streets, near Pier 49, in Block 648. The Stewart & Co. pottery was located between West 18th and West 19th Streets, in Block 690. The paint/varnish/chemical works class is represented by five sites; one was a paint works, two were related to varnish works, and two were chemical works. The products of both the Marchand & Co. Chemical Works and the unidentified chemical works building are unknown. The paint and varnish manufacturers and chemical works were all clustered between Bank Street and Gansevoort Street in Blocks 648, 649, and 650. This area was also occupied by numerous metalworks. The metal-working resources described in this report were all located in Blocks 649 and 650. The four piano-related factories were located between West 49th and West 55th Streets. The Milton Piano Company occupied a building or buildings between West 54th and 55th Streets. The Autopiano Company occupied a building between West 49th and West 50th Streets before moving to a larger factory between West 51st and West 52nd Streets, in the former soap works building. The two buildings associated with the Autopiano Company also housed factories that produced actions for player pianos.

The E.S. Higgins & Co. Carpet Factory consisted of three properties in Block 1091, located between West 43rd Street and West 44th Street. Three sites have been assigned to the Cooperage/Carton industry. The oldest of these, dating potentially to 1859, is located between West 15th and West 16th Streets (Block 692). A second cooperage was located between West 50th and West 51st Streets (Block 1098), and the box factory was located between West 20th and West 21st Streets, opposite Pier 60 (Block 657).

Prior studies have been supplemented by specialized research conducted at the New York Historical Society, the New York Public Library, the Library for the Performing Arts at Lincoln Center, and the Engineering Societies Library. All of these repositories are located in New York City. Additional research in the manuscript schedules of the federal census of manufactures was completed at the New York State Archives in Albany. These efforts have been focused on the types of industries previously identified, providing additional information on the businesses themselves as well as a characterization of the organization of activities and structures associated with each business. In some cases, this approach refined or otherwise altered the preliminary dating offered by previous investigations. A historical overview is presented in Chapter II of this document and Chapters III through XI contain discussions of the different classes of manufacturing sites.

II. HISTORICAL BACKGROUND

Underlying the transformation of the United States economy after the Civil War were three major interrelated and mutually reinforcing social processes: urbanization, transportation, and industrialization. Total population of the country grew substantially but at a progressively slower pace after 1870, increasing by 30.1 percent between 1870 and 1880, by 24.9 percent between 1880 and 1890, and by 20.7 percent between 1890 and 1900. The population of New York City in the same period increased by 28.0 percent between 1870 and 1880, by 25.6 percent between 1880 and 1890, and by 35.1 percent between 1890 and 1900 (U.S. Bureau of Census 1883:209, 451, 419, 422, 450, 453; 1892:433-434; 1903:2-5, 201, 279, 484-485, 620, 622, 631). Admittedly, the last decennial increase was inflated by geographic expansion in the 1890s. Nevertheless, the city's growth curve amply justified Walker and Gannett's observation that "the most notable change . . . in New England and the middle states, including Ohio and Indiana, has been the increase in density of population and the migration to the cities with the consequent increase of the urban population" (Walker and Gannett 1883:xix).

The transformation of industry itself relied on technological innovation, capital accumulation, and a system of collection and distribution as well as on expanding markets and reliable labor supply. New York City emerged as the national leader in 12 of the 15 major industries as defined by the U.S. Department of Commerce and Labor (1907). By 1900, the city led the nation in the arenas of clothing, printing and publishing, tobacco products, liquors and malts, and lumber milling; it was the second leading producer of furniture, grist-milled products, and silk goods. In fact, it was ranked among the top five producers in 12 out of the 15 major manufacturing areas. In 1905, the value of products manufactured in New York City ($1,526,523,006) exceeded the value of goods produced in each of the remaining 49 states and territories. While the city clearly became a leader in the manufacture of finished consumer products, it was noticeably absent from the heavy industries, namely iron and steel, and industries with strong geographical associations, namely, cotton and leather (U.S. Department of Commerce and Labor 1907:cclxxx-cclxxxi).

The primacy of New York City in manufacturing during the late nineteenth century is specifically related to the geographic and economic forces that influenced industrial development during the period. Access to railroad transportation continued to be a major factor in the development of industry, but waterborne transport was often the preferred alternative because of its relatively low cost. In areas, such as New York, where manufacturing had already become established, "transportation lines and trade channels . . . accommodated themselves to supplying materials for workers in these industries and to distributing the products of their labor" (Clark 1929:181-182). Transportation was important for both delivering raw materials and shipping finished goods. Thus, it is not surprising that industries clustered in Manhattan on the west side where the facilities for interregional transportation systems, both rail and water, were located.

Manufacturing involves two basic steps: the processing of raw materials into usable products and/or the assembly of these usable products into consumer goods (Alexandersson 1967:3-31). Depending upon the specific industrial processes involved, manufacturing became increasingly independent of geography-related power requirements as well as the integration of architecture into the production of goods. Introduction of steam power emancipated textile, iron, and other early industries from the need for access to sources of hydropower, thus eliminating one constraint in locating industrial plants. Plants were sited based on raw materials, costs of transportation, and markets (Collins 1910:163; Greaves-Walker 1919:182). Thus, it was cost-effective to ship iron to coal, leading to the concentration of iron and steel industries in Pennsylvania. The parameters varied slightly from industry to industry. Indeed, costs of transportation emerged as the determining factor in the interregional competition between Pittsburgh and Birmingham, Alabama. Interests based in Pittsburgh essentially won because they controlled the cost of freight (see discussion in Woodward 1951).

As markets expanded and new natural resources were identified, such as the iron ore in the Mesabi Range in Eastern Minnesota, industrial centers emerged and shifted. However, once a facility was established, it required "a very considerable shock to dislocate it from that position" (Clark 1929:181). The mere existence of a viable facility created self-perpetuating, positive feedbacks that increased its likelihood for success. Pools of skilled labor formed supporting communities, and transportation and communication links were established (Clark 1929:182).

In some instances, notably textiles and ink, the survival of a viable industry in New York defied purely quantitative, economic logic. Ink, for example, was valuable relative to its bulk so transportation costs were not a determining factor in siting the plant. There was advantage to siting an ink factory near to its consumers and New York City represented an enormous market, particularly for printer's ink. Nevertheless, "there appears to be no strong reasons for locating ink factories in the very center of the metropolis," one analyst observed in 1928, "yet a number are there" (New York 1928a:30). The Stafford ink company on Manhattan's Lower West Side sold its product throughout the United States as did the Sinclair and Valentine factories, both located on the Upper West Side. "The explanation," the writer concluded, "probably lies in the value of established trade names" (New York 1928a:30).

Early twentieth-century analysts of the textile and clothing industries made a similar point. "Certain branches of textile manufacturing," they observed, began in New York in the nineteenth century, "while the country was yet young and the West was undeveloped" (New York 1928d:78). A series of specialist (dyeing and finishing) as well as ancillary industries (harness-making, card-cutting) developed. Other enterprises equally dependent upon skilled labor and expert services were attracted to the area, thus establishing both critical mix and critical mass, planning concepts that had yet to be articulated although the phenomena were recognized. "The momentum of an early start, combined with a certain hesitancy about forsaking the well-trodden ways," the writers concluded, accounted for the vitality of New York City's textile industries. "The localization of the textile industries in New York and its environs is due, therefore," they stated:

not so much to intrinsic or positive advantages of their present locations as to the fact that, once started, they met with no disadvantages strong enough to offset the attractions of New York City [New York 1928d:78].

The Industrial Revolution of the late nineteenth and early twentieth centuries combined two seemingly contradictory impulses: the tendency to specialize and segment and the tendency to consolidate. Thus, the same decades that witnessed the rise of white collar, specialized professions also saw the emergence of monopolies, mergers, and the modern corporation. Within industrial plants themselves, this was captured by the notion of the assembly line, which organized a series of discrete, specialized activities into a single manufacturing process.

The history of the piano manufacturers Steinway & Sons illustrates the point. The firm pioneered piano manufacture in very large factories, most notably their facility in Queens, using such steam-powered heavy equipment as planers, saws, and lathes for the rough work and hoists for moving the semi-assembled instruments from one work station to the next, where specialized, skilled handwork occurred. Basic elements of the instruments, including the cases, soundboards, actions, keyboards, and stringing, were finished and installed by hand although many parts were mass-produced off-site. Steinway ultimately established an integrated works in Queens, which included on- and off-loading facilities, steam saw mill, iron and brass foundries for casting full steel frames, boiler and engine houses, and the assembly plant for the instruments themselves (Arnold 1987:20; Groce 1982:50-54; New York 1928c:41; Singer 1986:18, 90). Steinway may have become the most famous firm of its kind, while New York City generally became a center of piano manufacture; approximately 250-300 instruments were produced per week in 1865 (Clark 1929:128-129). New York remained an important center for manufacturing pianos in the early twentieth century, although other centers had also emerged, of which Chicago was probably the most important (New York 1928c:170).

As large plants in campus-like settings increased in number, particularly in the petrochemical industries, many designers and corporations sought to accommodate the auxiliary or support industries within a facility. At the same time, however, the presence of an industry created markets for other allied or support industries (Clark 1929:181). Soap manufacturers, for example, relied on the tallow which was a waste product of slaughter houses and textile works (New York 1928a:30). Thus, Proctor and Gamble, which became the largest soap manufacturer in the country, was located in Cincinnati, Ohio, near the stockyards (Gordon 1990:62). It is not surprising, therefore, that soap works were found near the stockyards and textile works on the west side of Manhattan or that cooperages, which provided packaging materials, were also located nearby.

New York and its environs, which included parts of New Jersey as well as the outer boroughs, exercised enormous economic influence on the national economy in the early decades of the twentieth century. Within the urban region, however, the locations of different industries shifted. Although transportation facilities initially accounted for the siting of industrial plants on the west side of Manhattan in the nineteenth century, the manufacturing and industrial base of the city changed subtly as the nineteenth century faded into the twentieth. Fewer of the successful industries continued to rely on transportation as a determinant, although access to transportation facilities was obviously a necessary, even if not the predominant, consideration. Rather, the industries that survived were those that met at least one of the following considerations: highly specialized labor was required; expanses of space were not essential; proximity to the consumer was an asset (as in the *perfumes and furnishings*); mechanization or large equipment was not necessary and economies of scale did not apply; value was high relative to bulk, allowing access to national consumer markets and offsetting the cost of transportation of both the raw materials and finished goods. Increasingly, goods produced in Manhattan were those of the specialty or niche markets.

III. SOAP WORKS

A. HISTORICAL CONTEXT

1. Historical Development

Originally a household enterprise, soap-making in the United States became a commercial activity in the late eighteenth and early nineteenth centuries. The chemistry of soap manufacture was fairly well understood by the end of the nineteenth century and the process used was fairly universal. U.S. manufacturers were innovators in the mechanization of the process, however, permitting high production with relatively low expenditures for labor, time, and energy (Stanislaus and Meerbott 1928:10).

John Slidell and Company (50 Broadway) was one of the earliest commercial soap makers. William Colgate, an employee of Slidell, opened the Colgate Company on Dutch Street in New York City in 1806. Colgate pioneered rendering fats as soap stock (Stanislaus and Meerbott 1928:7). The Company of James Pyle and Son originated the manufacture of soap powder or crystals in 1857, and in about 1864, James Atkins of Brooklyn built the first soap press. B.T. Babbit is believed to have introduced pressed cakes of laundry soaps in about 1865. At approximately the same time, soap makers began to use rosin in the manufacture of soaps appropriate for use in cold water. In 1870, the first U.S. patent for recovering glycerin from waste lye was issued, although the process was invented by the English. Proctor and Gamble introduced "floating soaps" in the 1880s. Located in Cincinnati, Ohio, Proctor and Gamble profited from their proximity to the meat-packing industries; their access to tallow, which was a by-product of meat processing, helped Proctor and Gamble to become the largest U.S. manufacturer of soap in the early twentieth century (Gordon 1990:62; Stanislaus and Meerbott 1928:8). Liquid soaps were introduced in the early twentieth century (Stanislaus and Meerbott 1928:9).

Among the innovations of the late nineteenth century was the appearance of soaps held to have therapeutic value. Advances in dermatology, hygiene, and bacteriology demonstrated the utility of soap as an antiseptic and certain soaps were construed as medicinal. Many of the medicated soaps were "superfatted" as a precondition to the addition of medicinal agents. Superfatting a soap compound consisted of adding a bland animal fat or olive oil to the finished soap to prevent the decomposition of the medicinals (Stanislaus and Meerbott 1928:9). In the early twentieth century, the development of the margarine industry led to increased competition for animal fats, prompting many soap makers to substitute less expensive materials. Among these was fish oil (Stanislaus and Meerbott 1928:9-10).

The late nineteenth-century soap factory was rectilinear and comprised three principal elements: the boiling house, the hot and cold storerooms, and the barring or cutting room and drying and packing rooms. The boiling house was located in the center with the storerooms to one side and the barring/cutting room and drying/packing room to the other (Cameron 1888:77-79). Equipment contained in the boiling room included kettles, frames, and lye vats, which were arranged around a large chimney. If the kettles were heated by either an open fire or steam, the furnace was placed in the basement with the kettle extending above the first floor, permitting the contents to be stirred. Illustrations of open fire and steam-heated systems are presented in Figures III.1 and III.2.

2. Property Types

The David S. Brown & Company Soap Works is first listed in a city directory in 1883, when the plant was located at the foot of Bank Street (Trow 1882/83:199). Brown's residence at this time was located at 209 East 15th Street. The company remained at the foot of Bank Street until 1895 (Trow 1895/96:222). It then moved to the foot of West 52nd Street (Block 1099). In 1898, the business address was listed as the foot of West 51st Street; this change of address simply reflects the fact that the soap works extended the full depth of the block from West 51st to West 52nd Street bordering on Twelfth Avenue (Trow 1896/97:161, 1898:164) (Figure III.3). The last entry for the business in the New York City directories is in 1910, when the address is listed as 655 West 51st Street (Trow 1909/10:185).

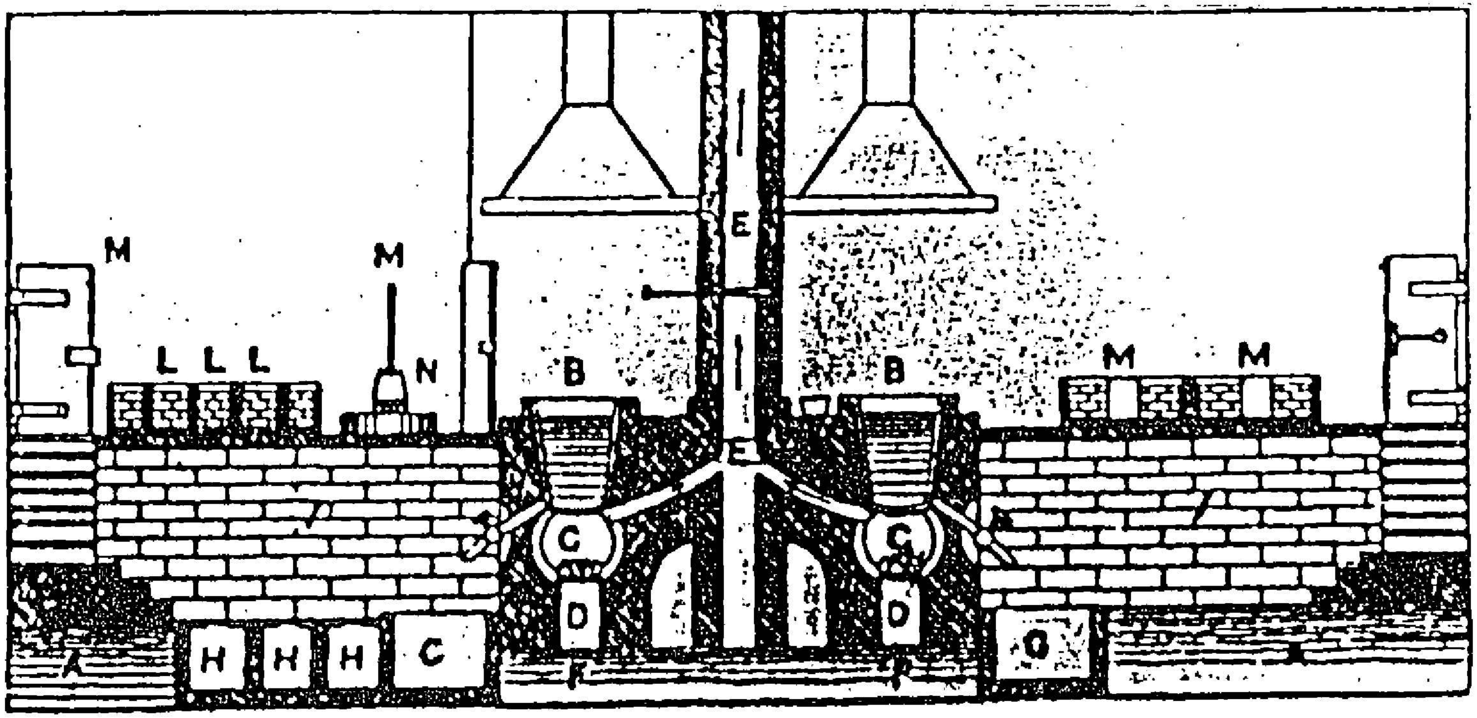
An 1899 fire insurance map (Sanborn-Perris Map Company 1899:5:103) shows the circa 1896 soap factory as a five-story brick building with basement around a central courtyard with a one-story brick boiler room addition and one-story frame stable at the eastern end. A fire insurance map from 1911 (Sanborn Map Company 1911:5:50) shows that this soap factory later housed the Autopiano and Standard Pneumatic Action companies (see Chapter VIII). By 1922, the former one-story boiler room was enlarged to four stories (Bromley and Bromley 1920-22). Around 1930, this building housed the Packard Motor Company Sales and Service offices (Bromley and Bromley 1930:80) and in 1934 the circa 1896 soap works building was demolished for construction of the elevated public highway (Bromley and Bromley 1934:80).

B. ARCHAEOLOGY

1. Research Potential

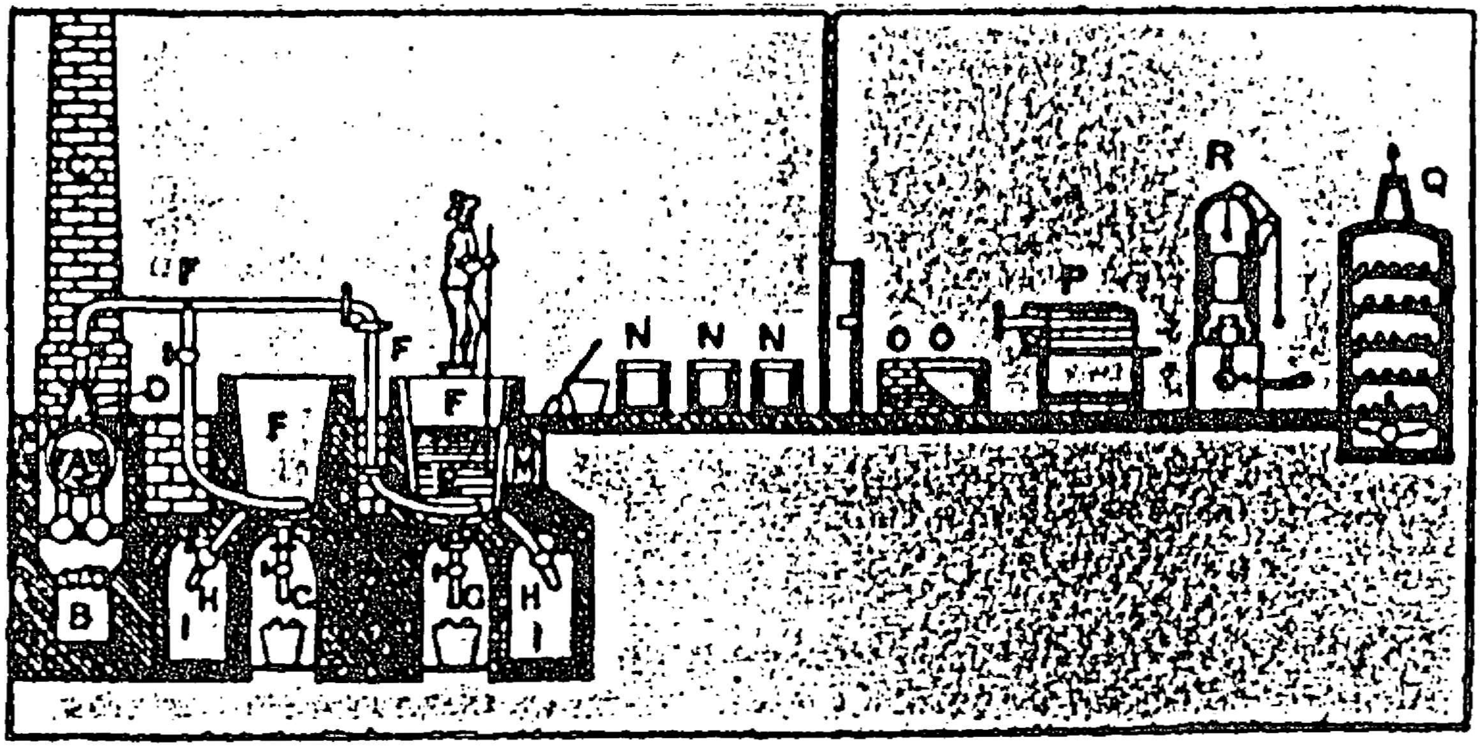
The construction of soap works within the Route 9A study corridor is reflective of the growth of the consumer market in New York City as well as the proximity to raw materials, namely tallow and other by-products of slaughtering, which occurred nearby. Like the chemicals industry, the manufacture of soap was increasingly mechanized through the nineteenth century. The soap-making process was expressed in the apparatus housed in factories that were characterized by a logical progression in the processing of raw materials into soap products.

The research potential of soap works resides primarily in the distribution of activities within the manufacturing site and how the organization of activities and labor was altered as technology advanced. In addition to the stimulus of demand, influences upon the technology included power source, raw materials, and increasingly sophisticated understanding of the chemistry of soap



A	Factory Building	G	Cisterns for Waste Lye
B	Kettles	H	Vessels for Oils and Fats
C	Fireplace	I	Cellars
D	Grate	L	Lixiviating Vessels (Placed Above Lye Vats)
E	General Chimney	M	Soap Frames and Store Rooms
F	Ash Pit	N	Apparatus for Pulverizing Crude Soda

FIGURE III.1 Arrangement of a Soap Factory, Pans Heated by Open Fire, ca. 1888 *SOURCE Cameron, ed. 1888:78-79*



A	Boiler	I	Spent Lye Cisterns
B	Fire-Grate	M	Foundation of Kettles
C	Chimney	N	Iron Lye Vats
D	Dome for Discharge of Steam	O	Soap Frames
E	Coil	P	Barring Table
F	Steam Pipes and Kettles	Q	Drying Room
G	Waste Pipes	R	Soap-Moulding Machine
H	Waste or Spent Lye Pipes		

FIGURE III.2 Arrangement of a Soap Factory, Pans Heated by Steam, ca. 1888

SOURCE Cameron, ed. 1888:78-79

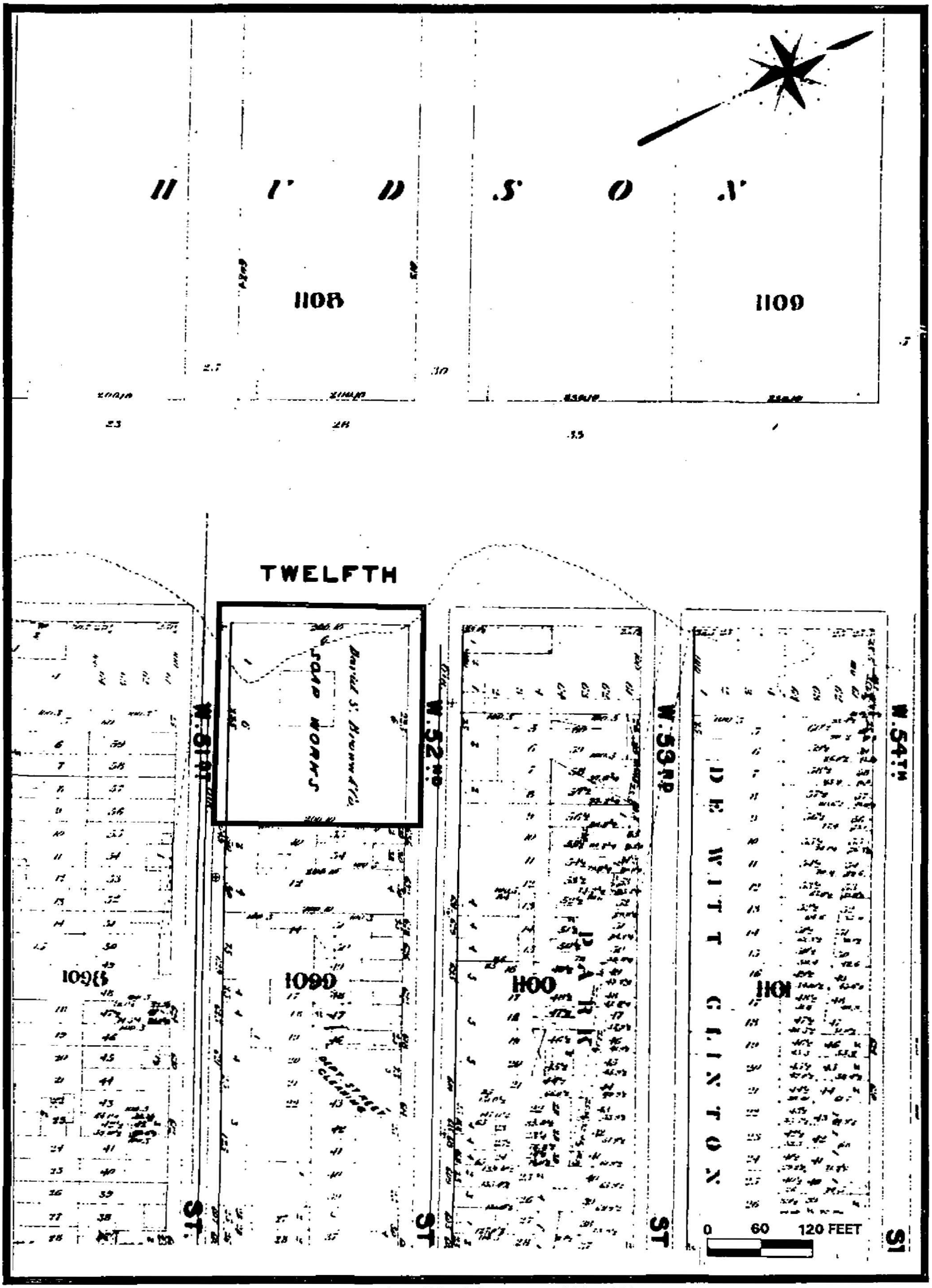


FIGURE III.3 Vicinity of West 51st Street, West 52nd Street, and Twelfth Avenue, Showing David S. Brown & Co., Soap Works, 1902

SOURCE Bromley 1902 Vol. 2:40

making. Critical in the manufacture of soap were the control of heat and the movement of quantities of liquid products and wastes. Thus, buildings had to be equipped with facilities for heating (e.g., furnaces and flues), boiling, and storage (i.e., tanks, vessels, etc.; see Figure III.2). Questions, therefore, that might be asked include the following: to what extent were demands related to heating expressed in distinctive engineering and/or architecture, such as construction of flues, additional insulation, and use of fire-retardant materials? Were there changes in the source of power, that is, from steam to electricity, and if so, was there a corresponding change in the organization of labor and activities within the building? How was technological innovation through developments in chemistry manifested in different equipment? How did labor inputs vary with alteration in equipment, and what changes resulted in the organization of activities and products within the factory as a result of these innovations, if any?

2. Archaeological Visibility

Late nineteenth-century descriptions of soap works indicate that most of the apparatus and equipment was portable. In urban areas, such as New York City, soap works were primarily organized vertically, as was the case with the David S. Brown & Co. Soap Works between 51st and 52nd Streets. The potential archaeological expressions of soap works, both in general and in this specific case, are likely to be limited to the footprints of the buildings that contained the apparatus, and possible remains of boilers, heaters, and/or flues. The David S. Brown & Co. Soap Works was a five-story brick structure with basement that was constructed around a central courtyard, but there is no available cartographic information on the interior organization of the plant. This industrial property would have low archaeological visibility because the manufacturing apparatus and fixtures would have been installed on multiple floors above ground. It is assumed that the soap-making equipment was removed when the building was converted for use as a piano factory. Although the one-story boiler room may have been retained initially, any heating apparatus used by the piano factory would have been generic, rather than specific to the soap industry. In addition, this boiler room was replaced or expanded sometime prior to 1922 and the heating equipment would probably have been removed or modernized. It is therefore unlikely that there would be archaeological evidence of the boiler room apparatus associated with the soap works.

C. CONCLUSIONS

The association of soap works with the Route 9A study corridor is reflective of the relationship between the raw materials (e.g., tallow) and other activities (e.g., slaughter houses) located in this vicinity. The locational information is well represented in the historical atlases and other sources consulted, while information on the technology and economics of soaps is similarly available through text sources. Whereas the buildings themselves might possess interest in their information concerning spatial organization of activities and processes, the building footprints and foundations, whether in dimension or in construction technique, do not appear to have been distinctive. Information on the source and control of heat absent the related equipment specifically associated with manufacture of soap has limited value. Thus, the value of the archaeological expression would appear to be low.

