OVERVIEW

While Wisconsin is widely recognized for its strong agricultural base, industry has also played a significant role in the state's growth and development. From the early mining activities in the southwest to the modern paper industry of the Fox River Valley, Wisconsin has supported a broad range of important industrial pursuits.

The foundation of Wisconsin industry is more than 150 years of small and large-scale industrial development. In general, the earliest industrial efforts in Wisconsin emerged to serve the pressing and comparatively simple needs of the pioneer period or to harvest the state's abundant natural resources. Much of the early settlement in Wisconsin was due to the mining activity in the rich southwestern lead mining region between the 1820s and 1840s. Communities such as Mineral Point, Platteville, Belmont, and New Diggings were established with early efforts to mine the region's rich reserves of natural minerals and ore. In later years, iron and copper were also mined, providing significant industrial revenue for the northern tier of the state. Beginning in the mid-nineteenth century and continuing to the present, stone quarrying and gravel production became important industrial pursuits. Quarries were located in various parts of the state, producing sandstone and limestone, mainly for building and road construction.

Wisconsin's abundant water-power resources were initially one of the most important factors in the development of many industries in the state. In crossroad communities throughout the early areas of settlement, small streams and riverways were put to work powering rudimentary machinery that manufactured such diverse products as lumber, shingles, flour, and farm implements. Small sawmills were one of the earliest industries to utilize Wisconsin's natural resources. Timber was harvested for the manufacture of lumber and other products for purely local consumption. By 1860, almost every village located on a stream with sufficient power to turn a water wheel had a local sawmill, often operated in conjunction with a gristmill, to supply the needs of the growing community.

From rudimentary beginnings, the state's lumber industry eventually developed into an operation that supported over 1,000 mills statewide. In 1899, the industry produced 3.3 billion feet of lumber, ranking Wisconsin foremost in national production for the period (Alexander 1929:42). Solidly established prior to the Civil War, lumbering received its greatest impetus with the subsequent settlement of the prairie states west of the Mississippi River. Throughout the late nineteenth and early twentieth centuries logging and lumbering, along with associated industrial concerns such as sash, door, and blind factories, cooperages, and furniture manufacturers, helped reshape much of the economic and physical landscape of the state. Logging and related industrial pursuits provided a livelihood for a significant portion of Wisconsin's population.

Flour mills, grist mills, and blacksmith operations were other industries that initially emerged to supply the needs of pioneer life. As technology advanced, as the population's needs expanded, and as industry became a viable investment, many of these early industries evolved into significant enterprises. The flour mill and grist mill industry was particularly vital to Wisconsin during the nineteenth century. It intially gained importance during the territorial period, ranking as the leader of Wisconsin industries until dairying eclipsed wheat production and introduced a new era of agriculture and industry. Although practically every village on a sizeable stream had its dusty miller who supplied the flour needs of his district, the milling industry centered in Milwaukee and in the lower Fox River Valley. During the years following the Civil War, Milwaukee ranked among the leading flour-producing cities in the world and surpassed Chicago to become the world's greatest primary shipping point for wheat (Alexander 1929:38).

As settlement in the state advanced beyond the pioneer stage, Wisconsin's various river systems, especially the Wisconsin, Rock, and Fox rivers, began to acquire even greater importance as corridors of primary industrial development. By the second half of the nineteenth century, due to several factors Wisconsin industry developed agricultural expansion, population growth, improved transportation facilities, and widening markets all contributed to the industrial growth. Flour milling was the most profitable industry throughout the Civil War period, with the lumber and timber industry was close behind (Alexander 1929:32040). A number of other major industrial pursuits also emerged. Among the enterprises that greatly influenced Wisconsin's role in the overall industrial development of the upper Midwest were the leather-making industry, shipbuilding, brewing, meatpacking, furniture manufacturing, and agricultural implement production.

Particularly noteworthy is the growth of the agricultural implement manufacturing industry which sprang into prominence during this period. It emerged and became prominent through inventions and improvements inspired largely by farm labor shortages during the Civil War. At that time, Wisconsin was primarily a wheat-raising state with a production of 28 million bushels of wheat in 1860 (Alexander 1929:35). Working in a Wisconsin machine shop, Appleby created the knotting device that made the McCormick and Marsh harvesters true self-binders. Inventions and improvements achieved by Case in Racine made the threshing machine more efficient. Case also perfected the self-propelling steam tractor. The Van Brunts of Horicon contributed the broadcast seeder and the disc drill, revolutionizing small grain raising. Similarly, Janesville, La Crosse, Madison, Port Washington, Racine, and Sheboygan Falls became manufacturing centers of improved plows. Mechanics such as Bain and Yule of Kenosha, Mitchell and Lewis and the Fisk brothers of Racine, and Mandt and Vea of Stoughton emerged from pioneer blacksmith shops to establish the wagon-making industry for which Wisconsin was long famous.

A large number of factories established during the period met the acute need for labor-saving machinery on Wisconsin farms. Following the war, these factories supplied machinery to farmers opening the vast prairies of the West and Northwest to cultivation. Many of the factories continued to