IV. ICE INDUSTRY

A. HISTORICAL CONTEXT

1. Historical Development

There were two considerations in the construction of cold-storage or refrigeration buildings: machinery installed to make the ice, and the insulation of the building to prevent heat loss (Cosgrove 1914:129). The quality of the ice manufactured was based on its clarity and transparency. By the early twentieth century, there were five known methods of achieving clear, transparent blocks or molds of ice: by freezing the water slowly by reducing its temperature; by agitating the water in containers during the freezing process to eliminate air trapped within the ice, which created the opaque or gray appearance; by freezing the water in thin slabs in what was called the wall or plate system; by freezing water in shallow stationary units; and by de-aerating the water before it was poured into the molds or forms in which it was frozen (Wallis-Tayler 1912:485). The last method was the preferred one since it required the least expensive and complex mechanisms, and by the early twentieth century it was the most widespread, particularly where large quantities of ice were manufactured (Wallis-Tayler 1912:485).

Manufacture of the ice required insertion of an apparatus into a container filled with water. The temperature of the water was reduced to below freezing and the resulting ice harvested. Two systems of machines might be employed in the manufacture of ice: brine and expansion. Of these, the latter system was simpler, more efficient, and hence the preferred (Wallis-Tayler 1912:486). There were variations on the two basic systems, which combined aspects of both of them. The simplest was the direct expansion plate system, which consisted of direct expansion zigzag coils to which one-eighth-inch iron plates were bolted. The direct expansion system with still brine was similar except that the coil was immersed in a brine solution. The third approach, the brine cell plate system, consisted of a cell or tank fed by distributing pipes through which the brine was pumped. The brine coil plate system was similar except that brine rather than ammonia was circulated through the coil. Finally, in the block system, the ice was formed on the coils, through which either brine or ammonia was circulated and the ice sliced off the coils by large steam cutters (Harris 1914:451-453).

Factories for producing ice consisted of a series of ice boxes or units in which the water was frozen by one method or another, overhead hoists or cranes for moving blocks of ice within the factory, and thawing or relieving tanks used to thaw the containers in which the ice had been frozen to permit the blocks of ice to be turned out (Wallis-Tayler 1912:518). Figures IV.1 and IV.2 illustrate arrangements within early twentieth-century ice factories. In addition to power required to operate the freezing apparatus, hydraulic or steam platform lifts were installed between floors of ice factories where required, as were run-ways, slip-ways, and gravity hoists. Hand tools required in the operation of the factory included ice-saws, hatchets, hooks and picks, hoisting tongs, and trolleys (Wallis-Tayler 1912:529). In addition to blocks and molds of ice, ice cubes and crushed ice were common products of ice factories (Wallis-Tayler 1912:530, 537).

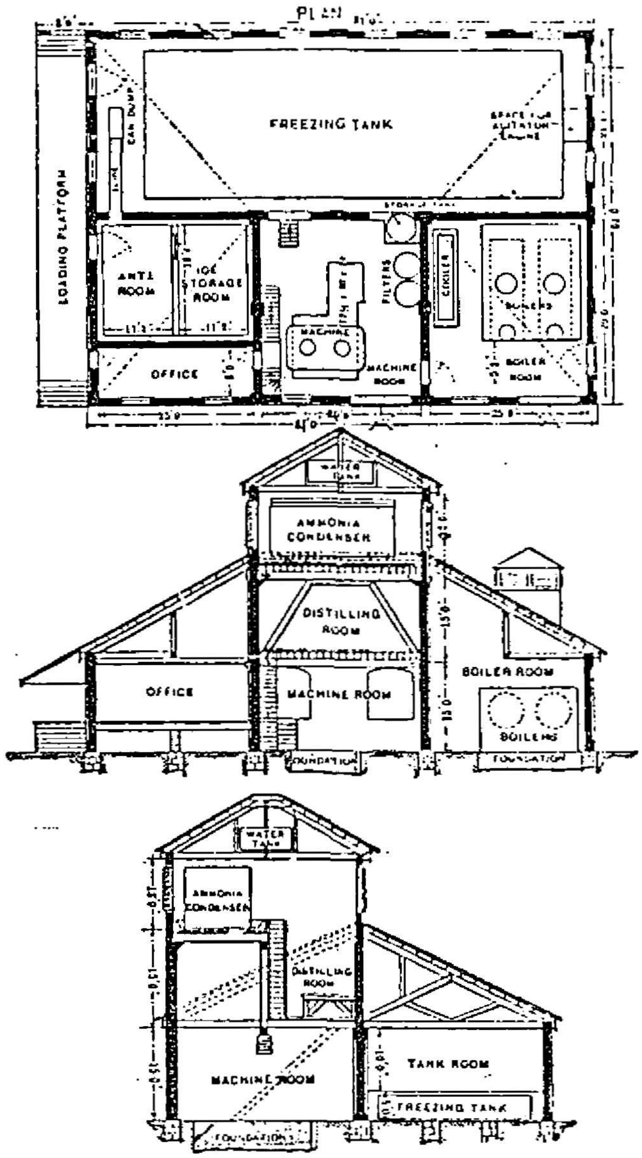


FIGURE IV.1 Plan, Side, and End Elevations of the Frick Company Ice Plant, 30-35 Ton Capacity, ca. 1912

SOURCE Wallis-Tayler 1912:522

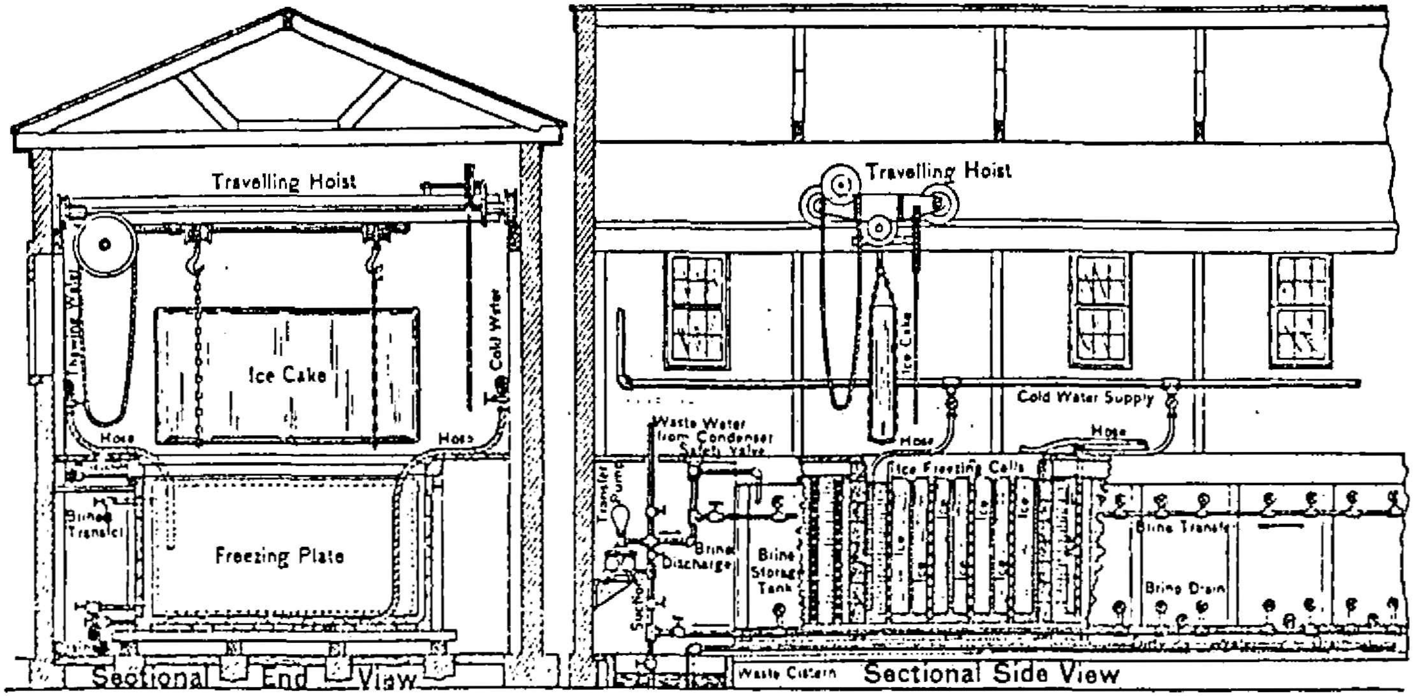


FIGURE IV.2 Sectional Elevations of an Eclipse Ice Plant, ca. 1914 *SOURCE Cosgrove 1914:452*

The construction technique of an ice factory was distinctive since efficient implementation of the process required well-insulated walls, ceilings, and floors. Dead air space was understood by the early twentieth century to be the most effective insulator, and materials used to trap the air included hollow tiles, mineral wool, coal cinders, hair felt, granulated cork, charcoal, and sawdust. Of these, granulated cork and charcoal were the preferred materials because they were not themselves good conductors of heat. Concrete was not widely used as a construction material in the early twentieth century, but it was already appreciated as a good insulator (Cosgrove 1914:139-141).

2. Property Types

The brick building in Block 1097 in which the Hygiene Ice Company Plant was located first appears in 1859, when it was occupied as a malt house. By 1911, the Hygiene Ice Co. building at this location was a five-story brick structure that covered most of the lot at the corner of West 49th Street and Twelfth Avenue (Figure IV.3). The building was removed after 1920.

B. ARCHAEOLOGY

1. Research Potential

The late nineteenth-/early twentieth-century descriptions of ice making indicate that the freezing process was accomplished through distinctive apparatus and equipment, arranged in a systematic fashion. In an urban environment, such as the Route 9A study area, this organization of space was complicated by the need to stack activities and move the process vertically. Thus, the arrangement of platforms, hoists, and other lifting equipment constituted distinctive features together with the freezing apparatus itself. The building for an ice plant functioned as an envelope or container into which the equipment was installed. However, given the climatic controls necessary to the manufacture of ice, as well as the need for access to water, the building had several characteristic engineering and architectural features—namely, specific insulation requirements and plumbing.

Research on early twentieth-century ice plants could address several research questions. For example: Can distinctive engineering and/or construction techniques or materials relating to climatic control and/or water management be discerned in the building? Can evidence of alterations in the ice manufacturing building in the Route 9A study area be discerned, specifically relating to the conversion of this space from a malt house to an ice factory? What physical evidence is there of the organization of space, activities, and labor?

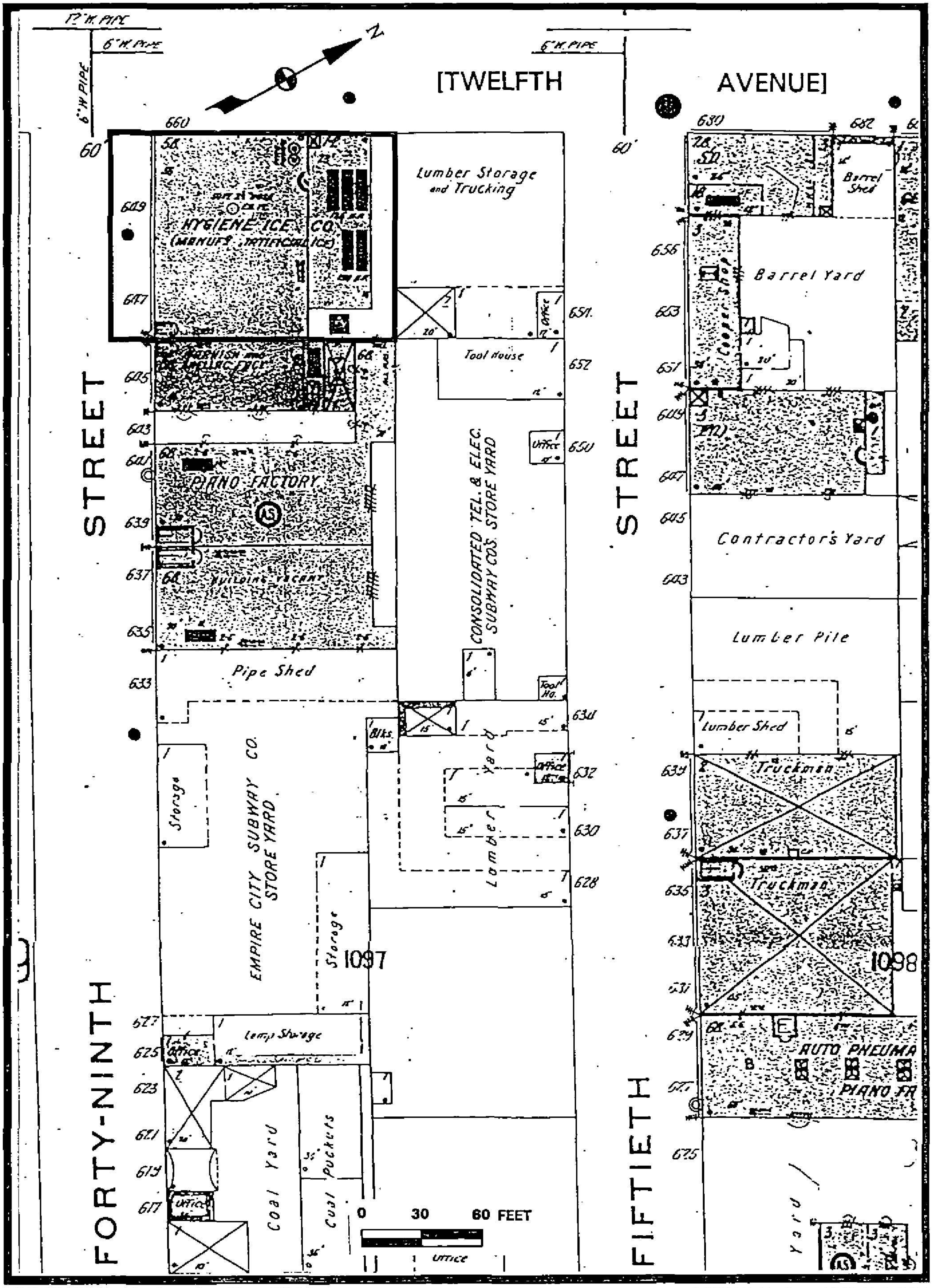


FIGURE IV.3 Hygiene Ice Co., 1911

SOURCE Sanborn 1911 Vol. 5:50

2. <u>Archaeological Visibility</u>

Surviving evidence of the Hygiene Ice Co. building is likely to consist of the structure's footprint and foundation, which either encapsulated or replaced the earlier malt house and covered the entire lot (see Figure IV.3). Since the activities of ice making were conducted at ground level or above, the site would not possess any distinctive archaeological visibility aside from these foundations. When the ice factory was closed down, the apparatus and equipment were almost certainly removed and installed elsewhere or sold as scrap.

C. CONCLUSIONS

One example of an ice factory was represented within the Route 9A study corridor. While the activities associated with the technology of ice manufacture were expressed in portable apparatus and organized vertically, the building itself probably contained distinctive construction features associated with climatic control and water management. Only the dimensions of the building and its foundation may survive, however, with the apparatus used in the manufacture of ice having been removed. The archaeological visibility of this property is negligible and would possess limited research value relating to late nineteenth-century construction techniques and engineering and their adaptation over time.

V. CLAY WORKS

A. HISTORICAL CONTEXT

1. Historical Development

Potters of the mid and late nineteenth century produced a wide range of goods, from tablewares to sewer pipe. There was a corresponding variability in the specifics of the factories depending on the product. The key elements of a pottery of whatever type included the kiln; drying house; storage facilities for raw materials, supplies (e.g., paints, glazes, and fuels) and finished products; systems by which raw materials and semifinished and finished products were conveyed between and within the buildings; grinding plant wherein the crushing machinery was housed; power source; and railroad lines, which were presumed to be the mode of transportation by which raw material was delivered to the plant. The actual configuration of a given plant balanced considerations of drainage, water, markets, product or ware, railroads, and freight rates (Greaves-Walker 1919:182-183).

The railroad companies usually controlled construction of the line or spur that serviced the pottery plant or clay works. It was recommended that curves measure at least 12 degrees and that structures be placed at least 10 feet from the center line of the railroad (Garve 1929:288-289). Raw material was supplied to the works by either flatcar or boxcar, depending on the type of clay, which was selected according to the type of ware produced. The way in which the raw material was shipped affected the type as well as the location of the storage facility. Stoneware and pottery plants, which required low refractory plastic fire clays or synthetic clays, as opposed to brick, which required quartzite, were served by boxcars, which were off-loaded from the top of the car into closed bins. Overhead conveyor systems and cranes were therefore efficient. Clays that were transported like coal via flatcar were off-loaded by hand or shovel from the side, usually with hoppers that funneled the material into temporary, covered storage facilities (Garve 1929:34, 218-219).

In the nineteenth century, foundations for clay-works buildings in which heavy machinery was housed were typically brick and cement mortar. By 1929, concrete or steel reinforced concrete was the preferred material since it was easier and cheaper to use in construction. Where possible, heavy equipment was bolted to pipes embedded in the concrete. The crusher, probably the heaviest single piece of equipment in the works, was placed in an excavated basement so that gravity worked within the process. Raw material was fed down steps or a plane to the machine and the processed clays were withdrawn by elevator (Garve 1929:245-247).

Although nineteenth-century foundations were typically constructed of brick, the superstructures of the buildings were usually timber, with the exception of pottery, tile, and porcelain plants, for which the superstructure was also brick (Garve 1929:249). Surprisingly little attention was given to the buildings in which the manufacturing process was implemented. Rather, construction of the drying house and kiln were the subjects of discussion.

The purpose of the "shell" of the drying house, that is, the roof and walls, was to prevent heat loss, and just as with the study of the engineering of ice plants, increasing interest was focused on methods of insulation. Brick, plaster, and hollow tile, which created dead air spaces, were all recommended and concrete and wood condemned. Foundations of properly constructed drying houses extended below grade to protect the subsurface flues and drainage systems that maintained interior temperature and humidity controls. The interior of the drying house was also equipped with a raised railway system by which wares were moved through the structure. The system was elevated to a height sufficient to allow breakage to accumulate underneath without impairing its function. A vent stack was placed at the cool end of the drying house to provide exhaust. Fans were also substituted for passive ventilation systems. Storage was provided at both the hot and cool ends of the structure (Greaves-Walker 1919:43-47, 57-59).

Kilns were either updraft or downdraft and might be square or rectangular. The principles of constructing the foundation of the structure, while not the physics of the process, were essentially the same regardless of shape or type. The critical feature was the length of the time for burning and the ability to maintain continuous processing, hence achieving greatest efficiency. The standard appears to have been six days or less (Greaves-Walker 1919:79-81).

The first consideration was providing appropriate drainage. Failing appropriate natural drainage, use of a sump was recommended. It was recommended that the kiln bottom be drained to a depth of 10-12 feet by running 4-inch tile drains from 18-24 inches beneath the area of the floor of the kiln. Foundations were to be deep enough to accommodate the weight of the structure as well as the weight of the ware. The bottom of the kiln was designed to provide equal distribution of the gases through flues, good draft, and easy cleaning (Figures V.1, V.2, and V.3; Greaves-Walker 1919:83-85, 111).

Adjacent to the kilns were the stacks, which were linked to the kilns by the main flue (Figure V.4). A single 40-foot stack might serve two to four kilns; rectangular kilns might use single or double stacks. It was recommended that single stacks be built with a physically independent inner lining. This enabled the stack to sustain extreme variations in temperature without damage to the exterior (Greaves-Walker 1919:86-87).

Particularly in the processing of the raw material, the manufacture of brick was in many ways similar to the manufacture of pottery, although the fabrication of the finished product was obviously quite different. A "fire clay," that is, a clay that was appropriate for manufacture into fire brick, was relatively free of impurities. While there was substantial variability in plasticity, density, shrinkage, tensile strength, and color, all fire clays were distinguished by fineness of grain and a relative absence of impurities. Fire brick was used in the construction of blast furnaces, rolling mills, potteries and brick kilns, boiler setting, gas houses, and other industrial settings in which resistance to high temperatures was required by the process (Ries et al. 1904:311, 322-323).

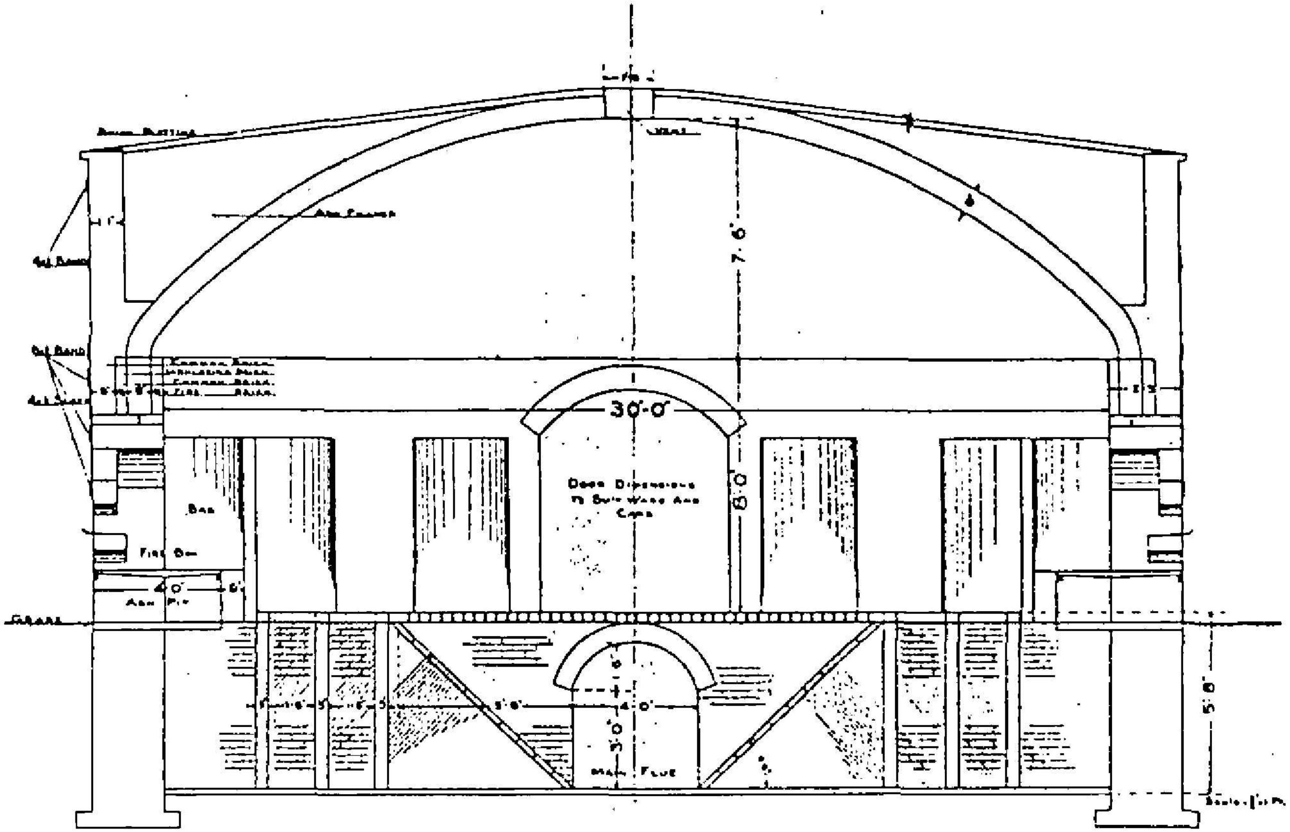


FIGURE V.1 Section of a Thirty-Foot Round Kiln, ca. 1919

SOURCE Greaves-Walker 1919:452

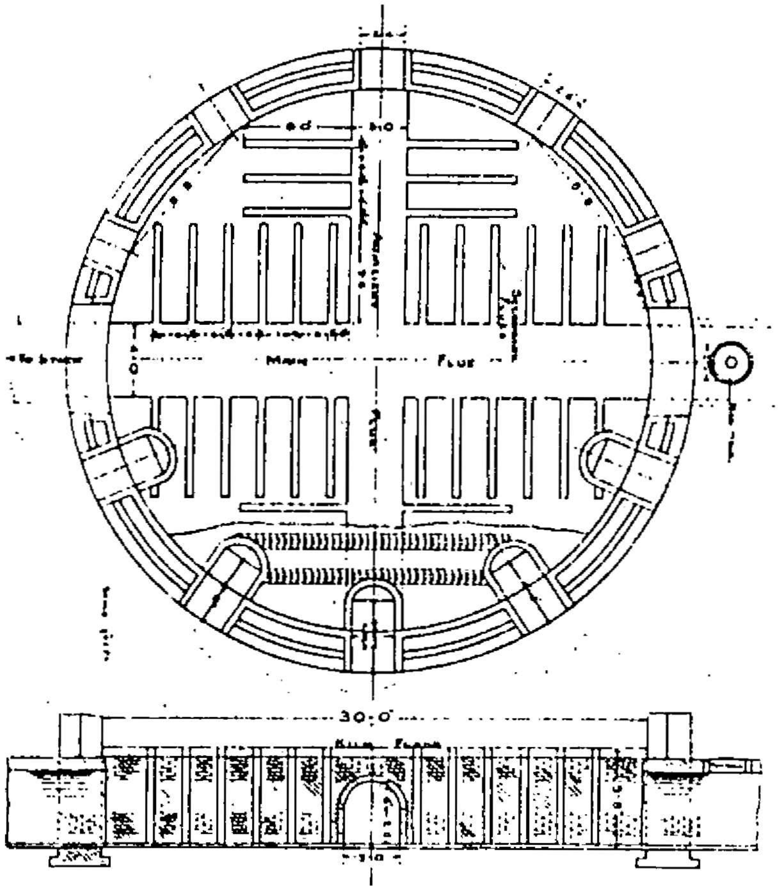


FIGURE V.2 Plan and Section of Bottom of Thirty-Foot Round Kiln, ca. 1919

SOURCE Greaves-Walker 1919:84

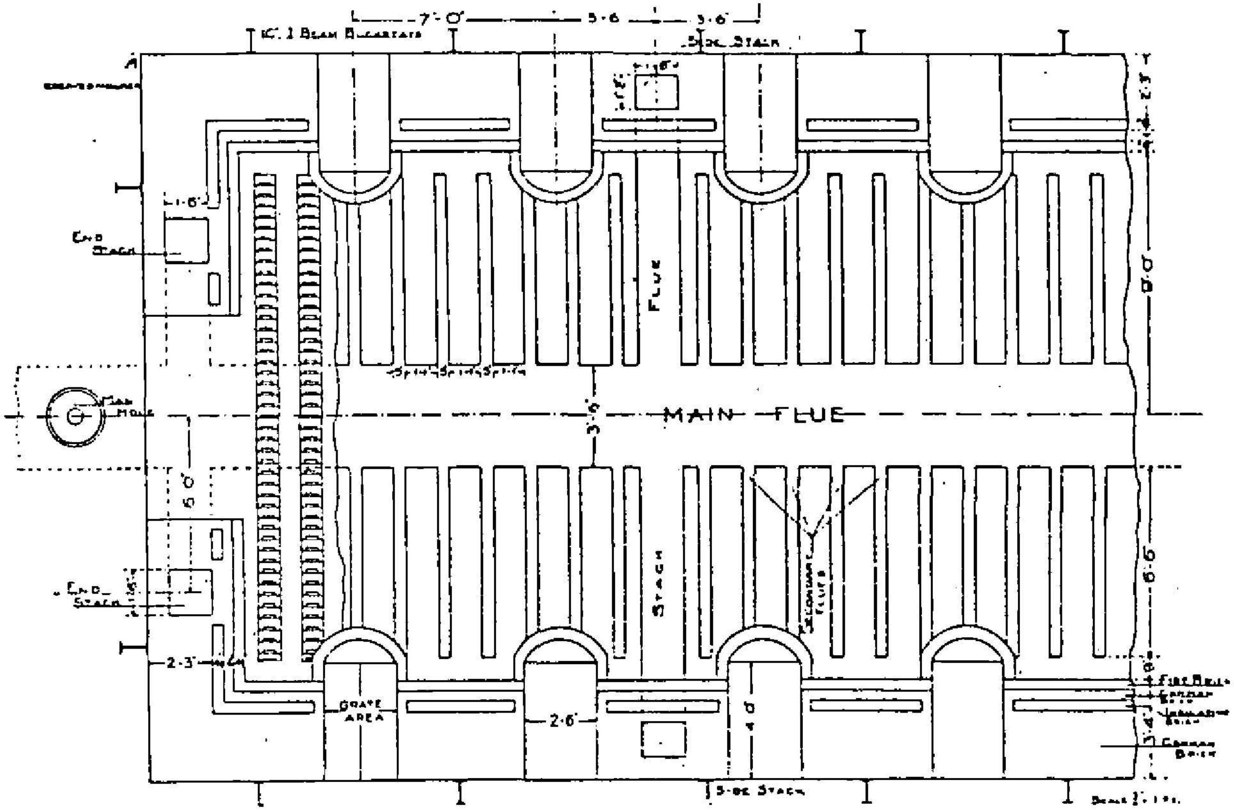


FIGURE V.3 Plan of Bottom of Rectangular Kiln, ca. 1919

SOURCE Greaves-Walker 1919:86

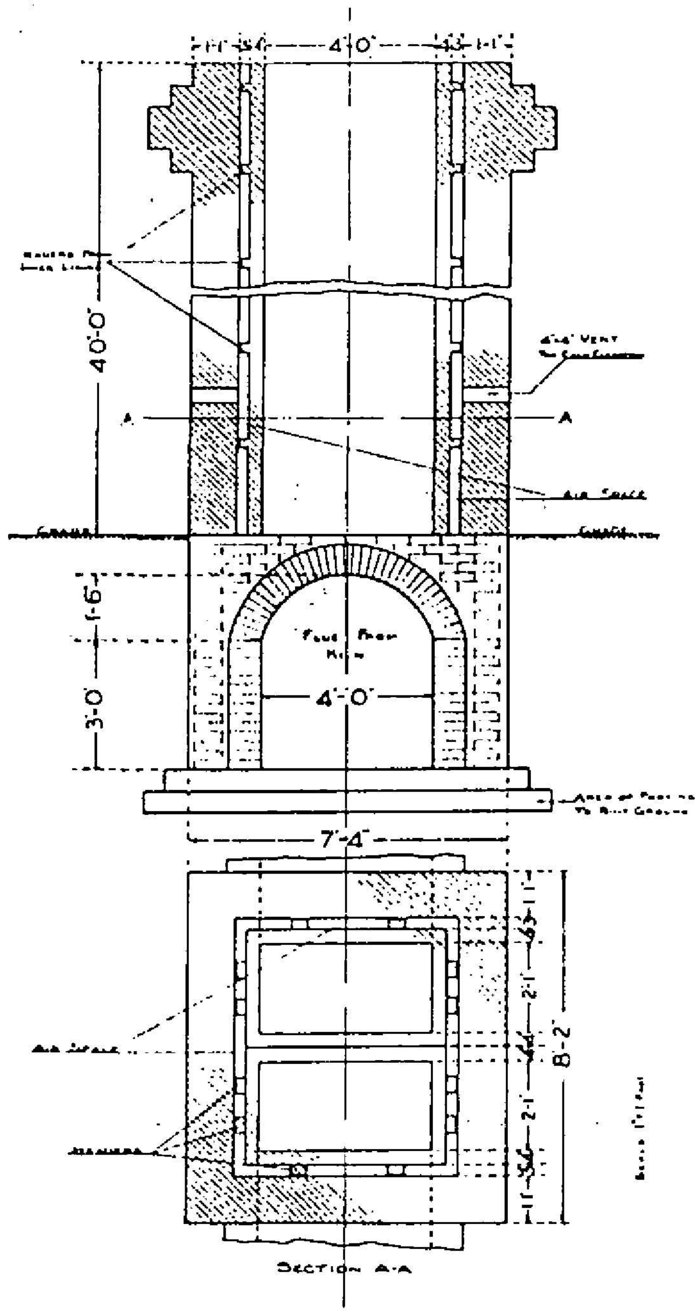


FIGURE V.4 Plan and Section of Two-Stack Kiln, ca. 1919 *SOURCE Greaves-Walker 1919:89*

The first step in the processing of raw clays (or shale) was weathering, which permitted impurities to become more visible or to decompose. Next, the dry clay or shale was crushed in one of three types of machinery: jaw crusher, dry pans, or disintegrator. The dry material might also be put through rollers (Ries et al. 1904:225). Depending on the intended product as well as the composition of the material, the clay might also be tempered or mixed in soak pits, ring pits, pug mills, or wet pans (Ries et al. 1904:226).

Bricks were molded by four methods: soft-mud, stiff-mud, dry-press, and semi-dry-press (Ries et al. 1904:226). Fire bricks were typically molded in soft-mud machines although some works employed stiff-mud equipment or hand labor (Ries et al. 1904:325). In any case, the clay was pressed into long bars, cut into bricks, pre-pressed, dried, and then placed in kilns (Ries et al. 1904:227-230, 325). Bricks were dried in covered yards, tunnels, pallet drivers, and on drying floors, warmed by flues beneath the surface. Kilns might be updraft, downdraft, continuous, or rectangular, although in the vicinity of New York at the turn of the century, the circular downdraft kiln appears to have been the most common (Ries et al. 1904:233-234, 325).

2. Property Types

Within the Route 9A study area, the pottery works between West 18th and West 19th Streets is associated with William D. Stewart, "potter," who first appears in the 1863 city directory at 261 West 18th Street; his residence was located at 114 Ninth Avenue (Trow 1862/63:831). The business last appeared in the 1896 directory (Trow 1895/96:1402). The "works" were located at the foot of West 18th and 19th Streets; offices for the firm were located at 540 West 19th Street and at 312 Pearl Street, where the company maintained a "depot" at the corner of Pearl Street and Peck Slip. This pottery works is shown as the Manhattan Pottery on an 1883 atlas (Robinson 1883:III:1). Interior organization of the pottery is depicted on the Sanborn-Perris plat of 1895 (Sanborn-Perris 1895:III:66 1/2) (Figure V.5).

Only one pottery was listed in New York City's Ward 16 in 1870, and it is believed to correspond to the Stewart company's plant, although the entry identified "Wm. Shuter & Co., pottery" (U.S. Bureau of Census 1870:269). The power was supplied by a steam engine and the plant employed 25 people per year. Three thousand tons of clay was required a year to produce 375,000 feet of "drain pipe." Ten years later, the Stewart company was listed unambiguously (U.S. Bureau of Census 1880:338). The plant, which employed 31 men and 2 children per year, was powered by steam. No details on either raw materials or product were supplied. In 1892, Stewart and Company advertised manufacture of drain and sewer pipe, terra cotta garden vases, and chimney tops (Trow 1891/92:1376).

A property labeled "Salamander Works" was located between Bank and Bethune from 1879 to 1902. This was the office and depot of a Woodbridge, New Jersey, clay manufacturer, established in 1825, that produced fire bricks, sewer and water pipes, and various specialty ceramic products (Clayton 1882:554). The Woodbridge pottery works were located in proximity

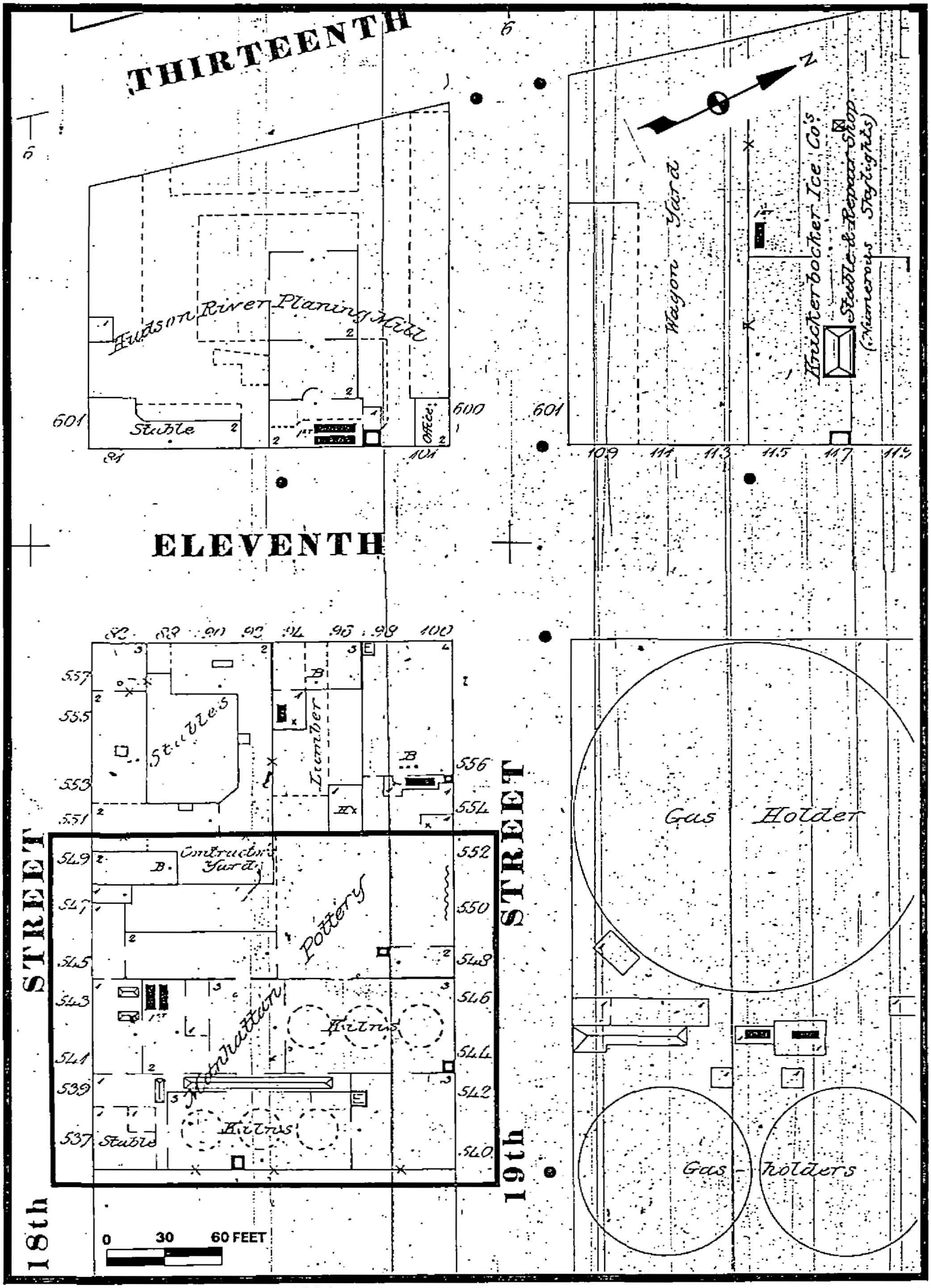


FIGURE V.5 Manhattan Pottery, 1895

SOURCE Sanborn 1895 Vol. 3:56½

to extensive clay sources. No clay manufacturing activities were located at the site in the Route 9A study area.

B. ARCHAEOLOGY

1. Research Potential

Clay works have the potential to convey information relating to the technology of materials processing and manufacture. The distinctive features of this type of works include facilities for storage and handling of heavy bulk raw materials and fuels, management of heat, efficient organization of activities and goods, and installation and maintenance of large, heavy pieces of equipment that differed substantially in weight and manufacture from the smaller, more refined equipment associated, for example, with the chemicals industry. Key to the efficient management of a pottery was transportation of both raw materials and finished products, which most likely accounted for the location of the works near the piers.

Research questions may, therefore, be articulated as follows: What building construction materials and techniques were required to manage temperature control and how was the heat, the application of which was critical to the manufacturing process, conveyed through the works? How were functions, distributed horizontally in relatively expansive suburban and rural settings, managed within urban constraints, given limitations imposed by fuel and heavy raw materials? To what extent was the building itself structurally affected by these needs (e.g., ramps, extensive use of subsurface areas for construction of kilns and flues, permitting heat to rise through the building)? Given limitations in storage capacity, did the process encompass all steps from raw materials to finished product, or was the material received in a semi-processed and hence less bulky form for processing into finished goods?

2. Archaeological Visibility

Archaeological visibility associated with clay works is most likely to consist of building footprints, dimensions, and foundations. The 1895 Sanborn-Perris plat suggests that the Manhattan Pottery works located between West 18th and West 19th Streets, the site of the former William D. Stewart & Co. works, comprised several activity areas (e.g., contractors yard, stable) and contained the kilns within the main building (see Figure V.5). Thus, while the technological processes used in many other industries required apparatus that was organized vertically and within the buildings, the clay works buildings themselves are likely to exhibit distinctive engineering features and forms integral to the technology. In addition to the structural remains of pottery industries, the yards associated with these works may include wasters and other refuse illustrative of the products manufactured. Additionally, contemporary descriptions indicate that conveyors were raised, so that breakage fell below the mechanism but did not impede it. It is therefore likely that wasters and similar debris may have accumulated within the buildings themselves.

The other property within the Route 9A study corridor related to clay manufacturing is the Salamander works, located between Bank and Bethune Streets. This site was an office and depot, i.e., storage facility, for the company's manufacturing plant in Woodbridge, New Jersey. Archaeological expressions of this site may include building footprints and dimensions and possibly broken ceramic products that the firm may have temporarily stored at this location. In contrast to the pottery works at West 19th Street, this site would possess low archaeological visibility.

C. CONCLUSIONS

A pottery had specific engineering requirements associated with the processing of the raw clay as well as the management of heat by which the material was manipulated. Surviving late nineteenth-century plats suggest that evidence of the kilns and their associated engineering may survive within the Route 9A study corridor. The William D. Stewart and Co. Pottery/Manhattan Pottery works, moreover, was sufficiently large so as to exhibit multiple activity sites, not all of which were vertically encased in a single building. Thus, the entire site of the pottery has the potential to contain important information relating to the engineering and organization of an urban pottery works, in which, unlike a rural works, space was constrained. Further research to investigate preservation potential (Stage II research) is recommended at this location.

The Salamander works at Bethune Street was an office, possibly with limited storage for ceramic products that were manufactured in Woodbridge, New Jersey. This site is of less interest from the perspective of industrial archaeology and/or the history of technology. Examples of fire brick and other terra cotta products are well known. While the location of the depot in close proximity to the docks is significant, this information is recorded in the surviving documentary sources. No further archaeological work is recommended at this site.

VI. PAINT/VARNISH/CHEMICAL WORKS

A. HISTORICAL CONTEXT

1. Historical Development

The manufacture of paints and varnishes is associated with a variety of chemical products, such as pigments, linseed oil, and petroleum products (e.g., turpentine). Although for the purposes of this study chemical works have been included in this class of manufacturing, there were many chemical works and chemical products that were unrelated to the paint and varnish industries. For example, one of the most important classes of chemical products from New York City were soaps, the manufacture of which has been described in Chapter III.

The *Report on the Manufacture of Chemical Products and Salt* from the 1880 U.S. Census of Manufactures stated, "Chemical processes and products are, indeed, so intimately associated with nearly all manufactures as to be inseparable, and therefore it becomes a difficult matter to locate accurately the dividing line where manufacturing chemistry ends and purely mechanical operations commence" (Rowland 1880:12). The 1880 report on chemical products indicated that there were 217 establishments in New York State producing chemical products. The value of their products was $29.8 million, which accounted for just over one quarter of the total U.S. production (Rowland 1880:2-3). This enumeration did not include the preparations of drugs, pharmaceutical mixtures, and proprietary medicines, or the production of petroleum products, which appeared in a separate report. While the manufacture of white lead and colors (pigments) was included in the tabulation, grinding and mixing of paints and colors were excluded.

The New York City metropolitan area, described as the area within 30 miles of the city including adjacent states, accounted for 159 chemical products manufacturers with a total product value of $29 million in 1880. Table VI.1 lists the quantities and value of the chemical products included in Rowland's 1880 report. The dominant products were soaps, pigments, manure, ammonia, and sulfuric acid. It is presumed that most of these chemical products were produced in less populated areas outside of Manhattan because of fire and emissions hazards. Most of the chemical manufacturers in Manhattan appear to have been associated with specialty products, such as laboratory chemicals and perfumes.

By the 1920s, the New York City metropolitan area was the country's largest single center for the manufacture of chemicals, with the exception of coke, a coal derivative the manufacture of which was dominated by firms in Pennsylvania. The industry was classified into five groups: heavy chemicals; fine chemicals; petroleum; paints, dyes, varnishes, and inks; and "other" chemical products, which included soaps, fertilizers, glues, and explosives.

TABLE VI.1

Quantity and Value of Chemical Products from Metropolitan New York City in 1880

PRODUCT	QUANTITY	VALUE
Aniline Colors	32,000 pounds	$ 42,500
Anthracene	265,516 pounds	$ 73,650
Sulphate of Ammonia	4,900,000 pounds	$ 188,250
Alum	5,220,000 pounds	$ 100,375
Castor Oil	200,000 gallons	$ 200,000
Stearic Acid Candles	940,000 pounds	$ 150,000
Oleic Acid Soap	1,964,946 pounds	$ 102,874
Other Hard Soaps	82,619,995 pounds	$ 4,128,531
Soft Soap	5,006,390 pounds	$ 37,550
Glycerine	2,190,000 pounds	$ 312,000
Nitro-glycerine	454,990 pounds	$ 338,037
Manufactured Manures	121,605 tons	$ 3,532,652
Dry Colors	16,418,968 pounds	$ 1,695,134
White Lead	28,868,000 pounds	$ 1,725,750
Other Salts of Lead	5,234,360 pounds	$ 292,400
Zinc Oxide	16,774,756 pounds	$ 654,051
Sulphuric Acid	80,731,175 pounds	$ 862,817
Other Products		$ 14,564,223
TOTAL VALUE OF PRODUCTS		$ 29,000,794

Source: Rowland 1880:10-11

Between 1920 and 1922, the number of chemical plants in the greater New York area more than doubled, with the preponderance of growth occurring in the heavy chemicals and in the outer boroughs, New York, New Jersey, and Connecticut. Like the heavy chemical industries, factories producing soap, along with those involved in grease rendering, oil pressing and refining, and the production of varnishes, also tended to leave lower Manhattan. "Such plants as remain in Manhattan," an analyst commented, "are chiefly west of Broadway" (New York 1928a:16). The principal exception to the general migration of the chemicals industries from Manhattan was the expansion between about 1910 and 1920 in perfumes and cosmetics manufacture, industries which developed in Manhattan south of 59th Street. Most of these were very small plants of fewer than 20 employees, and most were located, along with small factories producing paints, inks, and dyes, east of Broadway and south of Park Row and the approaches to the Brooklyn Bridge (New York 1928a:15-16).

Despite the variability of products within the industry, siting a chemical plant required consideration of several common factors. These included need for large spaces (for which the configuration of city blocks was unsuitable), fire hazards and generally noisome environmental conditions, relatively modest labor requirements, costs of transportation, and the predominance of consolidated or large interests (New York 1928a:12-13).

Sulfuric acid, which was produced in quantity in New York City, was one of the most important industrial chemicals. It was used for making dyes, drugs, explosives, and fertilizers, in metallurgical processes, and in the refining of petroleum. Sulfuric acid was commercially manufactured by burning sulfur to form sulfur dioxide. The gas was then purified, washed and dried, and then oxidized at 450° C in the presence of a catalyst, to sulfur trioxide. The trioxide was then absorbed using concentrated sulfuric acid and diluted with water to the desired strength. A relatively dilute acid could also be produced by combining sulfur dioxide, oxygen, water vapor, and oxides of nitrogen in a large lead chamber (Bridgwater and Kurtz 1963:2065).

Manufactured manures in the late nineteenth century were dominated by mineral phosphates (Rowland 1880:16). These were produced through the mining of guano deposits, common in the Pacific region and the West Indies, and various phosphate-rich rocks, including apatites found in New York and New Jersey (Wiley 1895:177). Many of the fertilizer companies with offices in New York City represented shippers and suppliers of these products, which would have been produced near the mining locations. This was especially the case with companies such as Clark's Cove Guano Co., Mapes Formula and Peruvian Guano Co., and Pacific Guano Co. (New York Agricultural Experiment Station 1894), which specialized in imported guano.

As stated above, the major chemical products from New York City, aside from sulfuric acid, manufactured manures, and hard soaps (described in Chapter III), were pigments, dominated by white lead and zinc oxide (see Table VI.1). Aside from these two widely used white pigments, there were other inorganic pigments that included red lead (lead oxide), vermillion (mercuric sulphide), and chromium green (chromium oxide). Other pigments included the lake pigments made by mixing some animal or vegetable coloring matter with an inorganic base, usually alumina.

White lead, a colorless substance with great opacity, is a double compound of carbonate and hydrate of lead [$2PbCO_3 \cdot Pb(OH)_2$] (Hurst 1913:68). Although the health hazards of exposure to white lead had been commonly recognized since the mid-nineteenth century (Condit 1883:176; Hurst 1913:100), it was not until the 1970s that the use of lead paint for most purposes was curtailed. The white lead industry in the United States dates to circa 1777, when Samuel Wetherill established a factory in Philadelphia for the manufacture of chemical products (Holley 1909:15). Wetherill & Sons were importers and dealers in dye stuffs, various chemicals, and white and red lead. Companies manufacturing white lead in New York City at the turn-of-the-century included the National Lead Company ("Dutch Boy" label), which owned the Atlantic White Lead and Linseed Oil Works, Bradley White Lead Works, and Brooklyn White Lead Works.

The most ancient method of preparing white lead is the so-called "Dutch process" or stack corrosion. In this process, lead in the form of coils or gratings is stacked up over pots containing dilute acetic acid or vinegar and imbedded in fermenting horse dung. The heat from the fermenting dung causes the acid to vaporize and, in the presence of carbon dioxide, causes the lead to corrode. This corrosion is white lead, which is then scraped from the uncorroded metal, ground, and then washed (Hurst 1913:69-76; Parry and Coste 1902:78). The production of white lead by the stack process was typically performed in a small brick shed, about 16x13 feet and 20 feet high, or series of attached sheds.

Paint was manufactured by two methods—paste and liquid—in the late nineteenth century, and these processes continued to be used, with some improvements in machinery, through the early twentieth century (Bannon 1897; Cameron 1886; McIntosh 1899, 1908; Sabin 1917). Both the paste and liquid methods employed free-standing machinery (Figures VI.1 and VI.2) that was manufactured off-site and installed as needed (Toch 1925:6). The plant buildings used by paint and varnish manufacturers do not appear to have had special structural requirements.

In the paste method, the raw material was mixed with linseed oil to yield a heavy paste. The tint was added during this first step. The paste was then drained into a stone mill and ground. From the mill, the mass was funneled into a cooling trough and then stored in barrels to be thinned at a later point in the process. In the continuous paste method process, the paste was thinned immediately after grinding. Rather than cooling in the cooling trough, the material was fed into a mixer into which oil, thinner, and drier had been placed. A sample from the liquid mixture was compared with the standard and the color adjusted as needed. Once the color was correct, the liquid was packaged (Toch 1925:6).

Paints of lower specific gravity, namely, varnish and floor paints, were made by the liquid method. Essentially the reverse of the paste method, in this process the liquid and pigment were mixed on an upper floor and drained into the floor below into a liquid mill. From the liquid mill, the fluid was poured into containers (Toch 1925:8).

As previously mentioned, the method of manufacturing varnish was similar to the liquid method of producing paint. Materials used in the manufacture of varnish included resins, oils, and

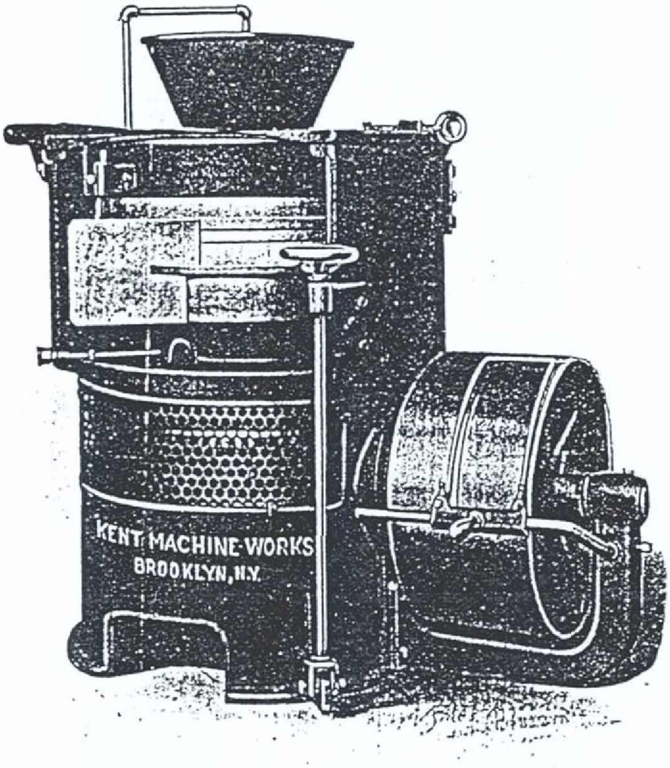


FIGURE VI.1 Mill for Paste Paint Grinding, Manufactured by the Kent Machine Works, Brooklyn, NY, ca. 1925 *SOURCE Toch 1925:7*

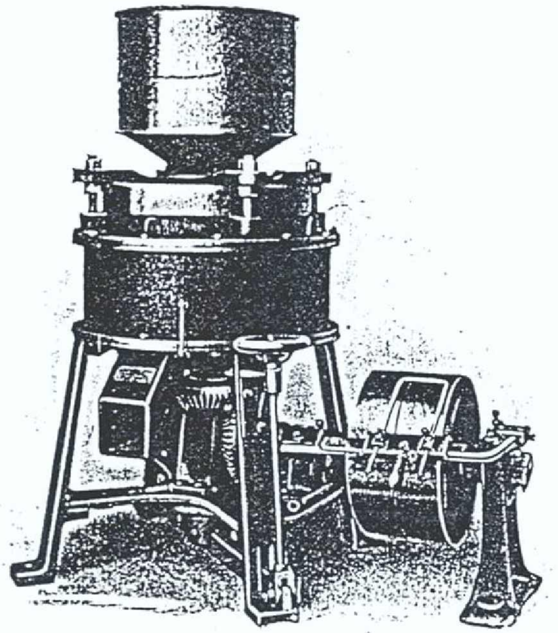


FIGURE VI.2 Standard Liquid Mill for Paint, Manufactured by the Kent Machine Works, Brooklyn, NY, ca. 1925

SOURCE Toch 1925:9

turpentine or benzine as well as lead and manganese compounds. The process differed in that the heat was applied to the mixture to achieve the desired chemical change. In this sense, it was similar to a distilling rather than a mixing process. Varnish factories were distinguished, therefore, by the presence of a furnace and boiling/heating apparatus, namely, the boiling kettle (Sabin 1917:121).

Varnishes were made by boiling resins with linseed oil, and then diluting the mixture with turpentine or another petroleum spirit (Bannon 1897:2, 176). Bannon (1897:177-182) describes six stages in the process used to manufacture varnish in the late nineteenth century. These were: 1) melting the resin, referred to as gum running; 2) boiling the [linseed] oil; 3) mixing the melted gum and boiling oil; 4) boiling the mixture; 5) thinning the boiled varnish; and 6) clearing. The first step, gum running, was done in large cylindrical copper vessels that held from 8 to 50 pounds of gum or resin. These pots were moved around a varnish manufacturing plant by placing them on wheels or fixing them onto rails. It was also necessary to fit each pot with a hood connected to a flue in order to carry away noxious vapors produced in this process. The linseed oil was boiled at 500° F for 1 to 2 hours and after mixing with the gum/resin was boiled again for 4 to 5 hours at a similar temperature. To thin the mixture, the contents were mixed with turpentine; this procedure had to be done away from fire, typically outdoors or in a shed. The final step, clearing, was accomplished by aging the product for 6 months to 2 years. Figure VI.3 illustrates the sorting and cleaning of resins in a top floor of a nineteenth-century varnish factory and Figure VI.4 is a section and elevation from a similar varnish factory showing the open furnace and required ventilation system used for heating resins.

The systems to make both paints and varnishes relied heavily on manufactured equipment that was then installed in the plant. The arrangement of the various apparatus within the factory was designed to take advantage of both gravity and the state of the material. Thus, the process was begun at the top of the plant and the paste or liquid drained from one step to the next (Figure VI.5). One-story paint factories were considered inefficient; different heights were achieved by elevating the various pieces of equipment on platforms (Figure VI.6) and moving the storage tanks on castors (Toch 1925:10-17).

A plan and an elevation of a varnish factory are illustrated in Figure VI.7. Although the different types of varnishes required different proportions of resin, oil, and turpentine, the steps were essentially the same (see Sabin in Bottler 1912:160-161; Sabin 1917:113). The resin was melted in the varnish kettle, which was wheeled into the varnish chimney. After the resin had melted and the resulting vapor discharged, the kettle was removed from the heat. Linseed oil was added and the mixture stirred and returned to the fire. When the resin and oil had cooked sufficiently, the kettle was wheeled into a cool, well-ventilated room where turpentine was added as a thinner (Sabin 1917:112-119).

The organization of space in chemical works probably varied with the types of materials that were manufactured. There were, however, several attributes that were common to well-designed chemical factories. These included access to transportation, supporting workshops, drainage, foundations, retaining walls, and fire prevention and control (Dyson and Clarkson 1912:18-25).

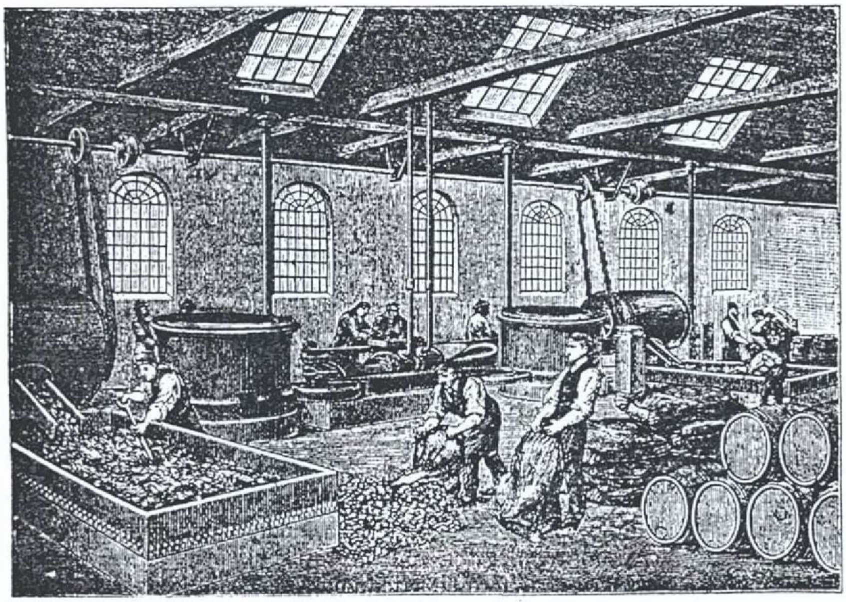
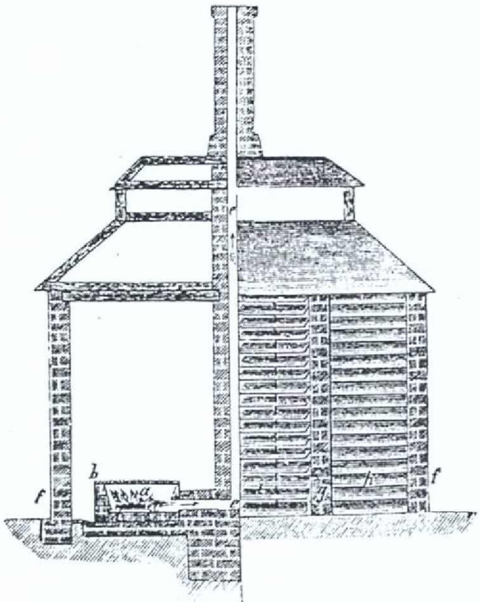


FIGURE VI.3: "Gum" Washing in a Varnish Factory *SOURCE: McIntosh 1908:89*



a, furnace; c, chimney stalk; f, retaining walls of ventilators

FIGURE VI.4: Varnish Factory Section and Elevation *SOURCE: McIntosh 1908:99*

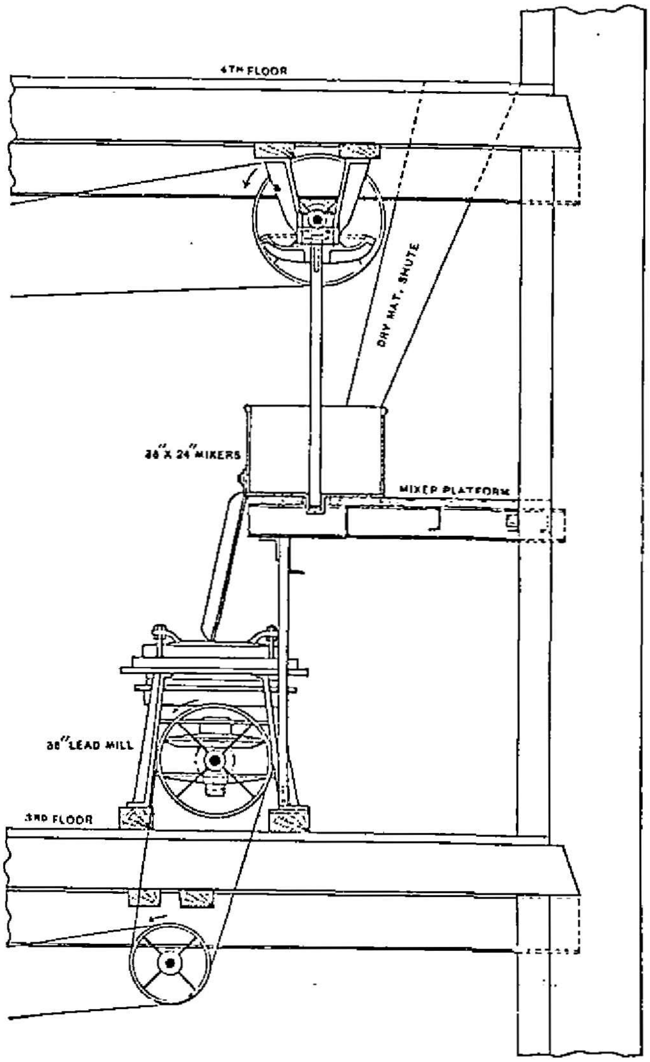


FIGURE VI.5 Configuration of Equipment within a Multi-Story Paint Factory, ca. 1925

SOURCE Toch 1925:16

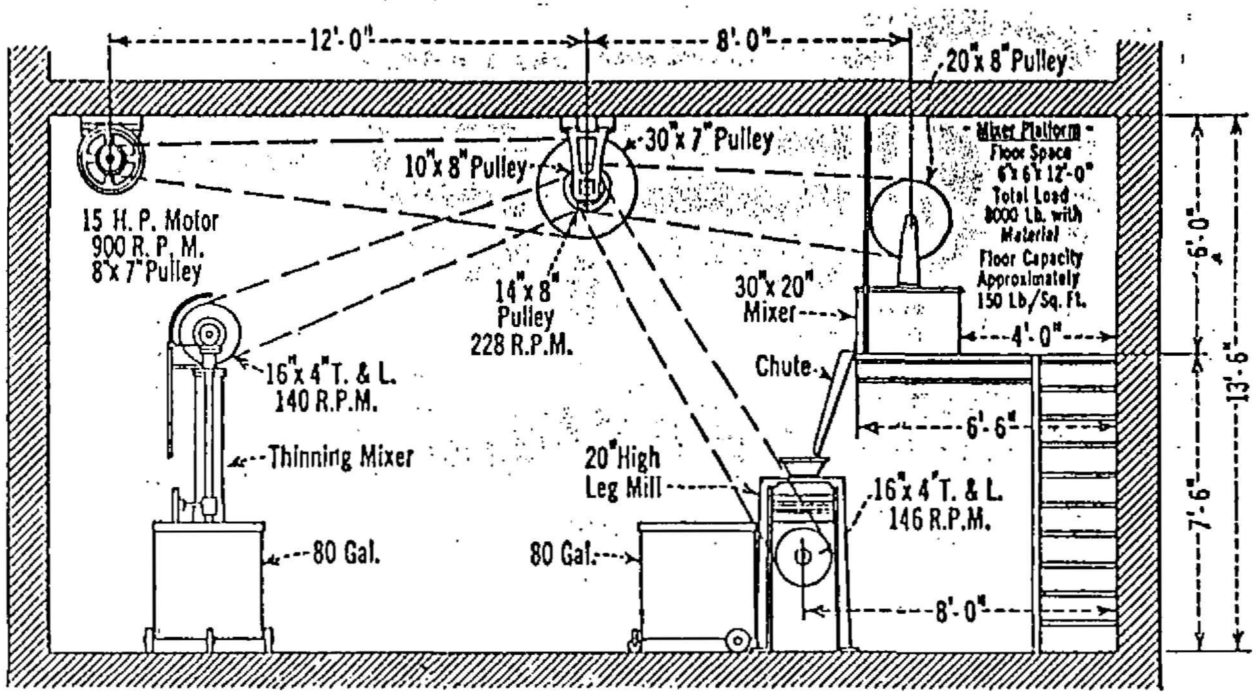


FIGURE VI.6 Configuration of Equipment within a One-Story Paint Factory, ca. 1925

SOURCE Toch 1925:17

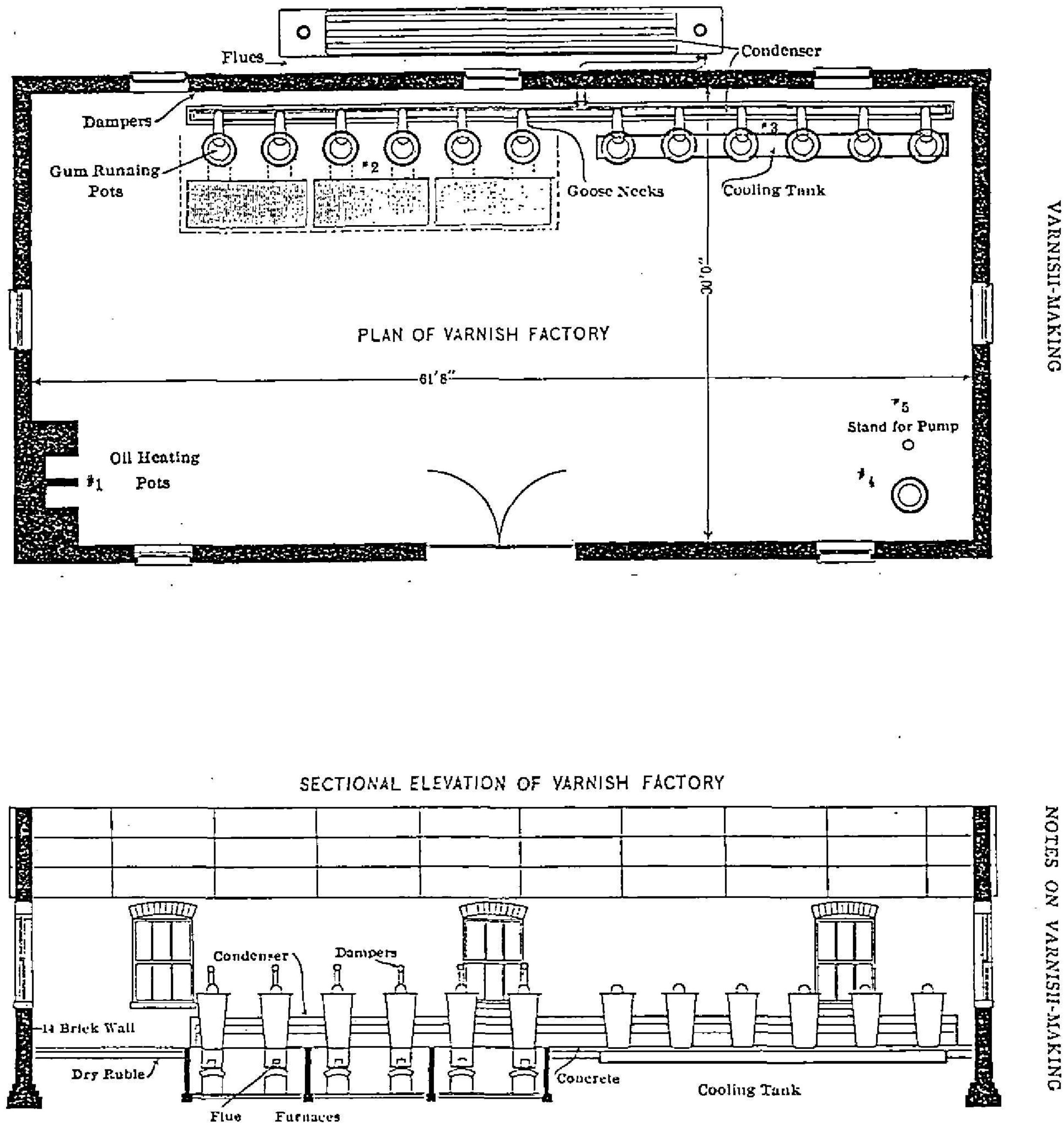


FIGURE VI.7 Plan and Section Elevation of a Varnish Factory, ca. 1912 *SOURCE Bottler 1912:162-163*

Principal among these in the siting and configuration of the plant was access to transportation. Water transport was preferred when raw materials were required since water was less expensive than rail systems. Even where raw materials were delivered by water, however, access to the railroad either directly or on a spur was recommended as were two-lane roads suitable to sustain cart traffic. Located near the wharf or railroad spur were the power house, storage facilities for raw materials and fuel, areas for disposal of ash and clinkers, and those process buildings in which large quantities of raw materials were used. The remaining process buildings were distributed as needed in such a manner as to ensure efficient movement of partially finished material from one step to the next and ending up with the finished product at the storehouse or loading dock from which it was shipped out of the plant. In general, buildings related to the process were kept separate from buildings used as storehouses and buildings in which the supporting crafts (e.g., blacksmith, plumber) were housed. An internal tramway and overhead crane system were also recommended.

2. Property Types

The Brooks & Company varnish factory is represented by Sites 56 and 299, located at the northwest corner of the intersection of Little Twelfth Street and Jane Street (Blocks 649 and 650). Clarence Brooks & Company, manufacturers *of varnish, first* appears in the 1863 New York City directory (Trow 1862/63:110). The business was then located at 384 West 12th Street; Brooks's residence was located at 11 Charles Street. The business expanded in 1891 to include an addition at 490 West Street (Trow 1890/91:162). The last entry for the company appears in 1896 (Trow 1895/96:173). The original Brooks & Co. factory (Site 299) appears on the Bromley 1879 atlas and the factory extension (Site 56) is shown on the Robinson 1885 atlas (Hartgen Archeological Associates, Inc., and Historical Perspectives, Inc. 1990b:VI-84). The 1895 fire insurance map (Sanborn-Perris Map Company 1895:3:61) shows the Brooks & Co. varnish factory to have been a five-story brick building, described as a "storehouse," which suggests that the processing works had been relocated by this date.

The company is reported in both the 1870 and 1880 federal censuses (U.S. Bureau of Census 1870:1441; 1880:212). In 1870, the business was listed under the name of Brooks and Fitzgerald. The varnish works employed 16 people and required gum copal, linseed oil, turpentine, and fuel to produce 1,500 barrels of varnish a year. Ten years later, the firm appeared under the name of Clarence Brooks and Company, which employed 17 men. No details on power, raw materials, or product were provided.

The first entry for Marchand & Company Chemical Works occurs in 1883 when the city directory noted "Marchand, Charles & Co., *chemists*" at 513 West Street; Marchand's residence was at 20 East 16th Street (Trow 1882/83:1113). The following year, the firm occupied premises at 47 1/2 West 3rd Street and the west corner of Horatio (Trow 1883/84:1156; i.e., Block 650). The last entry in the city directories for this firm dates to 1886, when the company was reported at 10 West 4th Street (Trow 1885/86:1291). Marchand & Co. Chemical Works (Site 307) was shown on the 1885 Robinson atlas. The Sanborn-Perris Map Company

(1895:vol.3:61) plat, which only exhibits a portion of the block west of West Street, nonetheless, does show the chemical works building. It was a six-story brick structure that covered the entire building lot and was served by an alley that extended south from Horatio Street.

An unspecified "chemical works" (Site 286) also appears on Block 648 and an anonymous paint works (Site 310) on Block 650. The chemical works is associated with a shed that appears on the Bromley (1879) atlas between Bank and Bethune Streets, and appears to have been removed within six years (see Hartgen Archeological Associates, Inc., and Historical Perspectives, Inc. 1990b:VI-70). The paint works was located at the southwest corner of the intersection of Gansevoort and West Streets. A brick structure, it was removed by 1902 (Bromley 1879:10; Hartgen Associates, Inc., and Historical Perspectives, Inc. 1990b:IV-136). The Sanborn-Perris Map Company (1895:3:61) describes the works as a series of three narrow five-story brick structures facing Gansevoort Street, which wholly covered the lots. Interior lighting appears to have been provided by skylights. These sites may have been extensions of the previously described Brooks varnish works and Marchand chemical works.

B. ARCHAEOLOGY

1. Research Potential

The development of chemical works parallels advances in chemical engineering. Increasingly sophisticated apparatus was designed to yield desired compounds and/or eliminate impurities or toxic solutions. Avenues of research include the history of chemistry itself, development of chemical apparatus, and control of the industrial environment, particularly safety. Many chemical reactions were understood to be highly unstable, creating hazards related to fire, explosions, and contact with toxic chemicals and by-products. The response by the industry to these potential hazards ranged from modifying the construction of manufacturing plants to paying greater attention to working conditions and safety (cf. Vilbrandt 1934).

In rural settings, the construction of buildings in which chemical apparatus was installed progressed toward increasingly insubstantial construction so that debris resulting from localized explosions would have minimal secondary impact. Studies of the Laflin Rand/DuPont Smokeless Power Works in Haskell, New Jersey, demonstrated that chemical apparatus was housed entirely above grade in deliberately flimsy buildings so as to reduce the damage from inadvertent explosions and fires that routinely occurred at these and similar petrochemical plants. The archaeological evidence of this type of plant consisted of a series of widely dispersed concrete pads and the footings for overhead tram systems (Louis Berger & Associates, Inc. 1987). Large manufacturers such as DuPont offered worker housing as a means of both controlling the labor force and isolating the industrial community from hazards (Louis Berger & Associates, Inc. 1987). In New York, however, various commentators noted that one of the appeals of siting a plant in the city was the proximity of working class neighborhoods, thus relieving employers of the need to provide housing for their labor force. Questions relating to the material culture of the work force and efforts to encourage safe practices among employees would therefore not arise. In addition, buildings in an urban setting, such as New York, would have been constructed with different safety and fire considerations than rural plants which were isolated from concentrations of buildings and population.

Research questions appropriate to the study of urban chemical plants would include the following: What was the organization of activities and labor within the plant? How did developments in engineering technology and chemistry affect the equipment and apparatus and how did this alter labor needs? How did increasing understanding of hazards (explosions from volatile reactions, fire) affect the distribution of activities within the building and affect construction techniques?

2. <u>Archaeological Visibility</u>

Paint, varnish, and chemical works would not be expected to have left much in the way of manufacture-specific architectural remains or features. Varnish factories might be associated with furnace remains; however, these furnaces might be indistinguishable from those found in metal works or soap factories. Like these other manufacturing plants, paint/varnish/chemical works would have been constructed of fire-resistant materials. The organization of activities in these structures was vertical, with apparatus contained above grade on several floors and/or platforms. The archaeological visibility of these works would therefore consist primarily of building footprints and dimensions, expressed as foundations. Chemical residues may be present from such activities as the production of inorganic pigments (white lead, for example) and the processing of resins; however, corrosive chemicals would have been neutralized before disposal in sewer or septic systems and would not have left identifiable traces of chemical products or processes.

C. CONCLUSIONS

The siting of the various paint/varnish/chemical works on the periphery of Manhattan suggests the transition to increasingly noisome industries with which petrochemical processing was associated. This information on the history of land use is well documented in historical maps and atlases. Similarly, the history of engineering technology as expressed in the various and specialized apparatus would be investigated through examination of the equipment, which is unlikely to have remained at sites within the Route 9A study corridor. At the Laflin Rand/Smokeless Powder Works in Haskell, New Jersey, for example, the apparatus was completely dismantled and moved to new works when the Haskell plant was closed (Louis Berger & Associates, Inc. 1987). Moreover, given the emphasis on safety issues, chemical and similar plants were carefully policed so that litter would not contribute to unsafe working conditions. Thus, evidence of the technology is unlikely to survive within the Route 9A study corridor. Finally, the buildings themselves were perceived as containers within which the equipment was installed. While there were specific requirements made of these buildings, the principal expression is likely to have been above rather than below or at grade level. The possible archaeological remains, such as building footprints and dimensions, already recorded on surviving historical maps and atlases, therefore, would be likely to contain little new or significant information.

Depending on the type of substances processed or produced at these manufacturing sites, the possibility of contaminants or hazardous materials should be considered prior to any archaeological investigation.

VII. METAL WORKS

A. HISTORICAL CONTEXT

1. Historical Development

When viewed from the national perspective, "New York," an analyst concluded in 1928, "cannot claim to be the metal center of the country" (New York 1928b:14). Metals were divided into four groups: heavy or bulky products, including items such as water heaters, stoves, machinery, boilers, elevators, wagons, heavy chains, and metal ceilings; technical instruments, such as typewriters, vacuum cleaners, fixtures, electrical and surgical instruments, apparatus, scales, clocks, and cameras; repair work and small finished metal products, such as metal plating, small castings, and machine-shop welding and forging; and jewelry and precious metals (New York 1928b:15). Between 1900 and 1922, the metals manufacturing in the region shifted away from the heavy metals to "one in which the light branches predominate" (New York 1928b:17).

Within the region, the number of plants in Manhattan south of 59th Street increased by 101.6 percent, with an increase of only 11.8 percent in number of employees, suggesting an increase in the number of small shops. In contrast, the number of plants in the borough of Queens grew by 1,497.1, percent, with an associated increase of 272.1 percent in the number of employees (New York 1928b:17). The most interesting trend south of 59th Street, the author observed, was "the radical loss in the plants making heavy and bulky products" (New York 1928b:18). This loss was partially offset by the development of automobile repair and maintenance shops in the vicinity of 59th Street (New York 1928b:18). There continued to be establishments representing all four groups of the metal industry on the west side, including a small concentration north of West 23rd Street and west of Tenth Avenue (i.e., in the general vicinity of the Route 9A study corridor), but it was modest in comparison with developments elsewhere in the city and region (New York 1928b:21).

Industries within the project area associated with metals included iron, tin, and lead in addition to a machinist's shop. Given the complexity of both the chemistry and the engineering of metallurgy, each group is described separately.

a. Iron and Steel

The key to understanding the science underlying the development of iron processing and the various finished and semifinished iron products that resulted from the different technologies is the amount of carbon contained in the product and the form that it took. Iron oxide ores are compounds of iron and oxygen. When heated with charcoal, the oxygen combines with carbon, allowing the metallic iron to precipitate out (Chard 1986:1). Also important to understanding the different technologies is the temperature to which the ore was heated, the condition of the iron when the ore was decomposed, and the ductility of the resulting material.

The oldest way of processing iron from iron ore was the bloomery method. The ore was simply combined with charcoal in a hearth, heated by a fire which was fed by a bellows. The oxygen was removed, and the iron accumulated as "hot pasty particles which were agglomerated by the operator into a lump of iron" (Chard 1986:2). "Bloomery" iron was low in carbon, very ductile, and easily crafted by a blacksmith. In the later nineteenth century, plants that used the old bloomery process, in which the temperature was never high enough to melt the iron, were known as forges (Chard 1986:11).

Blast furnaces had been introduced in the fourteenth century. Iron ore and charcoal were loaded into the top of a furnace while a blast of air was pumped in at the bottom by a water-powered bellows (Chard 1986:3). Later, crushed limestone was added as flux. The product was known as "pig" or "cast" iron and contained a relatively high amount of carbon, which the molten iron absorbed as it worked its way down through the charcoal in the furnace. As a result of the carbon content, the pig iron was quite brittle. Although it could be cast in the sand into final products, known as hollowware, it required a second processing, called "fining," to be rendered to a form capable of being worked by blacksmiths (Chard 1986:4-5).

The nomenclature of the reprocessing of pig iron became somewhat confused. According to Chard (1986:11), plants that remelted scrap or pig iron in charcoal hearths to produce low-carbon, forged bars or "blooms" were called "bloomeries" while the old-style works that continued to use the charcoal hearth technology to manufacture refined iron directly from the ore became known as "forges." Lewis (1976:14) observes that colonial-era forges and bloomeries contained similar equipment and produced the same product, although the forge was typically larger and its equipment more powerful. Unlike Chard, however, he notes that the purpose of the forge was to convert pig into wrought iron.

Swank (1884:107), a late nineteenth-century analyst of the iron industry, who wrote the report on iron and steel for the Tenth Federal Census (1880), used the terms interchangeably to describe the charcoal-fueled forges of the Champlain district. In 1883, he reported that "27 forges, or bloomaries" in this district produced 43,911 tons of "blooms," by which he meant iron refined from ore on forges equipped primarily with water-powered trip hammers (Swank 1884:107). The American Iron and Steel Association (AISA), on the other hand, defined bloomeries as "works which hammer blooms from pig or scrap iron" and forges as "works which make wrought iron from ore." The works in the Lake Champlain district, some of which called themselves bloomeries, or which, by their own report, produced blooms, were all classified as forges by the association (AISA 1880:168-170, 175).

Antebellum furnaces were either hot- or cold-blast, based on the temperature of the air forced into the furnace. Although hot-blast furnaces were much more efficient, cold-blast remained the preferred technology because it had been observed that furnaces yielded better iron in colder months. It was ultimately discovered that this was the result of drier conditions and not a function of temperature (Chard 1986:5-6). The technological innovations of the mid-nineteenth century in the industry as a whole included the successful use of mineral fuel, integration of steam engines in addition to or in lieu of water power, and the invention of Bessemer and Open Hearth steel processing, which made possible large-scale production of low-carbon structural steel (Chard 1986:17).

The technology of steel and iron advanced rapidly in scale and complexity in the second half of the nineteenth century and is fully explored by histories of technology (see, for example, Hogan 1971). In its simplest terms, the development of the Bessemer processing in addition to other technological innovations, exploitation of bituminous coal deposits in Pennsylvania and Michigan, and discovery of major iron deposits in Minnesota's Mesabi Range in 1892 resulted in the consolidation of the American iron and steel industry in Chicago, Cleveland, Youngstown, Pittsburgh, and Buffalo around 1900. New York State had ranked third in the nation in production of pig iron in 1860 and fourth in production of rolled iron. In 1880, New York was still a major iron- and steel-producing state, ranking third behind Pennsylvania and Michigan. Within New York State, the industry was dominated by the Albany and Rensselaer Iron and Steel Company of Troy. Most of the remainder of the state's production came from the Lake Champlain area and the Hudson Valley. After 1880, New York was overtaken by production capabilities in Tennessee and Virginia. By 1900, however, the production of New York, Tennessee, and Virginia collectively was less than that of Illinois, which ranked third after Pennsylvania and Ohio (Hogan 1971:I:57, 212).

The metals-related industries associated with the project area do not appear to be related to initial processing or reducing of iron or the manufacture of steel. This is not surprising since plants established for those purposes were sited close to the sources of raw materials, balancing the costs of shipping both the iron ore and the high-bulk, relatively low-cost coal. The two defining elements of these plants were the furnace, from which pig iron was produced, and the rolling mill in which semiprocessed pig or bar iron was converted into rails, plates, and other products. Given the demand for these and similar finished products, it is not surprising that rolling mills were located in New York City.

The purpose of the rolling mill was to generate sheets of iron or steel, the dimensions of which varied by the given product for which the material was intended. The key feature of the rolling mill was the train of rolls, which were composed of roll stands. The roll stand consisted of a frame, or housing, holding at least two parallel cylinders, or rolls (Kindl 1913:9). If the rolling mill was contained in a larger plant, then the iron or steel, processed in a furnace, was reheated in a furnace until it was soft and then passed through the rolls until the sheet had obtained the desired characteristics. In a reversing mill, two rolls were set up one above the second. After the material had passed through the first time, the process was stopped, the engine reversed, and the material passed through a second time. In a nonreversing or continuous mill, there were three rolls, eliminating the need to reverse the sheet (Kindl 1913:11-13).

Rolling mills were classified by the type of product manufactured. The product drove not only the technology but also primary and intermediate processing of the ore (Figures VII.1, VII.2, VII.3, and VII.4). Thus, pig iron might be processed in Bessemer Converters or Open Hearth Furnaces for manufacture into various types of ingots, which were then rolled or finished into

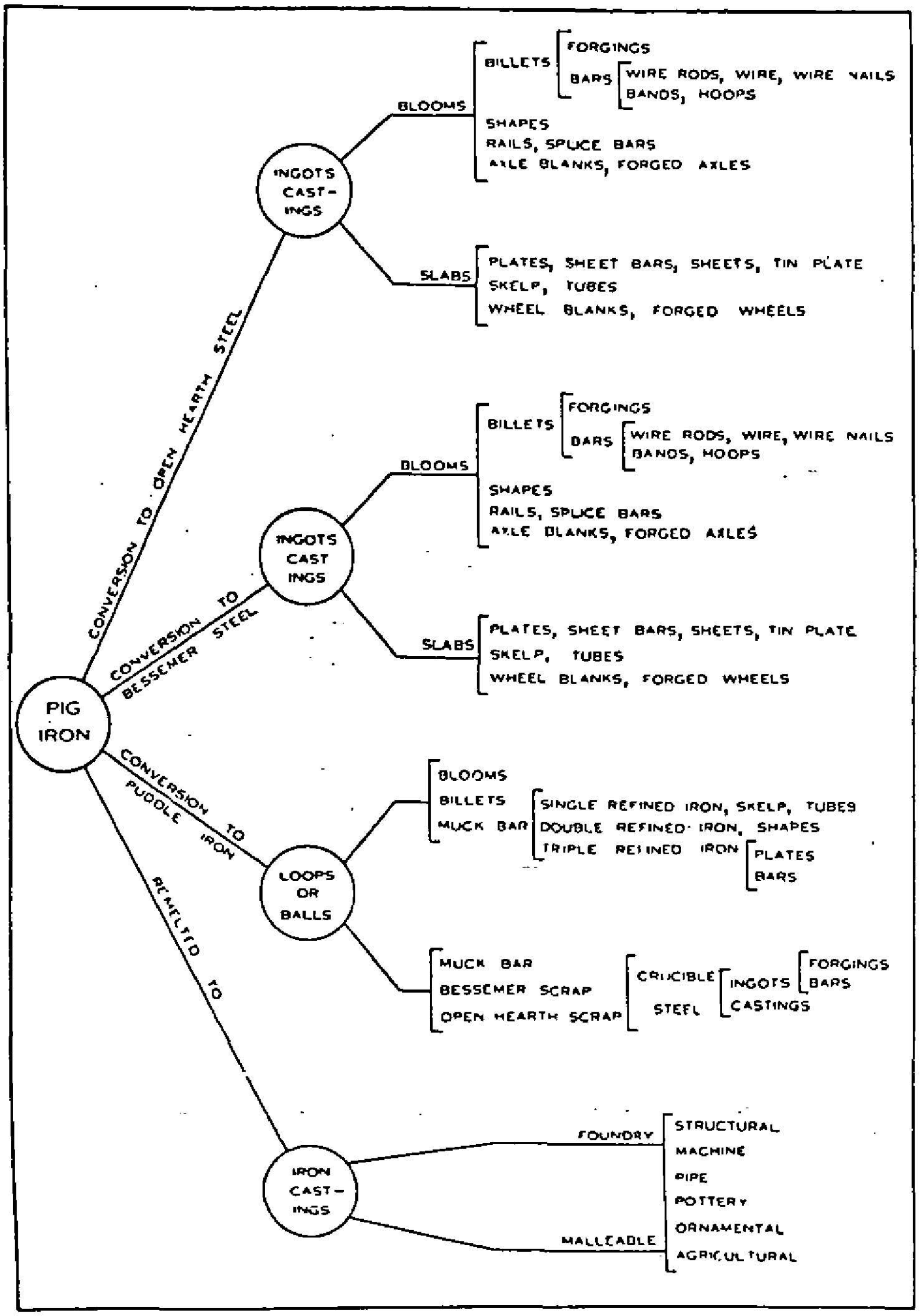


FIGURE VII.1 Conversion of Pig Iron into Ingots, Castings, Etc. and Finished Product *SOURCE Kindl 1913:15*

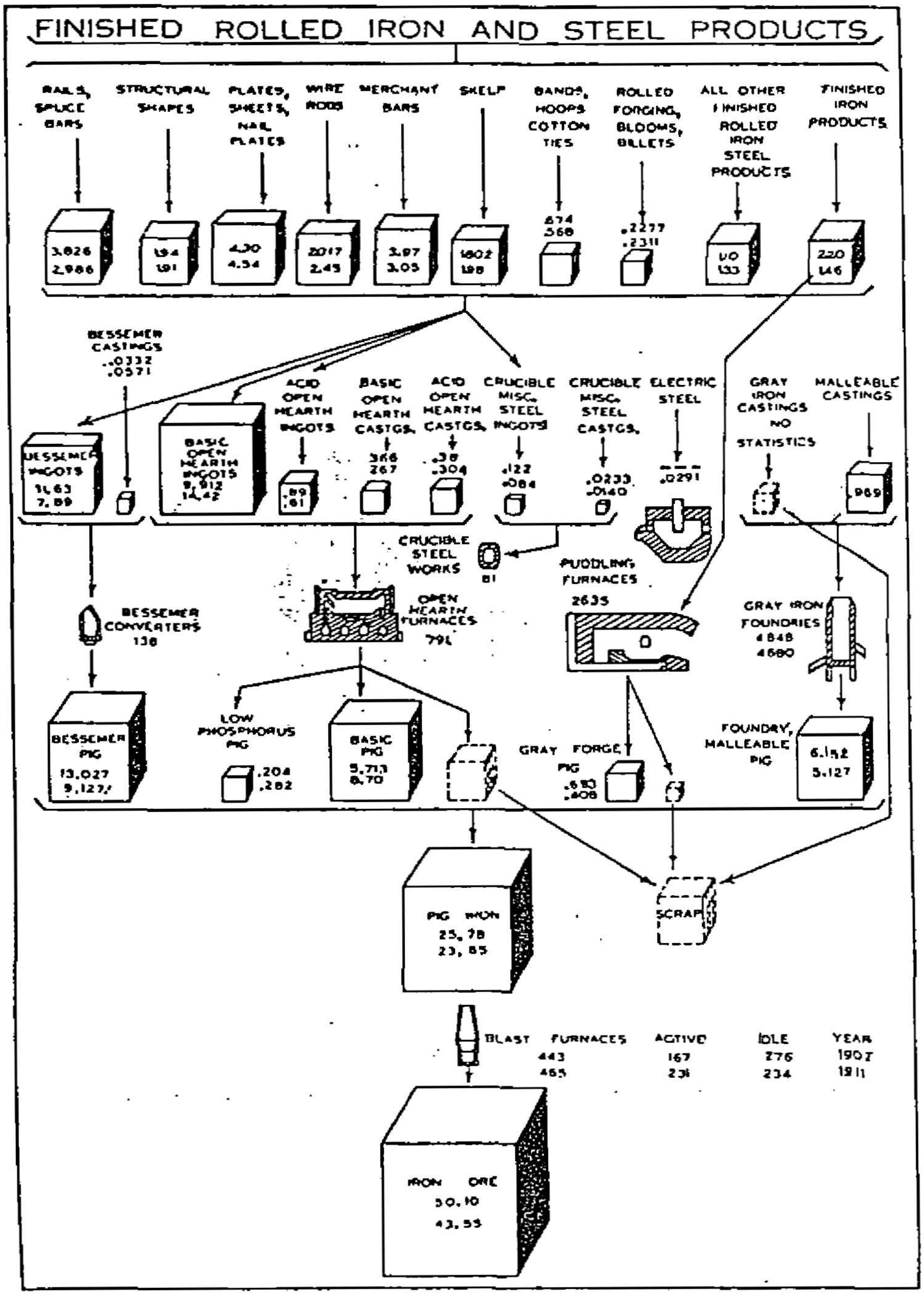


FIGURE VII.2 Product Conversion Chart (in millions of tons) for the Years 1907 and 1911

SOURCE Kindl 1913:17

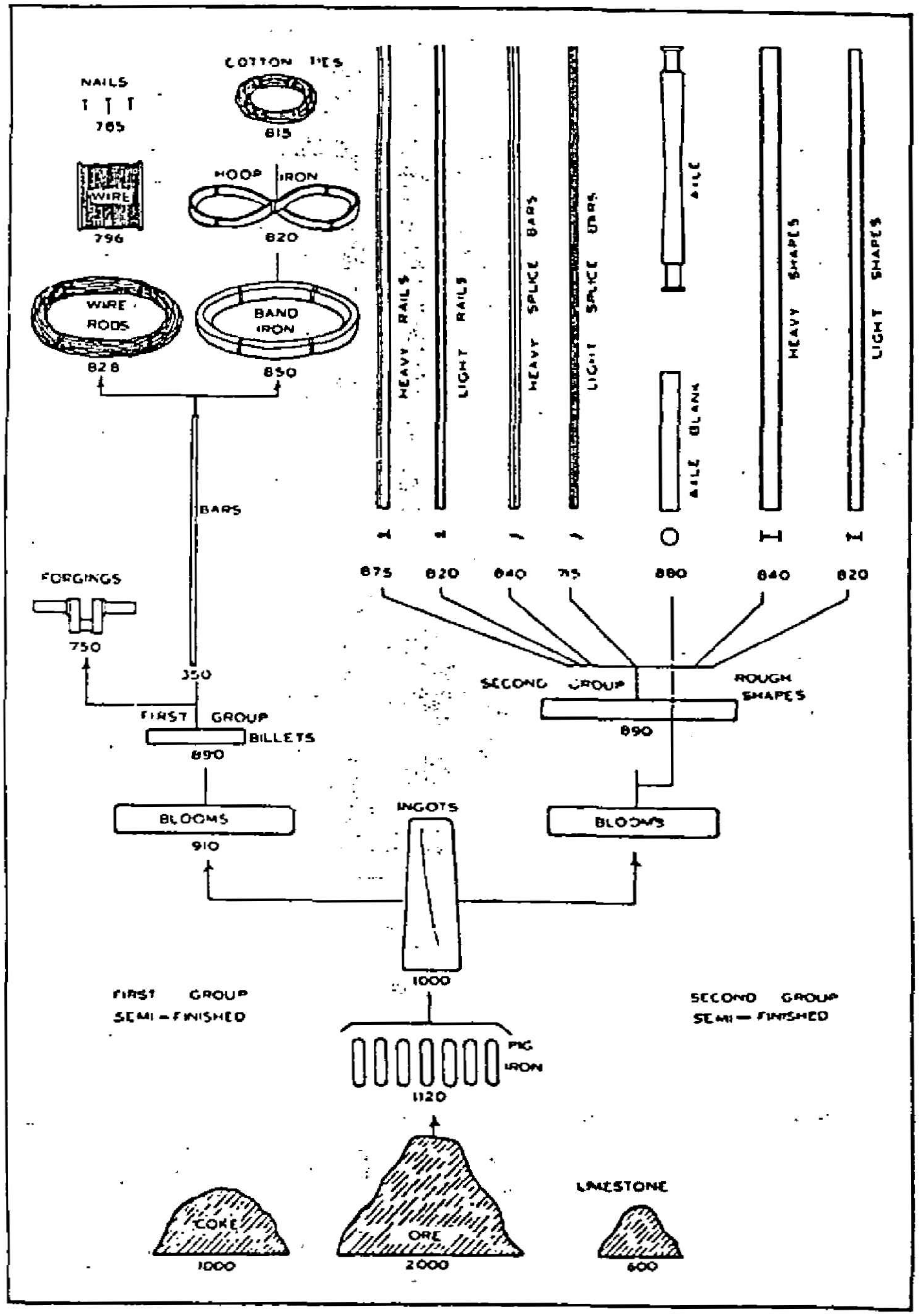


FIGURE VII.3 Product Conversion Chart Showing Open-Hearth Steel Products (Weight Given in Pounds) Obtained from 2000 Pounds of Iron Ore *SOURCE Kindl 1913:22*

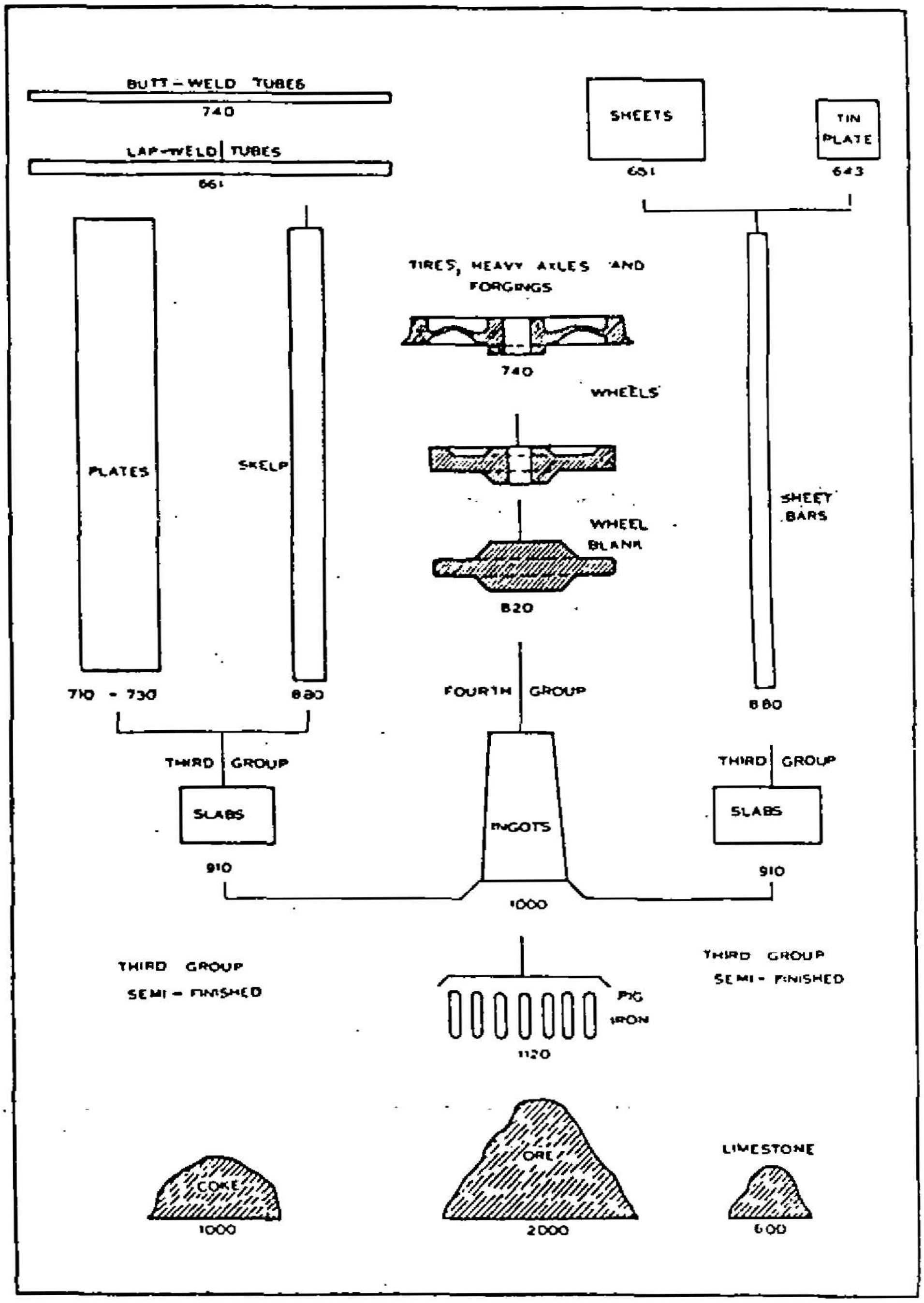


FIGURE VII.4 Product Conversion Chart Showing Open-Hearth Steel Products (Weight Given in Pounds) Obtained from 2000 Pounds of Iron Ore

SOURCE Kindl 1913:22

rails, shapes, plates, wire, hoops, or semiprocessed forms sold to manufacturers of finished goods (Kindl 1913:17, 21-33).

Wrought iron products, on the other hand, originally underwent a separate process. The antecedents of wrought iron dated to about 1350 when blast furnace processing of iron, the technological progenitor of modern blast furnaces, was introduced. Blast furnaces of different sorts yielded cast iron or pig iron, a brittle product with a relatively high incidence of impurities when compared with wrought iron. Wrought iron was the product of forge rather than furnace technology. The ore was heated and then hammered, resulting in a relatively pure and malleable substance that was more easily worked (Ashton and Story 1939:6-7, 9). By the mid-nineteenth century, forges were characterized by a hearth or crucible, a steam- or water-powered bellows forcing air into the forge, and the hammers.

The next step in the development of modern wrought iron was the introduction of puddling. In the puddling process, the molten iron was collected within the hearth of the furnace and reheated, forcing the remaining impurities to oxidize. In the original process, the iron collected, or "puddled," in a sand-lined hearth, resulting in a significant loss of iron. Joseph Hall's innovation of 1830 reduced the loss and became known as "wet puddling" or "pig boiling" because of the amount of slag and the vigorous boiling of the iron in the second step of the refining process. Production of malleable, ductile iron increased significantly and the method could be applied to both raw iron ore and pig iron (i.e., the semiprocessed product of blast furnaces) (Ashton and Story 1939:11-12; Flower 1880:157-158).

Furnaces were either single or double. In the latter, a single hearth, worked by four puddlers, shared the common back wall. The pig iron was melted and impurities oxidized with the chemical composition of the resulting material approaching pure iron. The desired consistency of the metal was spongy or plastic. At this point, the mass was divided into portions weighing 200-300 pounds, shaped into spheres or balls, and forced through a squeezer or press. The resulting "blooms" were rolled into flat sections known as "muck bar." This was sliced into shorter lengths, reheated, and welded or rolled into the desired form (Ashton and Story 1939:13-14).

b. Tin/Tin-Plate

Tin-plate or "white iron" was also a refinement of iron. It was manufactured in sheets that could be shaped into household utensils or hammered into roofs, a common use in the western states in the late nineteenth century. Manufacture of tin-plate began in forges where iron was subjected to the previously described puddling. The bars were then transported to the mills where they were cut into lengths suitable for the end-product. The mill consisted of two reverberatory furnaces, two pairs of rolls or rollers, and shears for cutting the sheets into the desired sizes. As was the case in manufacture of wrought iron, the iron bars were heated and rolled. The process was repeated once, creating iron sheets called "black plates," which were cooled and cut to size (Flower 1880:164-165).

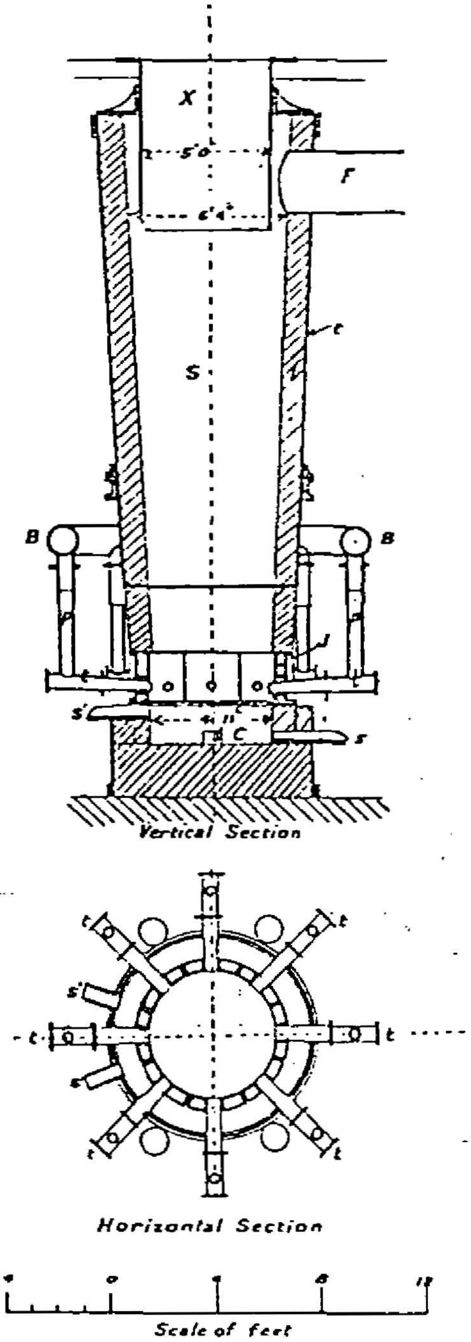
The black plates were, at this point, eight sheets thick, and were separated in the opening room to which they had been transported when cooled. The surface of the plates was cleaned by submersion in heated acid; this process was called "pickling." The black sheets were then subjected to annealing, or heating, to soften the surface, and then cold-rolled. The sheets were then put into a second annealing furnace and again softened. The sheets were immersed in a second acid solution to create the surface to which the tin coating would adhere (Flower 1880:167-168). At this point, the iron sheets were sent on to the tin house.

The apparatus required for coating the iron sheets comprised a "set of pots," placed in a below-ground brick fireplace above which a chimney or stack rose some 45 feet. The iron sheets, now called "white sheets," were left in tanks of water until moved to the tin house. There, the white sheets were plunged into a "bath of heated palm oil." Removed from the oil by tongs, the sheets were soaked in the pots of liquid tin with the result that "the iron sheets absorb the tin just as a sponge absorbs the water, and the two metals, like a man and wife, are joined together for better or worse" (Flower 1880:170). Removed from the pots, the sheets were placed flat on the hob, or flat iron plate, where they were rubbed down to remove loose tin. The sheets, now an alloy of iron and tin, were dipped again in a "wash pot" of tin and a third time into a "patent pot." From the patent pot, the sheets were raised and forced through a pair of steel rolls to spread the coating smoothly over the surface (Flower 1880:171). The sheets were cooled on racks and polished. From the tin house, the plates were transported to the sorting room where defective material was eliminated and the product packed for shipment (Flower 1880:172-173).

c. Lead

Also associated with the project area was lead smelting. Early twentieth-century texts noted that these plants were characterized by three levels: ore delivery, feed floor, and slag dump. Where natural terrain was suitable, the plants could take advantage of existing slope. Lacking advantages in the existing terrain, elevators or hoists were used for the feed floor, while ore bins were fed from elevated tracks. Key to the siting were railroad connections and sidings. After transportation access had been identified, the remaining issues were resolved by consideration of the type of ore (Collins 1910:163-164). Ores varied so much, the author cautioned, "that only practical experience can give the student some insight into the question" (Collins 1910:163).

Lead-smelting blast furnaces were similar in principle to the blast iron furnaces. Early twentieth-century furnaces were circular or oblong with tuyeres (i.e., the pipe through which the air from blast was forced into the interior) arranged around the exterior. The furnace itself was contained within an exterior iron casing or structure. The temperature at tuyeres was maintained at a constant level by water, leading to the name "water jacket." There were various types of water-jacketed furnaces, one of the most common being the Pilz Furnace, which is illustrated in Figure VII.5. The Pilz Furnace was invented in Freiberg by Bergrath Pilz in 1863 and became the prototype for American water-jacket furnaces (Collins 1910:165, 172).



S Shaft
c Casing of Boiler Plate
l Brick Lining
J Jackets
t Tuyere Nozzles
p Sheet Iron Bustle Pipes (supply air)
B Cast-Iron Blast Pipe
C Crucible
s Spout
F Flue
X Charging Cylinder

FIGURE VII.5 Vertical and Horizontal Sections of a Pilz Furnace *SOURCE Collins 1910:173*

The height of the furnace varied with the quality of the ore. Ores with a high lead content were smelted at a lower temperature, which required a lower pressure blast and therefore a furnace that measured 10-14 feet. Ores of lesser quality required higher temperature and longer exposure and hence a higher pressure blast; these furnaces measured 16-20 feet (Collins 1910:165).

The lead itself was drained into an interior sump, which was tapped into an exterior tapping box or an interior crucible or well. The flow was controlled by a syphon tap. Continuous production into the crucible or well was the preferred approach, resulting in a higher quality of lead (Collins 1910:166-167). The slag, that is, the by-product of smelting, was drawn off above the crucible and dumped. Slag removal required its own apparatus; examples of slag carts and pots, which were moved on interior rail systems, are depicted in Figure VII.6.

2. Property Types

Five metallurgical works are associated with four locations in the Route 9A project area. These include one lead works, one machinist/iron works, one rolling mill, one wrought iron manufactory, and a tin/tin-plate works. Four of these industries, the New York Lead Works, the New York Smelting and Refining Co., the Eagle Wrought Iron Works, and the tin works, are associated with Block 650, between Gansevoort and Jane Streets. The iron works and rolling mill are associated with Block 648 (Figures VII.7 and VII.8).

The Bromley map of 1879 (see Figure VII.7) shows Site 309 at the northwest corner of Horatio Street and West Street as a Tin Works. By 1884 (Robinson 1884 Vol.4:25), the Monitor Tin Plate Works was at this location. An 1885 edition of the Robinson atlas, presented in Hartgen Archeological Associates, Inc., and Historical Perspectives, Inc. (1990c:VI-89, 164), shows the Eagle Wrought Iron Works at this location. In 1901, following the widening of West Street, the Eagle Wrought Iron Works was moved to 341 East 108th Street (Trow 1900/1901:364). The company was moved to West 108th Street in 1904 where it remained until 1910 (Trow 1903/1904:366, 1909/10:391).

The New York Lead Works (Site 499) was located at the northwest corner of the intersection of West and Jane Streets (Block 650). The New York Lead Works appears on the Bromley 1879 atlas between Horatio and Jane Streets (Figure VII.7). A long, narrow brick factory, it extended over about eight of the original long, narrow building lots, covering most of the available space. The 1884 Robinson atlas shows the building at this location occupied by the New York Smelting and Refining Works (Figure VII.8). This lead works is first listed in the 1866 city directory as the "New York Lead Smelting Works" (Trow 1865/66:750). It last appeared in 1872 (Trow 1871/72:896). The New York Smelting and Refining Company first appears in the 1880 city directory (Trow 1879/80:1154) and appears for the last time in 1896 (Trow 1895/96:1096). The New York Lead or Lead Smelting Works was listed in both the 1870 and 1880 federal censuses (U.S. Bureau of Census 1870:1441, 1880:377). In 1870, the works were steam powered, included 7 furnaces and 1 crusher, and employed 14 men. Raw materials included lead ore, antimony, tin scrap, flux, and coal, and products comprised pig lead, pig tin, type metal, and solder metal. Ten years later, the plant employed 25 men; no details on raw materials or output are provided.

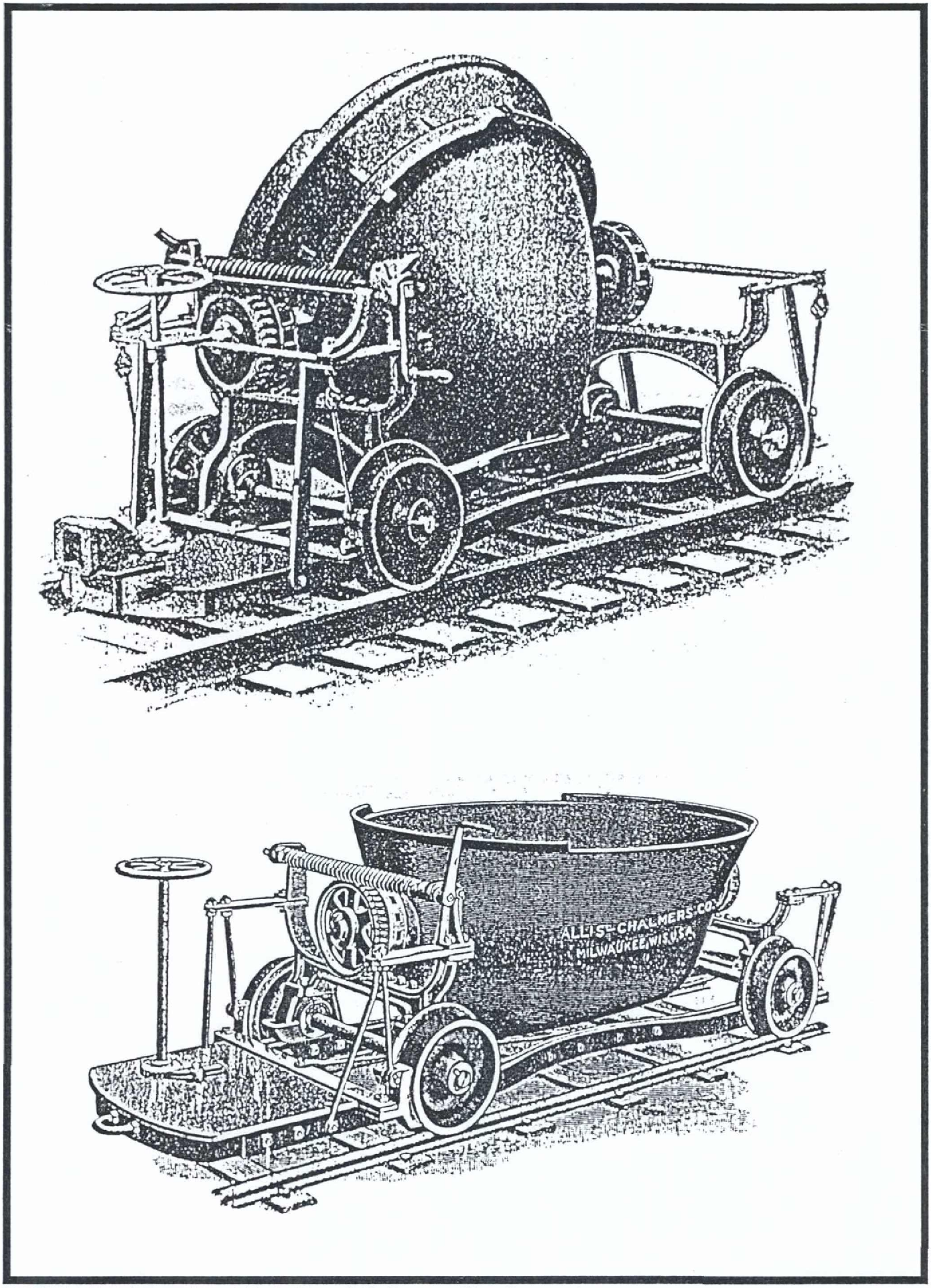


FIGURE VII.6 Examples of Early Twentieth-Century Slag Pots and Trucks, ca. 1910

SOURCE Collins 1910:210-211

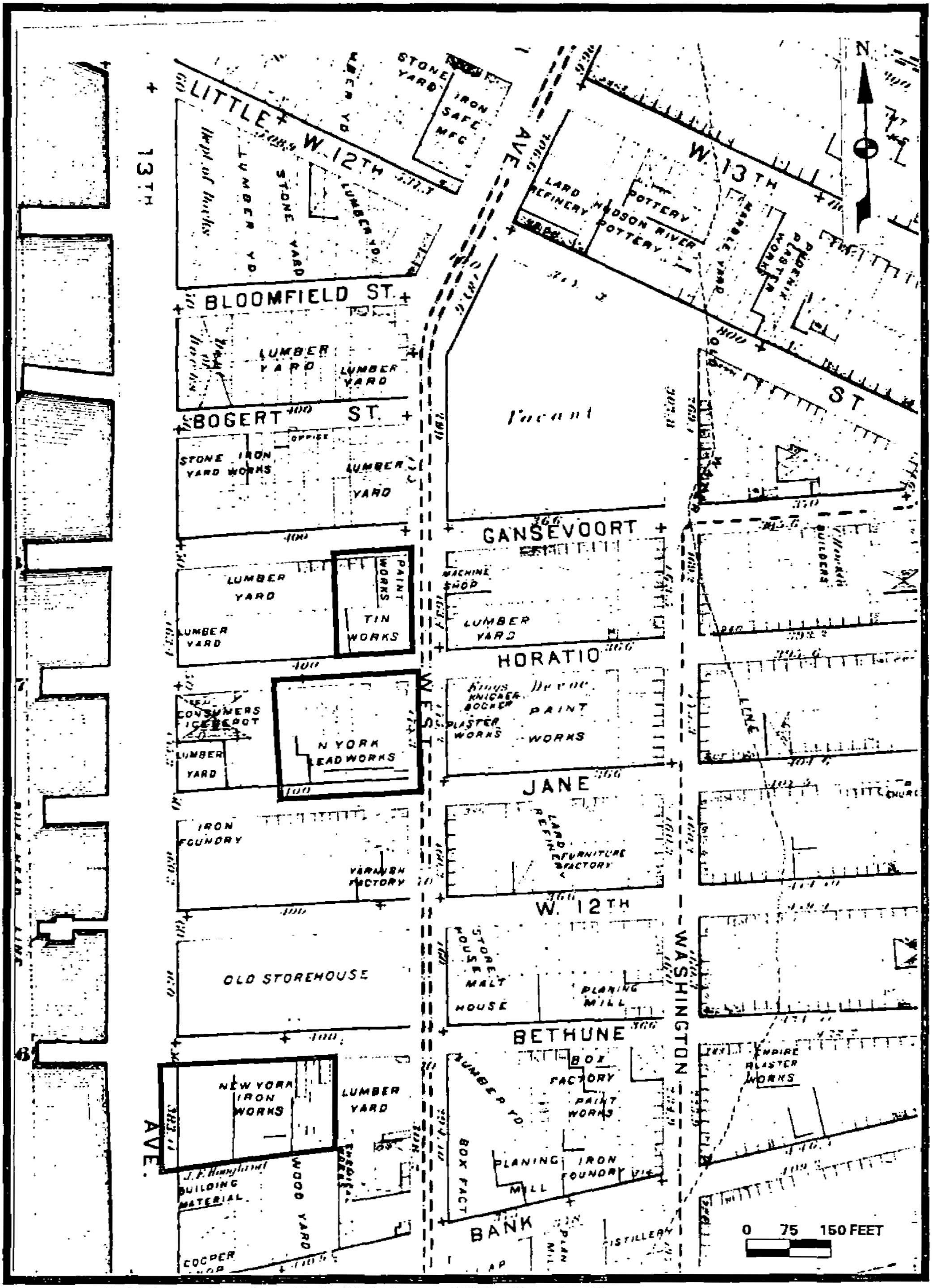


FIGURE VII.7 Vicinity of Bank to Little 12th Street, 1879, Showing New York Iron Works, New York Lead Works, and Tin Works

SOURCE Bromley 1879:10

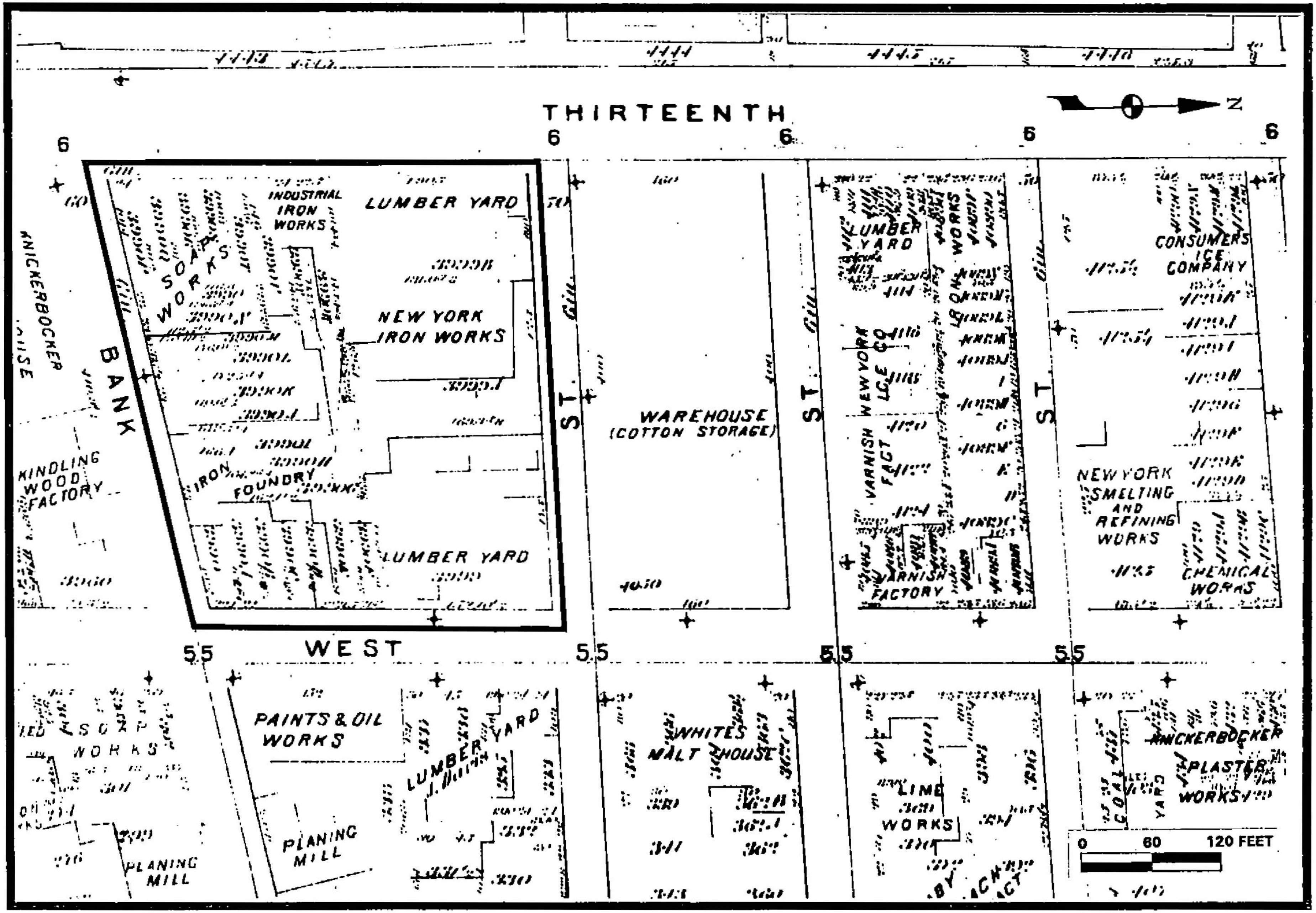


FIGURE VII.8 Vicinity of West Street from Bank to Horatio Streets, 1884, Showing Iron Foundry, New York Iron Works, and New York Smelting and Refining Works

SOURCE Robinson 1884 Vol. 4:25

The first reference to the firm of John Innes and Son in the city directories dates to 1863 when John Innes, "machinist," was listed at 450 West Street (between Bank and Bethune Streets), with a residence at 263 West 30th Street (Trow 1862/63:429). This identification persisted through 1874 (Trow 1873/74:636). The entry in 1880 read "John Innes and Son, engineers," at 453 West Street (Trow 1879/80:757). The entry the following year identified the firm as engaged in "iron" (Trow 1880/81:792). Through the 1880s, the entries variously read "machinery" or "machinist," with the most complete description contained in 1883. This entry described the firm as "Rapid Iron Works/John Innes' Son, Engine Builder and Machinist, Nos. 453 and 455 West Street, Between Bank and Bethune, Repairing steam engines and wood planers a specialty" (Trow 1882/83:48). The last appearance of the firm in the city directories occurred in 1891 (Trow 1890/91:663). The firm also appears in the 1880 federal census schedule of manufactures (U.S. Bureau of Census 1880:124). At that time, the works were steam powered and employed 10 people, four of whom were adults over the age of 16. No details on the type of raw material or the nature of the product are provided.

The Innes Iron Works, or machinists' shop (as suggested by entries in the late nineteenth-century directories) is exhibited on the 1885 Robinson atlas (see Hartgen Archeological Associates, Inc. 1990b:VI-70) and apparently remained in this location until ca. 1902 when West Street was widened. It appears to have been a small brick building with a frame extension over the rear yard area (Robinson 1884:4:25).

The J. Leonard Manhattan Rolling Mill first appears in the 1866 city directory, when it was located at the corner of West and Bank Streets (Trow 1865/66:593). It was then characterized as an iron works. Leonard's residence was at 121 Leroy Street. Leonard moved several times over the years before he finally established his residence in Montclair, New Jersey, in 1896. The mill continued to be listed in the city directories until 1896 (Trow 1895/96:844). It was not identified in the federal censuses. The J. Leonard Manhattan Rolling Mill encompasses sites 288, 289, 289, and 292 in Block 648. The rolling mill, located at the corner of Bank and West Streets, which, between 1884 and 1885, incorporated into its structure an earlier foundry (see Figure VII.8 and 1885 Robinson atlas, presented in Hartgen Archeological Associates, Inc., and Historical Perspectives, Inc. 1990b:Figure 6-10c). It replaced or incorporated a series of smaller brick structures that faced West Street. The resulting brick structure appears to have covered most of the available lot.

B. ARCHAEOLOGY

1. Research Potential

Questions typically asked regarding industrial sites address organization of space within the plant; the effect that technology, raw materials, and type of product had upon the organization of activities; the effect, if any, of changing technology upon the construction of individual buildings and requirements that the technology may have imposed upon the buildings; and the relationship between technology, process, and product. The general descriptions of all of the metal-working facilities emphasized the importance of the furnaces for smelting, the relationship between transport and storage of bulk raw materials and fuels, and the efficient movement of heavy bulk materials and heavy finished products within the plant and from the plant to the consumer. Most of the industries represented within this group, it should be noted, did not furnish products to the secular consumer market but rather produced finished intermediate goods (e.g., tin sheets) that would then have to be manufactured into finished consumer goods.

In an urban setting, as was the case with the chemical and clay-working industries, the challenge was to organize activities vertically as much as possible so as to minimize the demand for relatively expensive land. The various historical maps do not indicate extensive industrial campuses nor is there always substantial information on interior organization of space. However, there is evidence of specialized metal working at a series of sites in relatively close proximity. Thus, activities that might have been consolidated in a single, integrated plant in a rural or suburban environment were dispersed among a series of separate, mutually supportive entrepreneurs. This relationship appears to be illustrated by the J. Leonard Manhattan Rolling Mill at the corner of Bank and West Street, which, ca. 1885, incorporated into its structure an earlier foundry (see Figure VII.8 and 1885 Robinson atlas, presented in Hartgen Archeological Associates, Inc., and Historical Perspectives, Inc. 1990b:Figure 6-10c), and the New York Iron Works, located on the south side of Bethune Street, i.e., virtually around the corner from the rolling mill.

Several research questions offer themselves. With regard to the rolling mill, what evidence is there, if any, of reuse of the earlier foundry? How were functions at the two sites complementary and how were they competing? How was the transport and storage of bulk goods accommodated within tightly constrained urban settings? How did the processing of different metals (e.g., tin, iron) affect the heating/smelting operations and organizational activities common to both?

As in the case of clay works, control of the heat and the furnace was critical to the development of the technology. What, therefore, was the effect of heat and fuel management on the engineering of the buildings? Were these distinctive or did they become, as in the case of chemicals, merely warehouses or envelopes within which sophisticated equipment was housed? Since the description of the properties indicates that these buildings were reused for similar albeit different metal-working processing (e.g., the wrought iron works placed in the tin works building, or the smelting company placed within the lead works), to what extent is there evidence of the adaptive reuse of the key engineering features making possible the substitution of one industry for another?

2. Archaeological Visibility

Historical maps indicate that the equipment for the various metal-working industries within the Route 9A corridor was housed in a series of brick buildings. The review of basic historical information suggests that although large equipment was integral to the process, the apparatus posed special construction constraints upon the buildings, particularly the construction of the furnace, which was analogous to the kiln, that may be apparent in the foundations. While the apparatus from these sites would have been removed from these buildings, the archaeological visibility of these metal works is likely to include building foundations, dimensions, footings for heavy machinery, below-grade furnace foundations and flues, and ramps and stairs for movement of bulk fuel and raw material. Although slag and other waste products have been found on iron industrial sites (see Friedlander and Outlaw 1988:3-21), the constrained spaces and small urban lots suggest that significant accumulations are unlikely (New York Regional Plan 1928a:22). Moreover, the existing cartographic information suggests that the buildings wholly covered the lots and that waste was consequently removed. Indeed, even in rural environs, the slag from metal works was often removed for use in the construction of local roads.

C. CONCLUSIONS

The research potential of metal-working industries is inherent in the relationship among the process, equipment, and the construction of the buildings. Particularly noteworthy would be evidence of footings for furnaces and heavy equipment, subterranean flues and connectors, and distinctive ramps for the management of intense heat and movement of raw materials and bulk fuel. While full expression of the manufacturing process is not likely to obtain from the analysis of surviving archaeological data, there may be some interesting comparative engineering data, particularly in the comparison between structural remains at the J. Leonard Manhattan Rolling Mill and the New York Smelting and Refining Company. Also interesting might be comparisons between the iron works and the tin works, which shared similar smelting and rolling processes but somewhat different raw materials and chemical engineering practices. If preserved, these structural remains might possess the potential to contain information important to understanding the engineering of metal-working plants, particularly management of intense heat and movement of bulk materials in an urban setting where space was constrained. Further archaeological investigation (Stage II research) of the preservation potential of these sites is recommended.

VIII. PIANO INDUSTRY

A. HISTORICAL CONTEXT

1. Historical Development

Piano manufacturing in the nineteenth century was directly associated with furniture making and, therefore, the lumber industry. U.S. lumber production peaked in 1907 but declined by 27 percent by 1920. Nationally, centers of production included Grand Rapids, Michigan; Jamestown, New York; Evansville, Indiana; Rockford, Illinois; and High Point, North Carolina. New York State had ranked first in the nation in value of lumber and lumber products in 1840 and 1850 but had slipped to twenty-first place in value of products and to twenty-third place in quantity by 1920 (New York 1928c:13). This decrease in rank obviously reflects the opening of the west as well as the costs of transporting a low-value high-bulk product such as unprocessed or semiprocessed timber. Products that tended to survive in the city and its environs were high in value relative to their bulk, primarily highly fabricated items such as furniture and musical instruments. Additionally, in these industries demand for skilled labor was high but the space requirements were relatively low (New York 1928c:14, 17).

Not surprisingly, New York City's woodworking industries in the early twentieth century comprised a large number of small establishments in which skilled hand labor predominated and little use was made of relatively expensive power machinery (New York 1928c:17). In 1900, furniture manufactories concentrated in Manhattan south of 14th Street and east of Broadway, with a secondary cluster along the west side above 23rd Street. Over the next 20 years, the firms southeast of Broadway and 14th Street tended to migrate elsewhere, although the west side retained a modest concentration of woodworking establishments (Haig and McCrea 1927:54-55; New York 1928c:20).

The concentration of woodworking establishments closely mirrored the location of piano factories. The earliest piano factories were, indeed, located on the east side of Manhattan below 14th Street. By 1920, they concentrated west of Eighth Avenue in the vicinity of 50th Street, where piano manufacturing dated to about 1880. This had been a German and Irish neighborhood, and the Germans, in particular, were associated with the skilled labor required in the manufacture of pianos. As late as the 1920s, the analyst noted that "this is distinctly a manufacturing district, with large regular blocks and an abundant supply of labor living in the tenements of the neighborhood" (New York 1928c:40). Other centers of piano manufacture in the city included the lower Bronx and Queens (New York 1928c:40-41).

American piano manufacture had expanded significantly after 1860. By 1900, the U.S. commanded more than one-half of the world's market. This growth reflected protective trade policies in the context of increased consumer demand as a result of population growth and the adoption of the piano in the parlor as one of the principal symbols of the Victorian home

(Arnold 1987:17; Ehrlich 1990:128). Eighteenth-century piano manufacture had occurred in small workshops of master craftsmen. In the mid-nineteenth century, piano-making establishments began to expand partly to accommodate increased numbers of workmen and partly in response to changing technology. Constructing the simplest mid-nineteenth-century piano required 40 processes and six months (Groce 1982:49).

Jonas Chickering of Boston is credited with the application of modern factory techniques to the manufacture of pianos in the 1840s (Arnold 1987:18; Loebst 1987:37). Soon surpassing Chickering's success was the New York City-based influential and important firm of Steinway & Sons, which was begun by a family of German craftsmen in a loft at 85 Varick Street in 1853. The Steinways introduced a cast iron frame and a new, more resonant system of stringing. The firm prospered and pioneered piano manufacture in very large factories although its methods of organization and production were typical of the industry. Steam-powered heavy equipment included planers, saws, and lathes for the rough work and for moving the semiassembled instruments from one work station to the next. Principal elements of the instruments were hand finished and installed including the cases, soundboards, actions, keyboards, and stringing (Arnold 1987:20; Groce 1982:50-54).

During the latter half of the nineteenth century, New York emerged as a center for the manufacture of pianos (Groce 1982:69). Joseph F. Hale moved to New York in 1861 and converted the combined craft and machine-powered system that characterized Steinway & Sons to what was essentially an assembly plant of elements made elsewhere. Manufacture of piano components was not unique to Hale. Among the piano components that had already become specialized industries were soundboards, cases, felt, hammers, and wire (Dolge 1911:117-126). Hale differed from other piano manufacturers, however, in that his factory was only for the assembly of pre-manufactured parts; no building took place there at all (Groce 1982:74).

Manufacture of the traditional instrument remained heavily influenced by the techniques of woodworking, joinery, and carpentry. Features of piano factories included yard areas for drying lumber used in production of cases. Machinery typically found in an early twentieth-century factory would have been similar to furniture factories and included planers, sanders, saws, fans, drill presses, drills, and polishing apparatus, which by 1910 were electrically operated (Electricity in the Manufacture of Pianos 1916:1115). Other facilities commonly associated with traditional piano factories were iron and japanning works (Singer 1986:17-18).

The manufacture of piano cases became increasing separated from the construction or assembly of pianos. By 1879, Steinway had moved all of their woodworking operations and case building to Astoria. Completed cases were sent to New York city to receive the sounding board, exterior varnish and polish, and interior construction (Singer 1986:91). By 1900, nearly all of the manufacturers of commercial pianos were buying their cases ready made (Dolge 1911:119). In addition to using cases often built by furniture makers, many piano factories relied on parts, such as felt, wires, hammers, and iron plates or frames. "By the middle of the nineteenth century, many New York piano factories bought even such major components as piano actions, key boards and soundboards ready-made from subcontractors" (Groce 1982:74). These factories were essentially assembly lines. Piano factories still required large warehouse buildings advantageously located near piers to enable delivery of lumber and pre-manufactured parts.

During the 1880s, upright pianos came to dominate the market and during the 1890s and early 1900s, the automatic or player-piano gained popularity. Many of the New York instrument makers regeared their factories to produce the popular automatic instruments (Groce 1982:85-86). Automatic or player pianos were common by the turn of the century (Groce 1982:86). The Aeolian Company of New York became a leader in the manufacture of player pianos after 1906. The mechanism was an elaboration of the Jacquard textile loom, which operated with perforated cards. After a period of experimentation, resulting in the invention of the barrel organ, a rotating mechanical fixture was adapted to the 88-note upright piano (Meahl 1914:5-6). This was combined with foot-action pedals that mimicked the effect of fingers on the keys as directed by the perforations fed onto the rotating cylinder (Dolge 1911:134). Originally operating on a bellows principle, similar to the operation of an organ, other systems for operating the mechanism with foot pedals were also introduced. By the end of the nineteenth century, variations on the idea included using crank and electric motor systems.

The first pneumatic self-playing piano was probably a 39-note instrument that was built by R.W. Pain for Needham & Sons in 1880. Pneumatic players operated by pumping treadles, whereas electrical pianos used electricity to power the mechanism. In 1888, Pain built an electrically operated piano that did not require pneumatic actions (Dolge 1911:136-137; Ord-Hume 1970:4).

2. Property Types

Four sites in the study area are associated with piano manufacturing. These sites were in Blocks 1097, 1099, and 1102, between West 49th Street and West 55th Street. Four piano-related companies are associated with these four properties: the Milton Piano Company, the Autopiano Company, the Standard Pneumatic Action Company, and the Auto-Pneumatic Action Company. These last two companies produced pneumatic actions for player pianos, including those manufactured by the Autopiano Company.

The Milton Piano Company (Block 1102) first appears in the New York City directories in 1897 and on historical maps in 1902. It was at this time located at 1881 Park Avenue (Trow 1896/97:903). The company moved to 772 Twelfth Avenue in 1909 (Trow 1908/09:1013) and to 548 West 36th Street in 1920 (Trow 1901/02:1286). The company was still at this location in 1925 (Trow 1925:1610).

The Autopiano Company (Blocks 1097, 1099, and 1102), referred to on maps as the Auto Piano Company, was established in 1903. The Autopiano Company was one of the first manufacturers to market a successful interior player-piano, which they produced since 1904 (Roehl 1973:36). *The Purchaser's Guide to the Music Industries* from 1920 stated that "there are twice as many Autopianos in use as any other player-piano (Roehl 1973:36). The company, which manufactured the Autopiano, the Autopiano Grand, the Autopiano Electric, and the Autopiano Welte-Mignon.

The first entry in the city directories for the Autopiano Company is Trow (1905/06:62) in which the company is listed at the corner of Twelfth Avenue and 55th Street (Block 1102). This may be the same building occupied by the Milton Piano Company from 1909 to 1920, or the adjacent facility that has not been associated with a specific company. The following year, the Autopiano Company is listed at 639 West 49th Street (Trow 1906/07:65). The study area property on the north side of West 49th Street near the Hudson River, Block 1097/Site 460, is associated with the Autopiano Company on a 1906 atlas (Hyde 1906). The Autopiano Company then moved to the block between West 50th and West 51st Streets for about four years. Their address for three years was 619 West 50th Street (Trow 1907/08:69, 1908/09:64, 1909/10:63), and for one year was 614 West 51st Street (Trow 1910/11:65); these two addresses probably refer to the same factory site. The company then moved to a large facility that spanned the block between West 51st and West 52nd Street (Block 1099). This "modern six-story plant," which had been occupied by the David S. Brown Soap Works from 1896 to 1910 (see Chapter III), was "the largest factory in the world devoted exclusively to the manufacture of player-pianos" (Roehl 1973:36). The Autopiano Company is listed at this location, with the address of 653 West 51st Street, from 1911 to 1925, when there was a gap in the publication of the city directories (Trow 1911/12:67, 1925:328).

The Autopiano Company shared the former soap works building between West 51st and West 52nd Streets with the Standard Pneumatic Action Company, a manufacturer of piano actions. The first listing for the Standard Pneumatic Action Company in the New York City directories is 1910, when it was located at 610 West 50th Street (Trow 1910/11:1420). The following year, the company was reported at 652 West 52nd Street (Trow 1911/12:1502), where it shared the former David S. Brown Soap Works building with the Autopiano Company. The Sanborn Map Company (1911:5:50) plat shows the company's facility occupying the east half of the former soap works building (Figure VIII.1). The easternmost 50-foot section of the factory, which housed the former soap works boiler room, was retained as a one-story structure and housed the factory's kilns (see Figure VIII.1).

Between 1912 and 1925, the Standard Pneumatic Action Company was listed at various and alternating addresses, including 652, 648, and 638 West 52nd Street, that refer to the same factory building (Trow 1911/12:1504, 1914/15:1755; 1925:2157). By 1922, the former one-story boiler room was enlarged to four stories (or three and a basement) (Bromley and Bromley 1920-22:2:40). Around 1930, this building housed the Packard Motor Company Sales and Service offices (Bromley and Bromley 1930:80) and in 1934 the circa 1896 soap works building was demolished for construction of the elevated public highway (Bromley and Bromley 1934:80).

The *Standard Player Monthly*, which was published by the Standard Pneumatic Action Co. between 1916 and 1929, provides photographs of the both the interior and exterior of the factory between 51st and 52nd Streets. The frontispiece of the second issue shows a photograph of a section of the boiler room in the factory that contained a battery of eight boilers that supplied the power "required to operate the hundreds of automatic machines in the Standard Plant, as well as to supply the heat for the kilns, etc." (*Standard Player Monthly* 1916a:2). The boilers shown

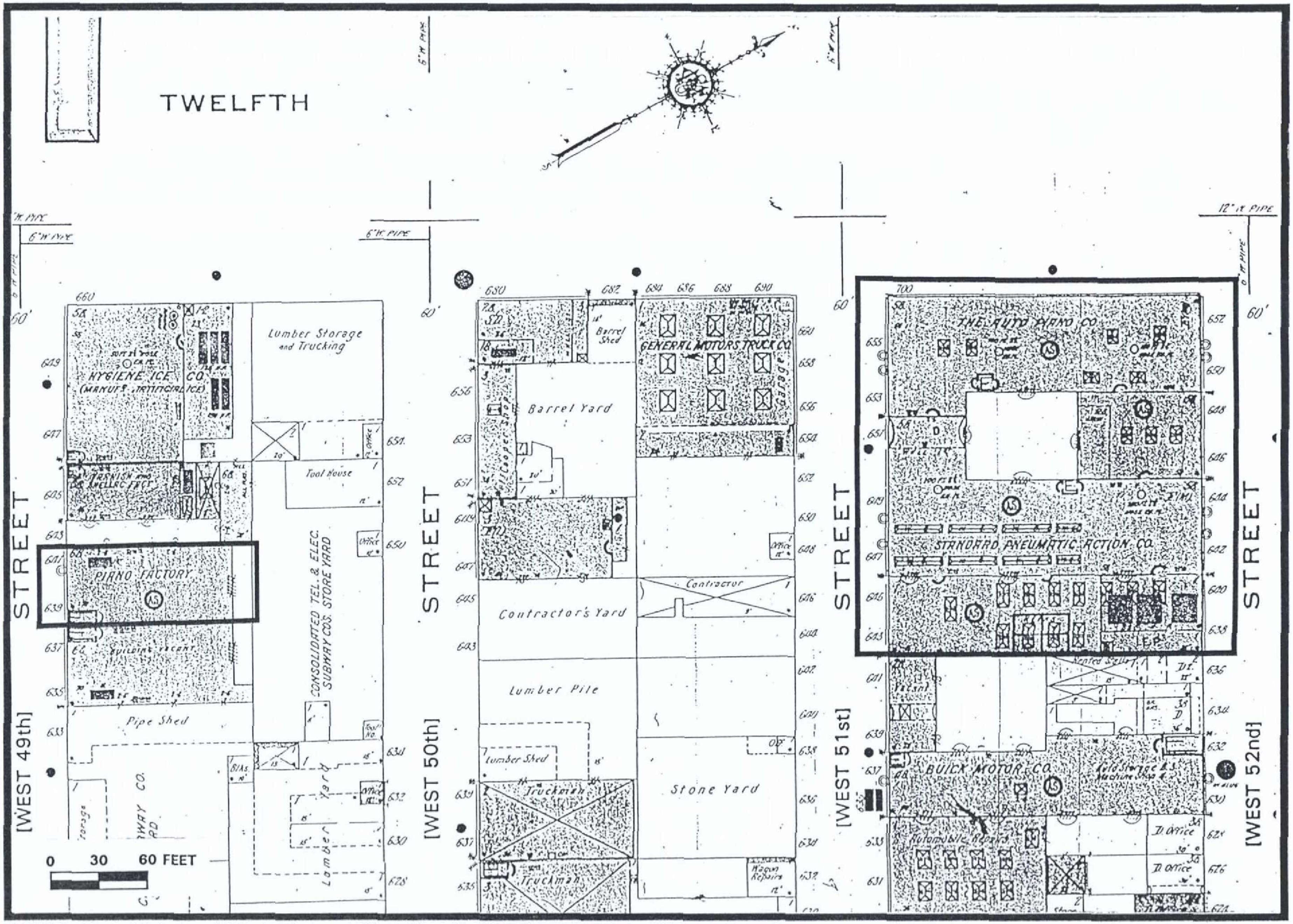


FIGURE VIII.1 Vicinity of West 51st and 52nd Streets, Showing Locations of Piano Factories

SOURCE: Sanborn 1911 Vol. 5:50

heating system from the form soap works had been replaced, although the boiler room, per se, experienced continuity of function (see Chapter III). Another photograph from the first volume of the *Standard Player Monthly* (1916b:16) shows a yard area where lumber was sorted with the east facade of the piano factory in the background. Two engravings from a 1920 issue of the *Standard Player Monthly* (1920:2, 19) illustrate workers operating equipment to make lead tubing and felt, respectively (Figures VIII.2 and VIII.3). A tour through the factory of the Standard Pneumatic Action Company was described in a 1921 issue of the *Standard Player Monthly* (1921:10-11), from the inspection of lumber before it is put into the dry kilns, to the mill room where the lumber was planed and sawed, and then to be drilled and bored. The wooden parts were then sent to the dipping department, where shellac was applied and to the scraping department where excess shellac was removed. All of these processes were highly automated. Other departments in the factory included the assembly of valves and pneumatics, making lead tubing, and testing of the Flexible Striking Fingers and fully assembled actions.

The Auto-Pneumatic Action Company, which manufactured the Welte-Mignon (licensee) reproducing player-piano action, was located at 653 West 51st Street in 1924 (Trow 1925:327). This is the same address as the Autopiano Company occupied by 1911. From 1910 to 1923, the company was located between West 50th and West 51st Streets, with alternate addresses of 619 and 629 West 50th Street (e.g., Trow 1910/11:65, 1911/12:67, 1922/23:310). These addresses represent two different buildings (Sanborn 1911:5:38). Between 1907 and 1910, the Autopiano Company occupied this location, prior to moving across the street. The Auto-Pneumatic Action Company, which was established in 1900, patented the "flexible finger" action in 1904, which allowed for a more natural tone in player pianos.

The strong associations in location between the Autopiano Company and both the Standard Pneumatic Action Company and Auto-Pneumatic Action Company illustrate the intertwined relationships of piano manufacturers and suppliers of components, as well as a suspected business association.

B. ARCHAEOLOGY

1. Research Potential

The historical description suggests that innovations in manufacture of pianos consisted in the combination of skilled craftsmanship with a form of assembly line production (i.e., a series of work stations). Piano manufacture also appears to have been early in the segmentation of specialized manufacture; thus, the action was manufactured separately and supplied to the piano company, which in many ways was as much concerned with assembly and finishing as it was with manufacture. For example, the Standard Pneumatic Action Company and the Auto-Pneumatic Action Company both specialized in the manufacture of actions used by player pianos and did not produce complete instruments.

Research issues associated with piano manufacture concern interior organization of activities, movement of large, semi-processed instruments, and the interface between mechanization and

FIGURE VIII.2: Manufacture of Lead Tubing for Standard Pneumatic Actions
SOURCE: Standard Player Monthly 1920, 5(8):2

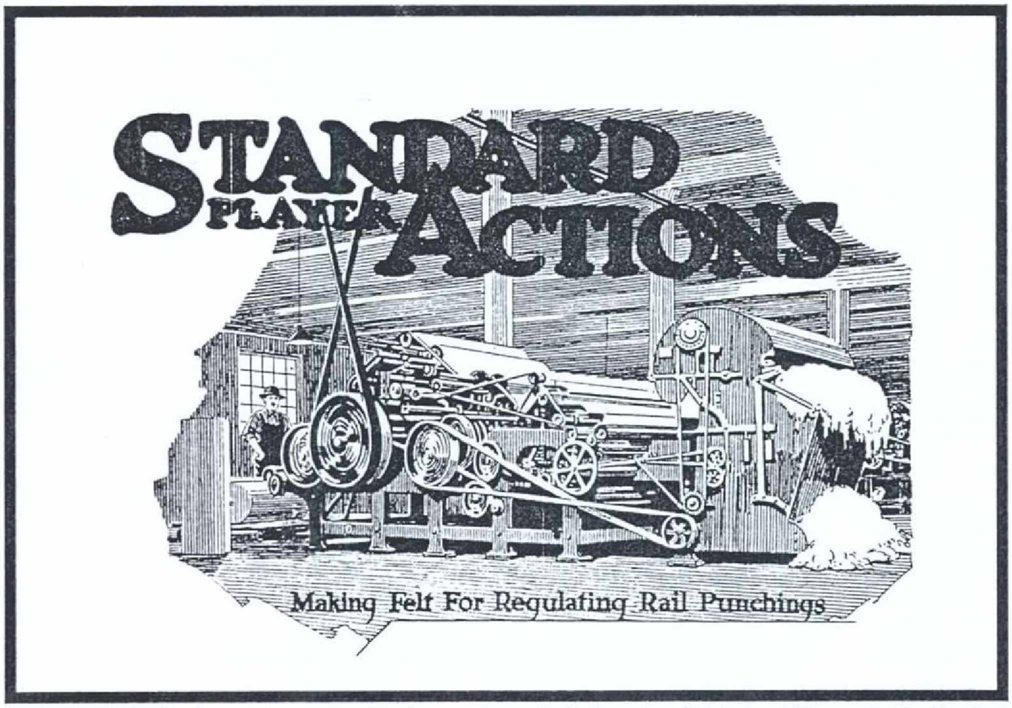


FIGURE VIII.3: Machinery for Making Piano Felt for the Standard Pneumatic Action Company *SOURCE: Standard Player Monthly 1920, 5(8):19* highly skilled craftsmanship, required by the joinery, assembly, and tuning of the instruments. Related to the organization of space and labor are issues of mechanization, specifically the use of power tools, hoists, and conveyor systems that allowed for greater productive capabilities. The question becomes how changes in technology and human labor were expressed in the adaptive reuse of the buildings and available space.

2. Archaeological Visibility

The Sanborn maps indicate that the piano manufacturing companies were housed in a series of multi-story brick structures for which skylights provided interior illumination in the long, narrow buildings that extended from street face to street face. The archaeological visibility of piano factories would be minimal, with the principal manifestation consisting of building foundations. The frequent moves of the Autopiano Company facilities from 1904 to 1911 illustrates the necessity for increasingly larger warehouse/factory space to accommodate assembly work as product demand increased. The ease with which the company relocated suggests that there were few capital investments in plant improvements that would be visible archaeologically; these buildings were merely structures that enclosed assembly plant activities and provided storage for both raw materials and products.

The dimensions of the buildings related to the piano industry in the Route 9A study area appear to have covered entire building lots. The piano factory between West 51st and West 52nd Streets that housed the Autopiano Company and the Standard Pneumatic Action Company, retained the interior courtyard that was a feature of the circa 1896 David S. Brown & Co. Soap Works. This courtyard would have provided interior lighting for the factories. Contemporary descriptions suggest that the activities were wholly contained within the buildings and that the buildings were shells or containers within which equipment, hoists, and tools were installed. A cultural resource study conducted for the proposed Union Square Rezoning Action (CEQR 87-283M) similarly found that early piano factories, while "historically interesting" were unlikely to have "significant archaeological expressions" (Louis Berger & Associates, Inc. 1988c:23).

C. CONCLUSIONS

New York City emerged as a center for the manufacture of pianos in the middle of the nineteenth century. It is not surprising that these firms were found in relatively close proximity to the lumber yards which were among their suppliers. The land use relationships are, however, amply documented in existing maps and atlases. The surviving archaeological evidence in the Route 9A corridor, however, is unlikely to improve current understanding of the manufacturing process, most of which appears to have been incarnate in the equipment, craftsmanship, and conveyor system installed in what were essentially warehouses. Architectural expression of these properties might contain interesting information on interior organization of space, mechanization, and labor. However, the archaeological evidence of foundations would provide information such as building dimensions and construction material that are already available in the historical cartographic record. No further archaeological work is recommended.

IX. CARPET INDUSTRY

A. HISTORICAL CONTEXT

1. Historical Development

Textile products were small, light, and relatively high in value; thus, transportation and space requirements were relatively unimportant. The textile industry that had started in New York in the nineteenth century continued to thrive in the twentieth (New York 1928d:78). In statistical terms and relative to the Greater New York Region, Manhattan south of 59th Street was relatively unimportant. It was characterized by a "surprising persistence and growth of small-scale manufacturing" and the predominance of "small wares plants," that is, small shops producing braids, bindings, trimmings, and labels. Indeed, 70 percent of the total number of small wares plants and 45 percent of the people employed in the manufacture of small wares were found in the shops in Manhattan south of 59th Street (New York 1928d:81, 90, 98). Cost and configuration of real estate in New York discouraged establishment of large textile mills, and the two plants located on the West Side between 42nd and 59th Streets in 1900 were gone by 1922. In general, during these decades, the industry, which had concentrated below 14th Street, drifted north of 33rd, reflecting growth within the industry rather than displacement (New York 1928d:81).

With regard to carpet manufacturing, the industry that was directly associated with the Route 9A study corridor, the largest plant in the New York City metropolitan area was Alexander Smith and Sons Carpet Company of Yonkers, which incorporated in 1872. It employed 6,000 people and was highly integrated. The plant housed the full range of processing, from spinning and dyeing the yarn through weaving the finished carpets. Other carpet factories were found in Brooklyn and Queens. Large plants, where most of the growth occurred, were located in northern New Jersey, in Passaic and Garfield, which were also historically textile manufacturing areas (New York 1928d:100-101).

Manufacture of textiles had been among the earliest enterprises to industrialize, that is, substitute power machinery for hand labor. Woolen yarns were classified as worsted or woolen; carpets were manufactured from worsteds. Although the worsted and woolen yarns shared steps in the preliminary processing of fleece, worsted yarns were more substantial than wool, with smooth, uniform fibers that were combed into parallel, even lengths and given even twist. This resulted in a smoother, harder surface and provided brighter color when dyed (Editors of American Fabrics Magazine 1972:97; Woolman and McGowan 1920:157). Most carpets were a type of pile fabric, which was woven in a process that employed extra filling or warp that was pulled through on the surface. Plush was then made by cutting the pile evenly (Editors of American Fabrics Magazine 1972:100).

Most innovations in textile and carpet manufacture originated in England, and many types of nineteenth-century carpeting carried English names (e.g., Axminster). In the U.S., Philadelphia was the center of carpet manufacture at the close of the eighteenth century, and in 1825, Alexander Wright established a mill for the production of ingrain carpet in Medway, Massachusetts. The company was bought out by the Lowell Manufacturing Company three years later and the equipment moved to the company's works in Lowell. The power loom was invented by Erastus Bigelow for the Lowell Company in 1839 and in 1848 the Brussels power loom was perfected, also for the Lowell Company. Nineteenth-century carpets were woven in 27-inch widths and rugs were then stitched together. Around 1900, the broad- or wide-loom was introduced, which made possible modern one-piece expanses. The second major innovation of the twentieth century was tufting, which largely replaced weaving as the manufacturing process for carpeting (Editors of American Fabrics Magazine 1972:487-489). Electricity was substituted for steam as the power source in the early twentieth century (Electricity in Carpet Manufacturing 1914).

Wool was the principal raw material, although jute, linen, and other textiles were introduced depending on the type and quality of the carpet. There were 16 steps in the preparation of the yarns, which were then sent on to looms for weaving (Murphy 1911:136-142; Woolman and McGowan 1920:120-121). The steps are as follows:

1. Sorting. Fleeces arrived at the mill in a raw condition. At long benches or tables, sorters removed skin, burrs, and other similar foreign matter, and then cut the fleece into two pieces. The pieces of fleece were then classified by quality, typically into one of seven groups.

2. Cleaning. The still dirty and greasy fleeces were then cleaned in a feeder, which was basically a hopper that forced the fleece through slats or spikes. This process removed straw, burrs, and dust that had not been eliminated during sorting. Extremely matted or dusty fleece was sent through a duster.

3. Scouring. Sheep secreted a greasy yolk into the fleece, which was removed during scouring. Scouring was basically a three-step process during which the fibers were soaked in three troughs or tanks containing different chemical solutions. In addition to the troughs or tanks and the pipes and boilers supporting them were apparatus for wringing out the soaken fibers. By the early twentieth century, it was recognized that the waste fluids contained valuable by-products, mainly grease and oils, that could be recovered and sold to soap makers. Recovery plants filtered the oil and pressed it into solidified blocks for re-sale.

4. Dyeing. The cleaned yet unspun fleece was dyed prior to carding and spinning.

5. Drying. Dyed fleece was still wet and was dried in a two-step process. It was put in a hydro-extractor, not dissimilar to a modern tumble dryer, which eliminated moisture by centrifugal force. The still-damp wool was then laid on a series of frames and hot air was fanned through it. Alternatively, it was placed in a chest held over hot air pipes rather like an oven.

6. Burring. In short staple wools, burrs frequently survived all of the previous processes and were removed before carding either through a chemical process or through a mechanical one, employing a series of rollers and brushes.

7. Blending. Blending involving combining various grades and colors of wools to obtain the desired weight and color for the eventual fabric.

8. Oiling. Natural oils had been removed from the wool during scouring and was returned after the processed wool had been blended. The wool was spread out over the floor and lightly sprayed with oil. Types of oil included olive oil, tallow oil, and different animal oils.

9. Picking. The first step in the spinning process, picking was similar to carding but its purpose was to open the entangled fibers prior to combing or brushing them. Picking machines were eventually incorporated into the carding machinery.

10. Carding. The purpose of carding was to comb out the fibers until they were parallel. The process usually involved at least three separate pieces of equipment and several steps. The wool at this step had been prepared into a film but the fibers were not yet separated and combed.

11. Preparing Gilling. A step in the combing process, the purpose of preparing gilling was to draw, straighten, and make the fibers parallel. The equipment comprised a gill box with rollers and rows of teeth.

12. Combing. Although arrayed in fibers, the wool arrived at carding with a mix of long, smooth and short, curly fibers. During combing, the short, curly fibers, which were called noils, were removed, leaving the long, smooth fibers, which were called tops. There were various types of combing equipment developed for the different wools. An illustration of the Noble Comb, developed to deal with both long and short staple wools, is presented in Figure IX.1.

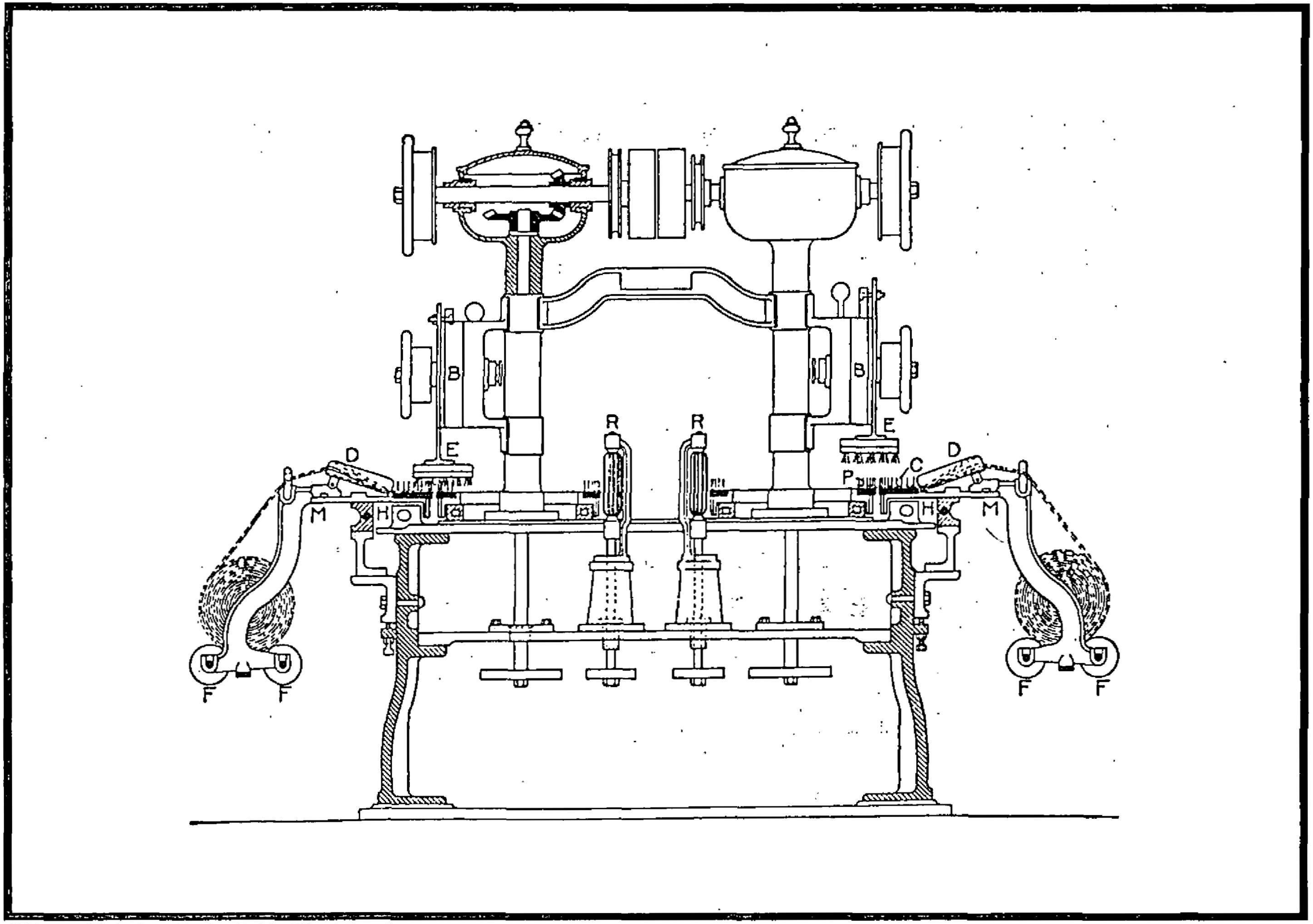


FIGURE IX.1 Detail of a Noble Wool Comb

SOURCE Woolman and McGowen 1920:139

13. Backwashing. Passage through the various pieces of equipment typically soiled the wool. Attached to both gilling and combing equipment were bowls, wringers, and drying apparatus. The wool was again oiled after intermediate washing.

14. Gilling. This step was essentially the same as that which preceded combing. Its purpose was to blend the tops through very fine combs.

15. Drawing. Tops were still fairly coarse. During this step, the tops were pulled and twisted onto bobbins.

16. Spinning. There were different methods of spinning, depending on twist of the intended yarn and the texture and body of the material to be woven. Soft yarns were spun on a worsted mule and closely twisted yarns on an upright frame.

Clearly, the intended fabric influenced the processes almost from the outset although the machinery became more specialized as the processing progressed. After the yarn was spun, carpets and other textiles were woven on mechanized looms. Ingrain and Brussels carpets, for example, were woven on *Jacquard looms. Modifications* in warp, dyeing, materials, and the looms themselves were introduced based on the quality and pattern of the product (Woolman and McGowan 1920:156-157).

2. Property Types

The E. S. Higgins Carpet Company (Block 1091) first appears in Longworth's American Almanac, New York Register, and City Directory in 1837 (1837:27). Then under the name "A. and E. S. Higgins & Co.," the company was located at 432 Pearl Street, that is, on the east side of Manhattan. It moved to 15 Murray Street by 1853 (The New York City Directory for 1853/54:306) and opened a branch at West 43rd Street, near Twelfth Avenue (i.e., within the study area) in 1855 (Wilson's Business Directory 1855:389). The name changed to "E. S. Higgins & Co." in 1858 (Wilson's Business Directory 1858:372). The company remained listed in the various city directories through 1899 (Trow 1898/99:570).

The E. S. Higgins Carpet Company was listed in both the 1860 and 1870 federal census of manufactures (U.S. Bureau of Census 1860:1; 1870:699). In 1870, the factory was equipped with steam power, and 425 men and 575 women were employed to produce 1,300,00 yards of carpet per year. Raw materials annually required by the process included 800,000 pounds of flax, 1,300,000 pounds of wool, and 2,500 tons of coal. Ten years later, the plant still used steam power, distributed among 350 woolen machines employing 400 men, 600 women, and 150 children. Materials required annually included 3,500,000 pounds of imported wool, 3,500,000 pounds of cotton, 2,500,000 pounds of jute, and 3,500,000 pounds of flax. The plant had diversified to include manufacture of tapestry, carpet, velvet, "Body Brussels," three-ply carpet, Ingram, and Venetian fabric. Of these, carpet clearly predominated.

The E. S. Higgins Co. Carpet Factory is depicted on 1859 Perris atlas (Figure IX.2), the 1879 Bromley atlas (Figure IX.3), the Sanborn-Perris 1890 plat, and the 1911 Sanborn Map Company plat (Figure IX.4). Although apparently taken over by the Manufacturers Real Company by 1911, the plat, presented in Figure IX.3, suggests that unlike many of the other industries associated with the Route 9A study corridor, the plant contained several discrete buildings and activity areas. As evidenced in 1922 (Bromley 1922:2:39), these comprised a series of one- to three-story brick buildings facing West 43rd and West 44th Streets with some open interior yards between the two street frontages.

B. ARCHAEOLOGY

1. Research Potential

Research questions associated with the investigation of textile works in general, and carpet manufacture in particular, address the relationship between mechanization, equipment, space, and structures. More general historical information concerns the organization and composition of the work force in the textile industry, which was among the earliest to employ women on a widespread basis (see Dublin 1979; Hareven and Langenbach 1978). These questions, however, are not amenable to answers through the archaeological data.

Archaeological investigations related to textile manufacture have been conducted at mill towns, such as Lowell, Massachusetts, and Paterson, New Jersey, where worker residences and manufacturing plants were contained in a single, broadly defined resource or cluster of resources (Beaudry and Mrozowski 1989; DeCunzo 1982, 1983). These studies have shown that when clusters of residential properties can be identified by socioeconomic group, the domestic deposits can yield significant information, although they may not be assignable to historically documented or known households. Thus, standards of living among textile workers is one area of investigation that can be addressed through archaeological data. However, in urban settings like the Route 9A corridor, manufacturing sites were located to take advantage of the urban work force which was dispersed throughout the city. From an archaeological perspective, these manufacturing sites would not provide data on the nonresident workers.

Within individual factories and from the perspective of the technology, the obvious questions for the study area include the arrangement of equipment to facilitate efficient flow from raw or semi-processed material to finished goods, while taking into account space constraints, power source, raw materials, type of equipment, and the market. Unlike many of the other industries represented in the Route 9A project area, the carpet works provided finished goods for consumers and as such might be expected to wax and/or wane with local prosperity. Moreover, the historical maps suggest that the E. S. Higgins Co. Carpet factory consisted of a series of specialized structures rather than a single structure within which activities were organized vertically.

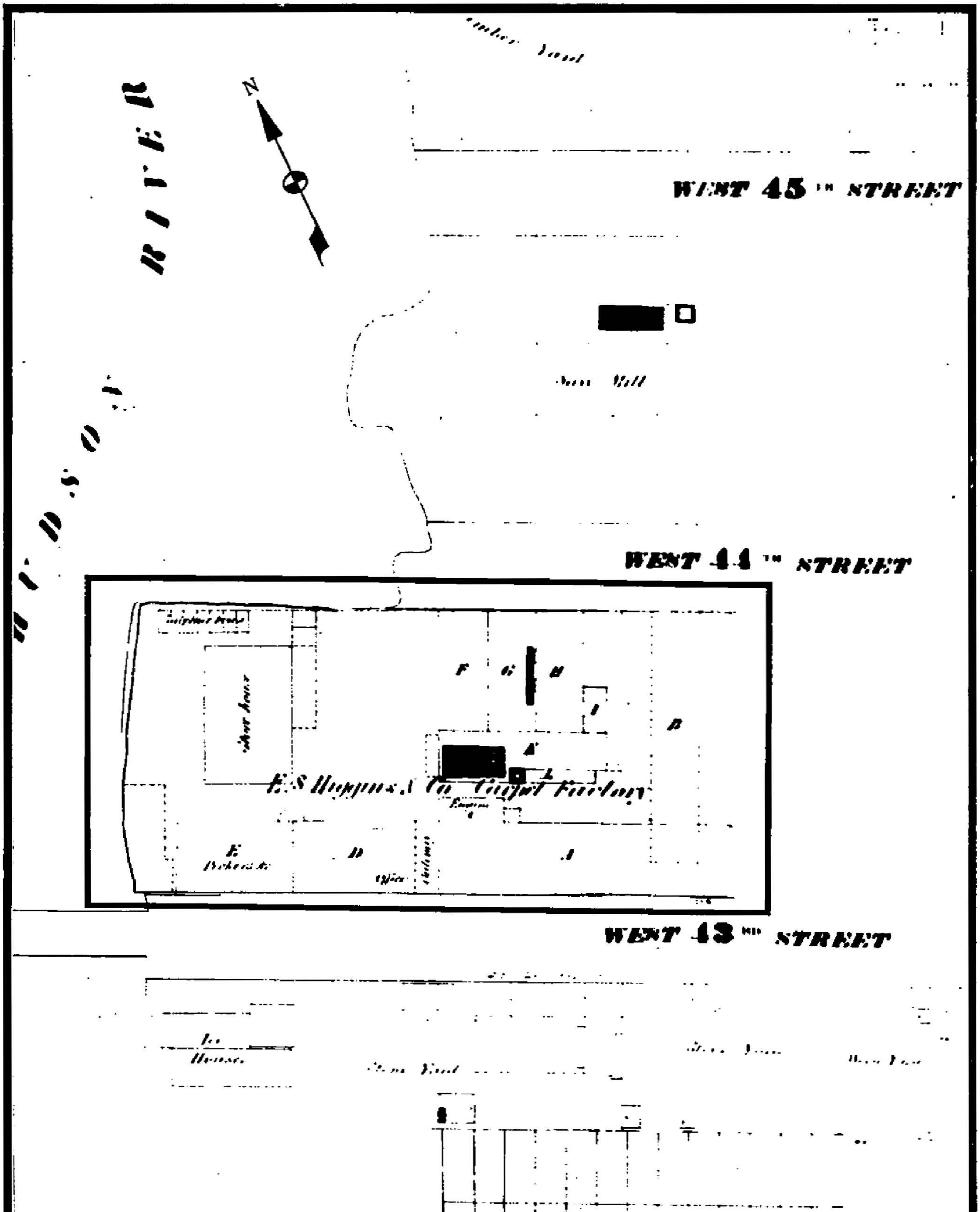


FIGURE IX.2 E. S. Higgins & Co. Carpet Factory, 1859

SOURCE Perris 1859 Vol. 6:99

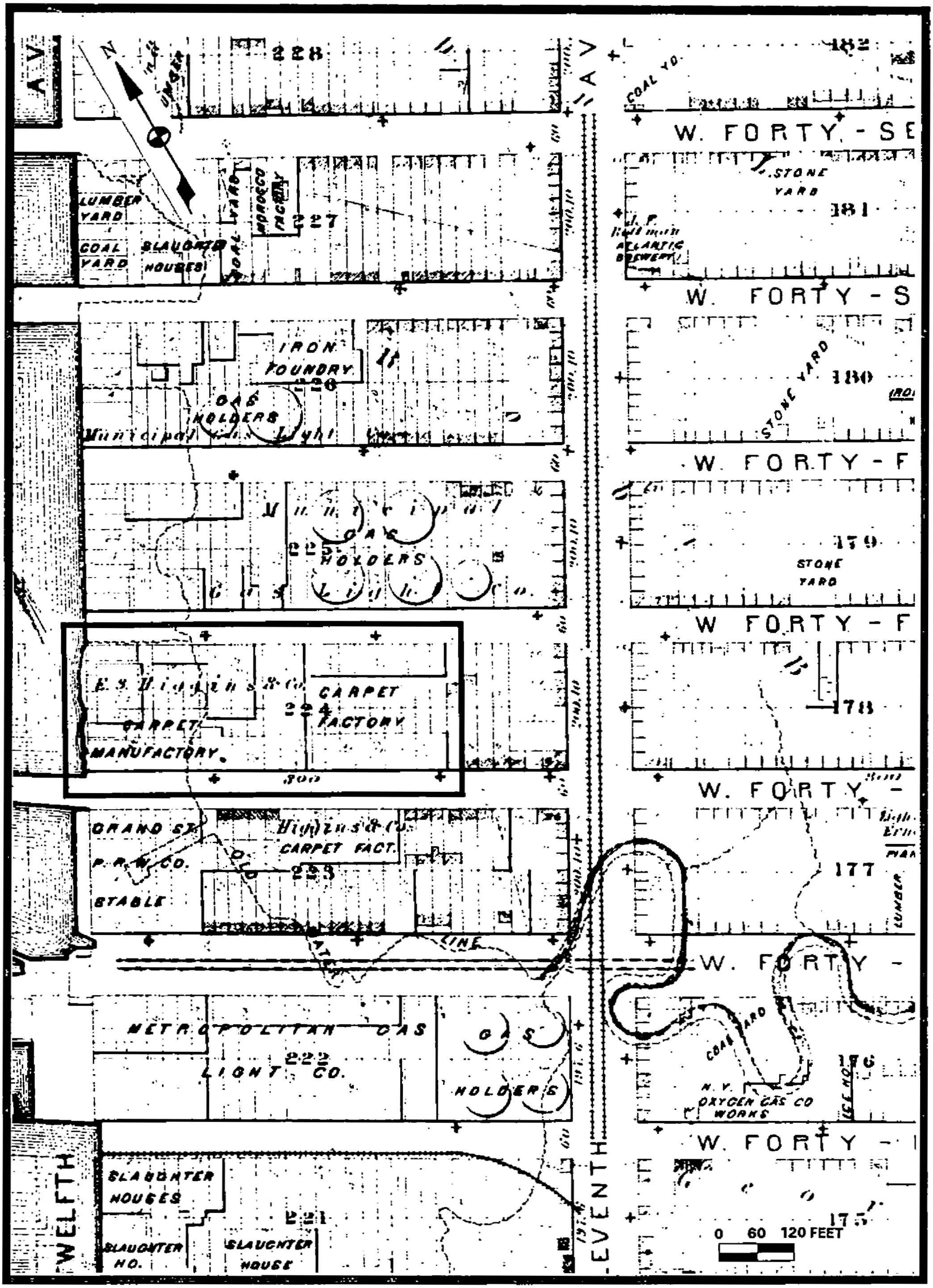


FIGURE IX.3 Configuration of Higgins Carpet Factory, 1879 — *SOURCE Bromley 1879:15*

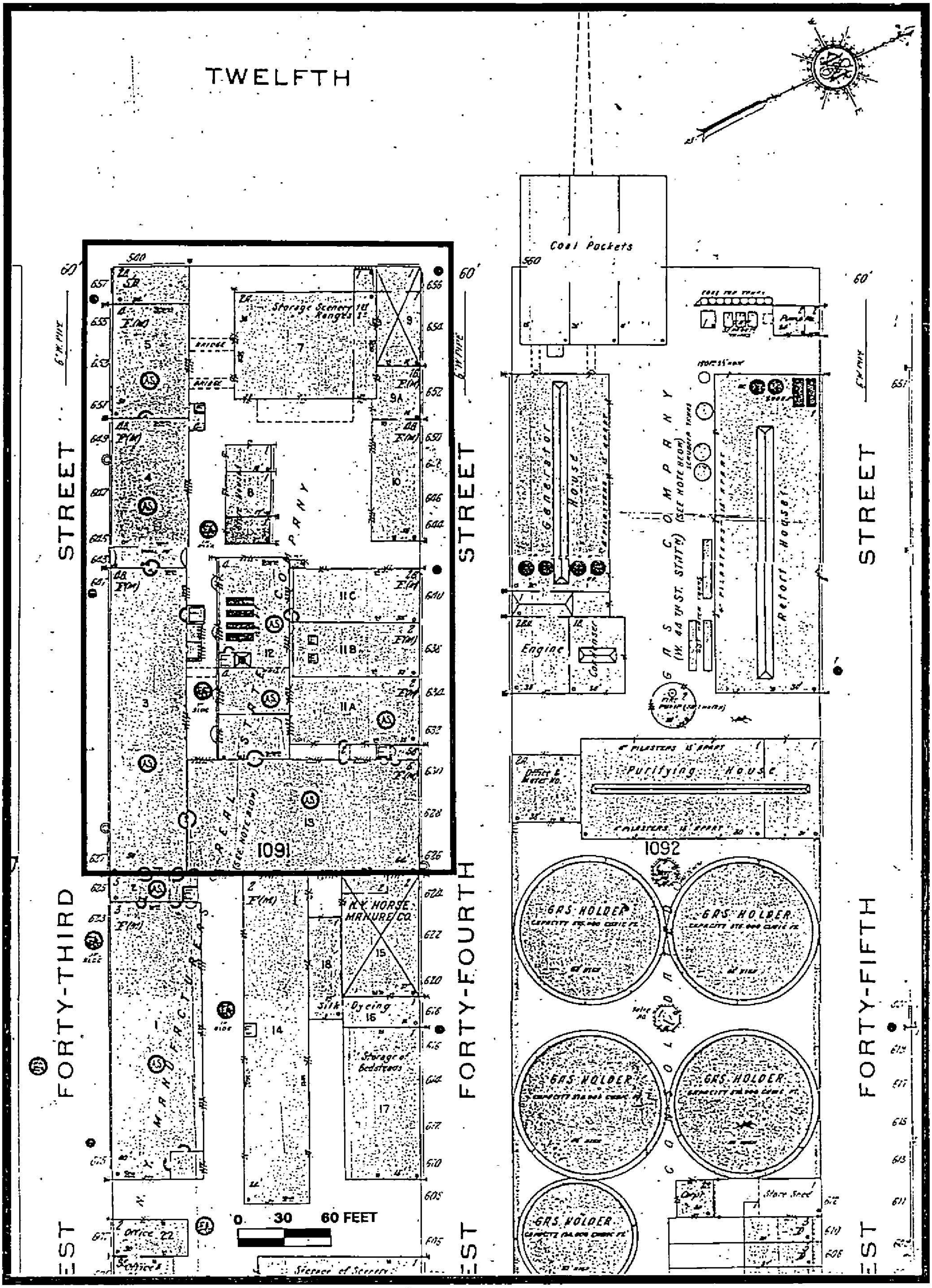


FIGURE IX.4 Site of Higgins Carpet Factory, 1911

SOURCE Sanborn 1911 Vol. 5:38

Textile manufacturers in New York City, such as E. S. Higgins, did not rely on hydropower as did many mill town factories. Research questions pertinent to this facility include the following: How were activities distributed within the site? To what extent was the organization of activities and labor affected by consideration derived from sources of power, movement of bulk fuels and raw materials, and the type of equipment required? How did the apparatus affect construction technique and materials? To what extent was the factory dealing with the full processing of wool from fleece to carpet, which is suggested by the word "pickers" associated with one of the potential resources. Picking was an activity associated with cleaning and stretching the fibers. As suggested by the metal-working industries, did the factory accept semi-processed goods, thus reducing its need for bulk storage of high volume yet low value goods, for manufacture into finished consumer products?

2. Archaeological Visibility

The Higgins plant encompasses sites 119, 120 and 121 in Block 1091, between West 43rd and West 44th Streets. The factory extended over approximately the western two-thirds of the block, and fronted upon the river in the 1880s but was developed as waterfront after 1900 (Hartgen Archeological Associates, Inc., and Historical Perspectives, Inc. 1990d:Figures 6-7B and 6-9C). About one-half of the original complex (the western half) is contained within the Route 9A study corridor. Available historical maps suggest that the building footprints, dimensions, and foundations constitute the principal archaeological expression of the carpet factory. The facility appears to have been steam-powered and there is no evidence of access to flowing water from channels, raceways, or other, similar conduits. Water may have been pumped into the facility from city mains for processing tasks. It is unlikely that evidence of the spinning and/or weaving equipment has survived although there may be some discard of broken tools in what had been the yard area intermixed with more generalized yard refuse. The site, therefore, has low archaeological visibility.

C. CONCLUSIONS

Siting the plant immediately adjacent to the waterfront suggests that one of the problems, movement of high bulk low value raw materials was minimized by its close proximity. The technology of carpet manufacture was inherent in large pieces of equipment. As was the case with regard to piano and chemicals manufacture, the buildings were essentially warehouses or envelopes within which the apparatus necessary for the work could be installed. No particular demands were placed upon the buildings except, perhaps, the need for large windows to permit maximum natural illumination of interior spaces. This, however, together with the organization of activities themselves is expressed above rather than below or at grade. Historical plats and atlases do not indicate the organization of activities by individual building, although at least one is labeled "storehouse." However, the presence of the individual pieces of equipment would be necessary to ascertain interior activity areas and from them to extrapolate the flow of work. In a general sense, this flow is already fairly well understood from other sources and from examples of the equipment itself. Absent associated housing, questions associated with lifeways of the work force are not answerable, and the surviving archaeological remains are considered of relatively low value.

X. COOPERAGE AND CARTONS

A. HISTORICAL CONTEXT

1. Historical Development

Although New York State had led the nation in value of lumber and lumber products in 1840 and 1850, by 1920, U.S. lumber production had declined by 20 percent from its peak in 1907. Nationally, centers of production included Grand Rapids, Michigan; Jamestown, New York; Evansville, Indiana; Rockford, Illinois; and High Point, North Carolina (New York 1928c:13). This shift in geographic centers reflects the opening of new, less densely settled areas as well as the costs of transporting a low-value high-bulk product such as unprocessed or semiprocessed timber. Products that tended to survive in the city and its environs were high in value relative to their bulk, primarily highly fabricated items such as furniture and musical instruments. Additionally, in these industries demand for skilled labor was high but the space requirements were relatively low (New York 1928c:14, 17). Not surprisingly, New York City's woodworking industries in the early twentieth century comprised a large number of small establishments in which skilled hand labor predominated and little use was made of relatively expensive power machinery (New York 1928c:17). However, the proximity to lumber yards together with the demand for packaging clearly sustained a small market from manufacture of boxes and containers near the city's growing industrial West Side.

Wooden packaging and containers were manufactured at cooperages. When these shops were included as elements in an industrial plant or campus, they were sited in close proximity to factories in which products were shipped out in wooden barrels, boxes, and kegs. Coopers had been important figures in preindustrial villages, where the range of their products included churns, butter tubs, vats, barrels, buckets, casks, and kegs (Early Trades and Crafts Society 1975:9). Packaging differed from the run of wooden products in that the construction element was the wooden "stave." Although containers varied in size and function, the basic elements were as follows: processing the stave (shaping, drying, jointing); raising (that is, forming the staves into the cylindrical form of the container); chamfering, crozing, and leveling (the three steps that finished the ends of the staves so that a tight seal would be formed when the heads were attached to either end), and then the finishing (Early Trades and Crafts Society 1975:25-33; Hankerson 1947:24-37).

Within each element of the process were a series of steps that included both soaking and heating to create malleable and moisture-resistant surfaces and containers. Thus, rough staves were kiln-dried to a uniform moisture content, then steamed during raising to soften the wide fibers, and finally fired after the barrel had been shaped. Trussing, that is, driving iron hoops around the semifinished barrels, was accomplished after the firing (Hankerson 1947:24-25).

2. Property Types

Although cooperages were known to have existed within the study area in the late nineteenth century, they were unidentified except with regard to function (Block 687, 692, and 1098). Three cooperages were reported in the 16th Ward of New York City in 1870, which included the study area (U.S. Bureau of Census 1870:261, 263, 277). Two of these, John & Sons and Henry Cooney, used staves or lumber to manufacture barrels, and the third, Stephen S. Baker, appears to have recycled "old casks." These were all small shops, each employing 3 to 12 workers.

Only one of the three cooperages/box manufactories associated with the Route 9A study corridor predated 1900 and that was the cooperage associated with the Bradish Johnson storehouse between West 15th and West 16th Streets in Block 687. Located directly across from the piers, its function as a packaging facility either for goods to be shipped out by boat (after being temporarily stored in the storehouse), or to be crated for shipment in smaller units within the city seems likely.

The two remaining cooperages included a large box factory between West 20th and West 21st Streets (Block 692), which operated between 1902 and 1913, illustrated on the Sanborn Map Company (1904:3:44) plat (Figure X.1) and a smaller cooperage at the corner of West 50th Street and Twelfth Avenue, with a barrel yard behind it (Sanborn Map Company 1911:5:50; Figure X.2). The former was a four-story building equipped with steam and gas power and light. The latter was a five-story brick building. The locations of both of these larger plants are quite interesting; both are sited near existing lumber and storage yards (stone, coal), which are relatively expansive land uses, implying that the property values in this vicinity may have been low relative to other locations were demand was higher.

B. ARCHAEOLOGY

1. Research Potential

The existence of the cooperages and box makers in the study area is reflective of the support industries that developed in association with transportation into and out of the city as well as the needs of the heavy industries located nearby. Not surprisingly, as observed with respect to the manufacture of pianos, cooperages and other wood-working sites were located near the lumber yards, which were presumably the sources of raw material. Manufacture of barrels derived from a far older crafts tradition. Thus, from the perspective of technology, the critical research questions include the following: As was the case in the manufacture of pianos, how did the introduction of mechanization, assembly line segmentation of the process, and introduction of economies of scale practicable under a factory system manifest themselves in the organization of labor and activities? To what extent was there evidence of mass production, or, in fact, were these "factories" similar to custom mills, which were geared to processing individual orders? Under the latter scenario, it might be expected that shops were smaller, activities were segmented and regimented, and greater evidence of individualized craftsmanship might be

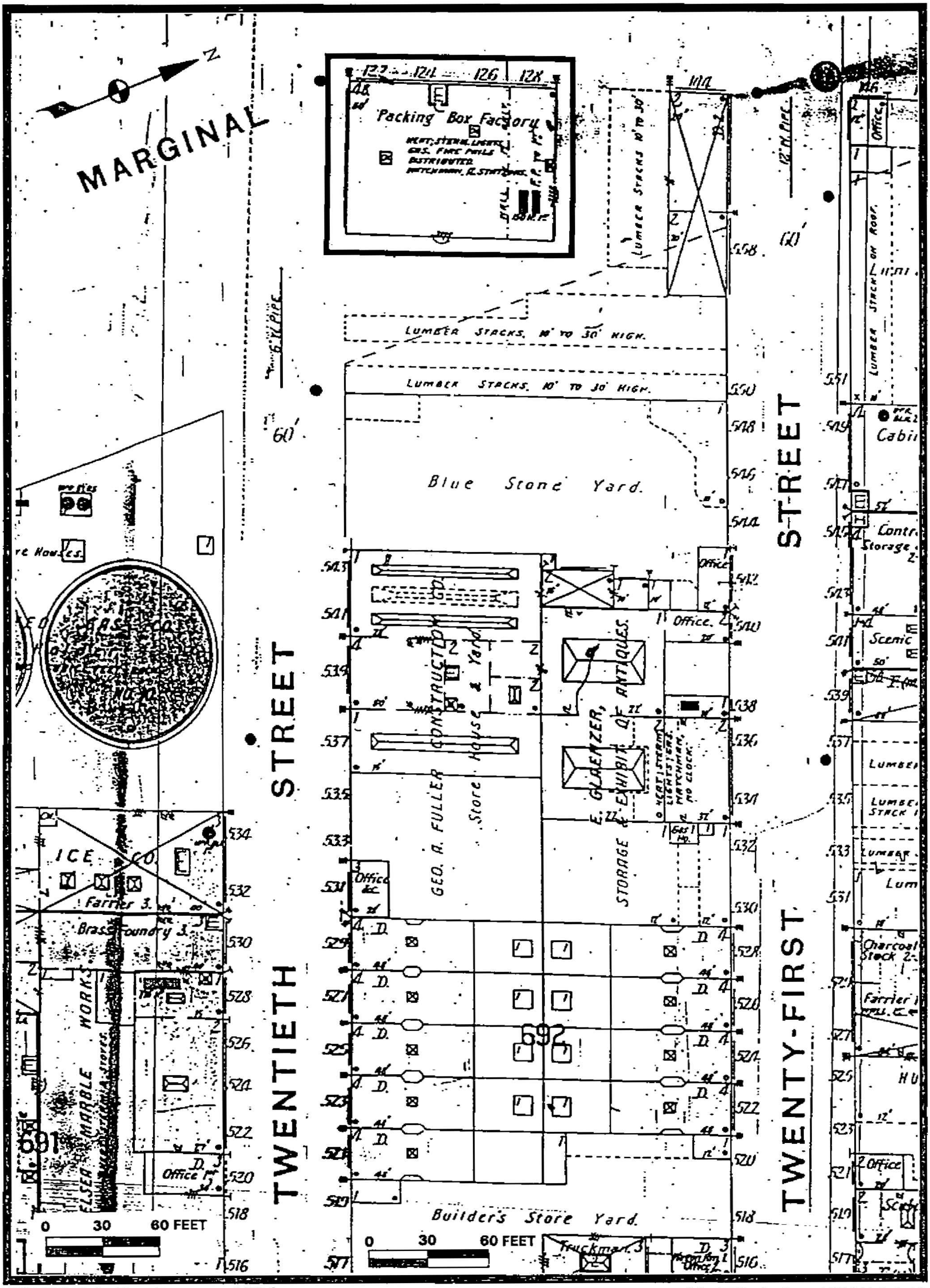


FIGURE X.1 Box Factory, 1904

SOURCE: *Sanborn 1904 Vol. 3:44*

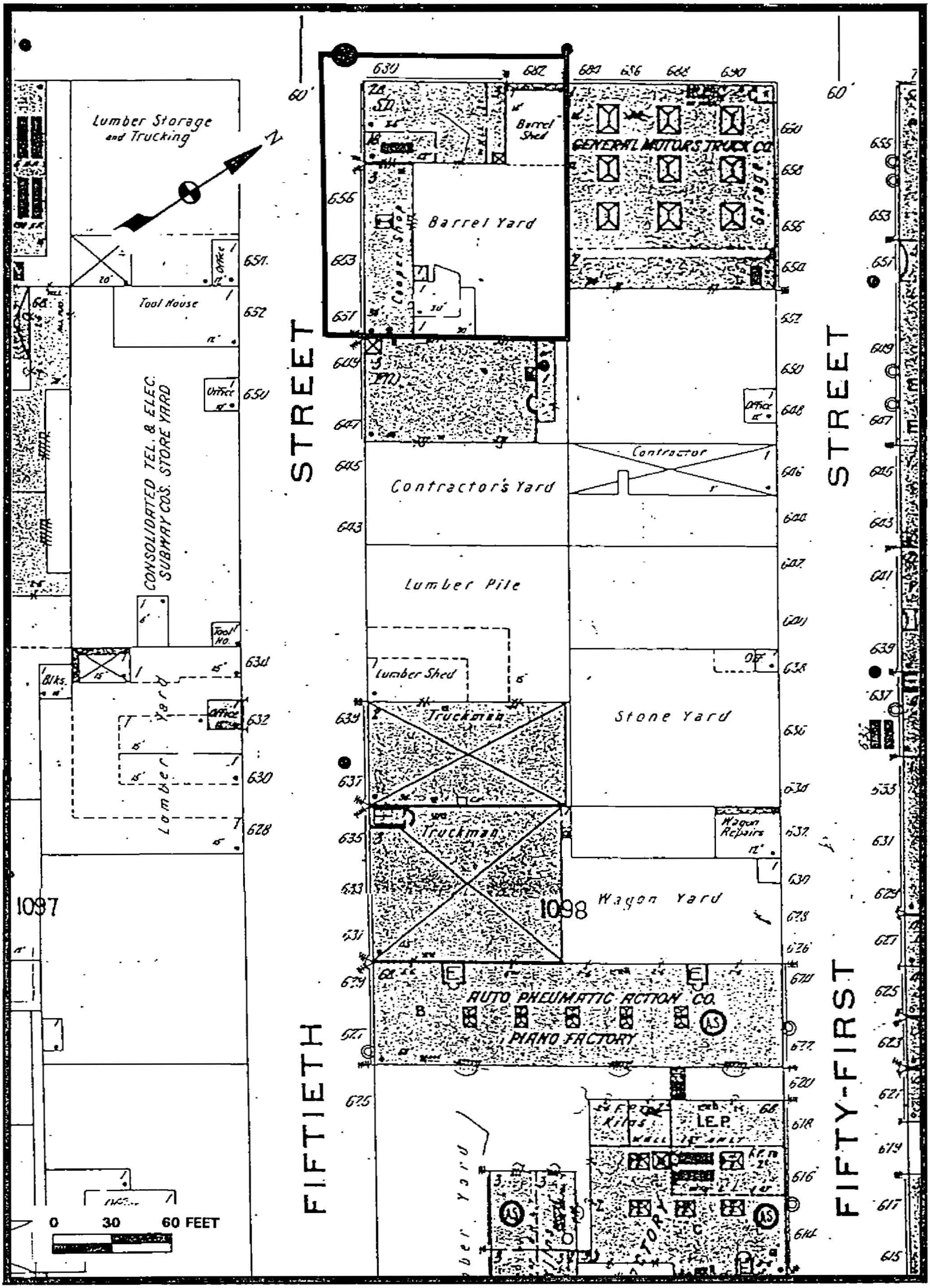


FIGURE X.2 Cooperage, 1911

SOURCE Sanborn 1911 Vol. 5:38

apparent. Finally, what were working conditions in the cooperages? How did they compare with working conditions in piano factories, which were somewhat similar and how were they affected by alterations in the scale of the factory and associated organization of labor and activities?

2. Archaeological Visibility

The box factory (Site 318, Block 692) appears to have been wholly contained within a single building, which would be manifest as a series of foundations, dimensions, and a footprint. The small cooperage (Site 94) dating to the mid-nineteenth century was immediately adjacent to and upon a pier. There may be footings and again evidence of the foundations still resting on the surface of the pier. These two sites have little archaeological visibility. However, the cooperage at the corner of West 50th Street and Twelfth Avenue (Site 465; Block 1098) may retain archaeological visibility. This site had an open yard area behind the shop, denoted "Barrel Yard" (see Figure X.2), which was presumably used for temporary storage. It is possible that, in addition to the building footprint, scrap related to barrels and/or parts may be recovered from the yard areas of this site. There may also be archaeological evidence of refuse deposits and discarded tools in the yard area that could be associated with the workers employed in the shop.

C. CONCLUSIONS

Potential archaeological remains fall into two broad categories: those associated with the building and those in the yard area. There is no evidence that the activities of a cooperage made special demands upon the construction of the building; hence the footprint and its dimensions, amply documented in surviving historical maps and atlases, possess little research value. Within the yard area, the wood scraps and refuse in and of itself possesses little interest. Prior research has demonstrated that analysis of wood samples yields little datable information although wood types may be identified (Louis Berger & Associates, Inc. 1988b:VII-6). Although of some interest from the perspective of identifying sources of raw materials used by manufacturers in New York City, the same finding may be obtained from investigation of the lumber yards and does not address questions specific to understanding cooperages and their role in the port of New York. Yard deposits assignable to the work force, if preserved, would contribute to the establishment of a data base on industrial working conditions. However, these data would possess little research value absent the collection of data from other comparable settings. Archaeological testing conducted by Louis Berger & Associates, Inc. at other industrial sites (Holt and Alterman 1991; LeeDecker 1991; Louis Berger & Associates, Inc. 1990) has demonstrated, however, that the likelihood of preservation of deposits that provide data on working conditions is extremely low and difficult to assign. No further archaeological work is, therefore, recommended.

XI. MALT INDUSTRY

A. HISTORICAL CONTEXT

1. Historical Development

The Maltster's Guide (White 1869:9) defines malting as "an art, whereby grain, such as barley, oats, bere or bigg, rye, maize, wheat, beans and peas, is converted into a sweet friable substance, termed Malt; which is used for the purpose of brewing beer, or the production of saccharine wort, from which, when fermented, alcohol is extracted by the process of distillation."

The process of malting starts by steeping a grain, usually barley, to promote germination, which is stopped by applying heat and the loss of moisture (White 1869:53-54). The only materials required for the manufacture of malt were a grain, fuel, and water. Typically, the grain was steeped in cold water for about 50 hours, with the water changed once during this interval (Prescott 1870:51). The germinated grain, which would be soft and swollen, was then placed on a rectangular frame where its tax value was assessed. It was then drained and spread on a floor, usually of slate, tile or stucco. The maltster would turn the grain to regulate temperature and obtain even growth. The grain was then heated in a kiln to arrest germination. The heat in the kiln was maintained between 140° F and 210° F, depending on the type of malt desired, for about 3 hours. The heat source was a wood or charcoal fire underneath the perforated kiln floor (Prescott 1870:51-52).

Malt kilns consisted of perforated floors below which were furnaces to supply heat for drying. In order to save fuel and space, the kiln floors (in malt houses) were placed one over the other, usually two in number, but sometimes three (Wahl and Henius 1902:585). Malt kilns were often roofed with wooden domes through which steam could escape. The steam would cause the dome to revolve and the speed of the revolutions became a measure of the baking and a bench mark by which the maltster evaluated the process (Prescott 1870:53).

Different kinds of malt, which included pale, amber, high-dried, porter, and patent or roasted malt, were used to produce a variety of alcoholic beverages (e.g., beer and porter). In the manufacture of roasted malt, for example, pale malt, which had been dried at a lower temperature, was roasted in cylinders until it was blackened. Patent or crystallized malt employed drying equipment, which consisted of an oven with iron doors within which a mechanized iron cylinder was rotated. The process required about three hours and resulted in a sweet, aromatic grain (Prescott 1870:53-54).

Malt houses were typically situated where there was a good supply of water, good drainage, and free ventilation (White 1869:120). A malt house contained three facilities: a cistern for steeping the grain, a couch-frame, and a kiln for drying the grain.

2. Property Types

An unnamed malt house is associated with the Route 9A study corridor (West 49th Street and Twelfth Avenue) from 1859 to approximately 1913 (Block 97). By 1911, however, the site was occupied by the Hygiene Ice Company (Sanborn Map Company 1911:5:50). As shown on the Robinson (1883:1:17) atlas, this was a brick, L-shaped structure that occupied the corner of West 49th Street and Twelfth Avenue. The subsequent ice company appears to have taken over and extended the older building until it almost completely covered the available lot (Figures XI.1 and XI.2).

B. ARCHAEOLOGY

1. Research Potential

The possible adaptive reuse of the malt house as an ice factory poses several interesting questions. Both processes required easy access to water, thus presumably making possible at least some reuse of the malt house's plumbing for purposes of ice manufacture. However, the environmental controls essential for efficient ice manufacture were quite different. In particular, heating apparatus and features related to the malt house kilns would have been at best superfluous for ice making. The question would be, however, whether unnecessary features within the building were removed when the building was occupied by the ice-making company, or were they simply ignored and encapsulated within the expanded building.

2. Archaeological Visibility

The brick malt house (Site 130) is exhibited on the Sanborn-Perris Map Company (1859:6:102) plat. At that point, the building fronted the then-unfinished Twelfth Street but was essentially immediately on the Hudson River. There were yards to the east and north and the remainder of the block extending eastward was largely undeveloped. Subsequently, however, a varnish and shellac factory was built flush against the building which, by 1911, was an ice factory (see Figure XI.2). A lumber storage and trucking yard occupied what had been an open area north of the malt house.

The archaeological expression of the malt house is likely to consist of the building footprint, dimensions, and foundations. The evidence is most probably contained within the more recent building, if not wholly destroyed by it. Except for the small kiln and access to water as part of the processing of the grain, the process of malt manufacture had few distinctive construction requirements. Remains of yard deposits from the manufacture of malt at this site appear unlikely. The archaeological visibility of this industry is considered to be low, given the type of manufacturing process and the subsequent land uses documented at this location.

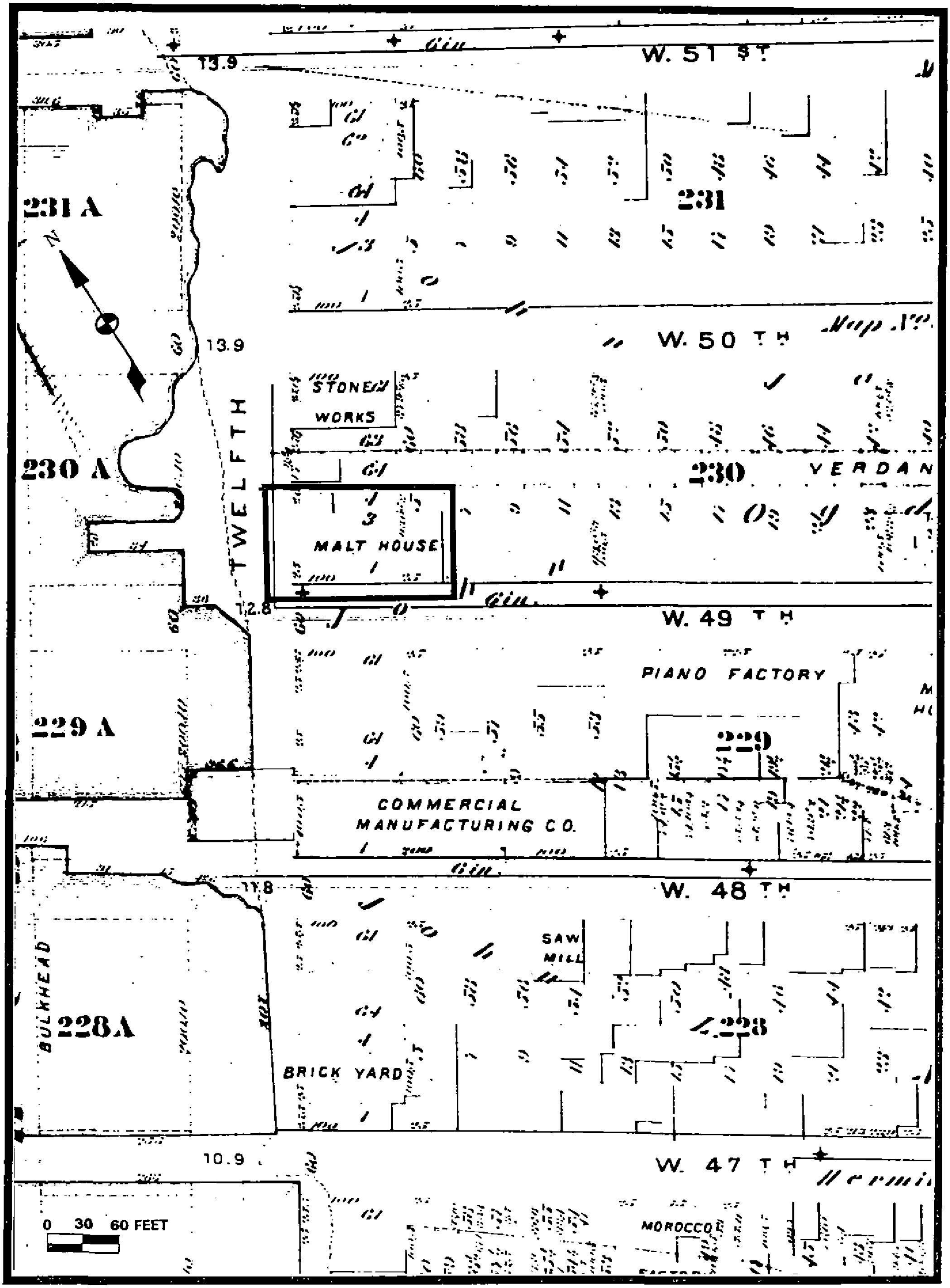
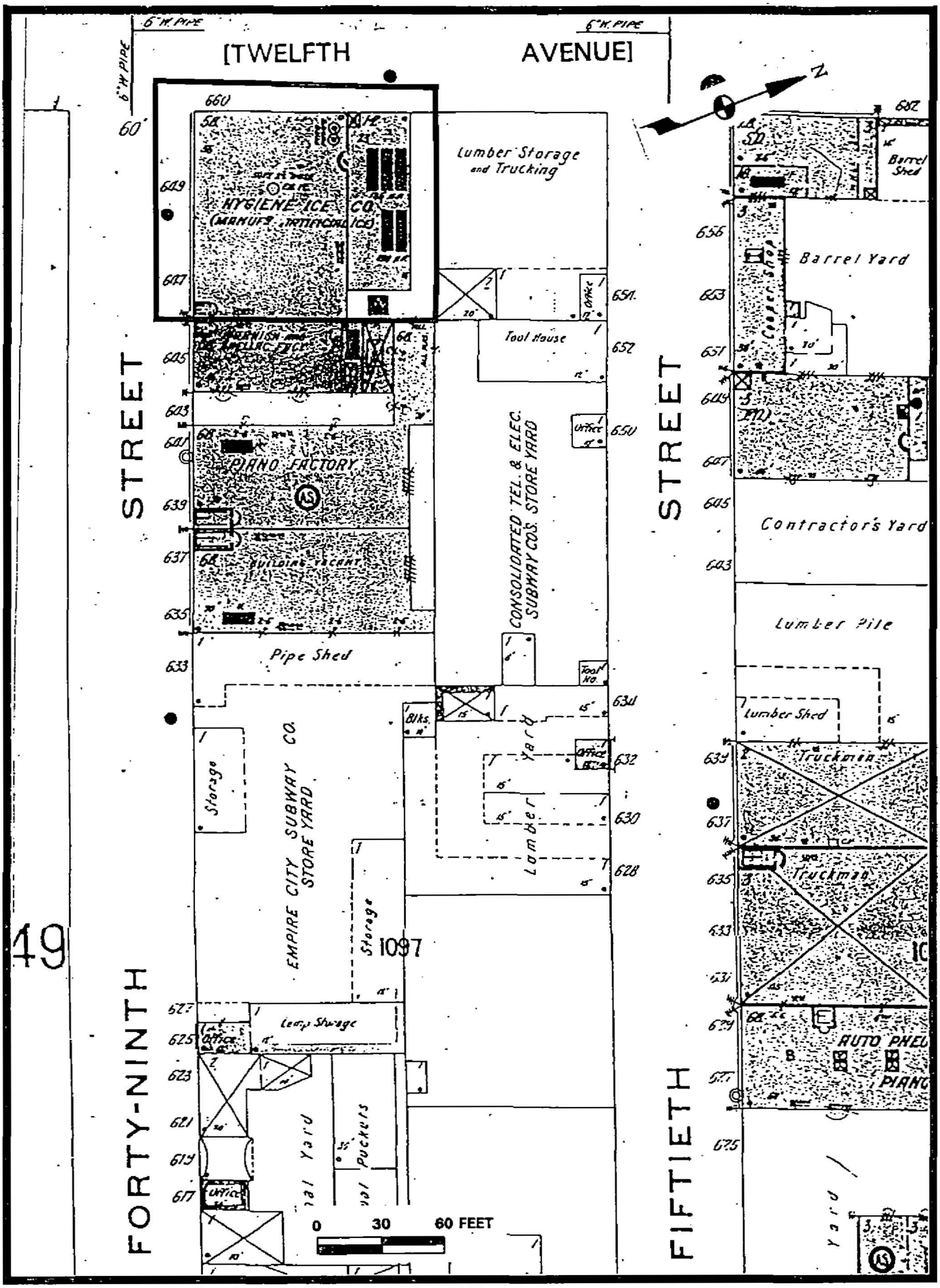


FIGURE XI.1 Vicinity of Twelfth Avenue and West 49th Street, 1883, Showing Unidentified Malt House

SOURCE Robinson 1883 Vol. 1:17



[TWELFTH AVENUE]
6"W. PIPE
HYGIENE ICE CO.
(MANUF'G. ARTIFICIAL ICE)
Lumber Storage and Trucking
Tool House
PIANO FACTORY
BUILDING VACANT
CONSOLIDATED TEL. & ELEC. SUBWAY COS. STORE YARD
Pipe Shed
EMPIRE CITY SUBWAY CO. STORE YARD
Storage
Lumber Yard
Barrel Yard
Barrel Shed
Contractor's Yard
Lumber Pile
Lumber Shed
Truckmen
AUTO
PIANO
Lamp Storage
Office
FORTY-NINTH STREET
FIFTIETH STREET
49
1097
0 30 60 FEET

C. CONCLUSIONS

Except for the kiln and the water management, most of the equipment (roasting kiln, drying cylinder) required for making malt was portable and installed in otherwise anonymous buildings. Overbuilt by the later Hygiene Ice Company building, the above-ground construction might possess interest for the adaptive reuse of the older structure. The archaeological remains, however, would consist only of building foundations that possess little research value.

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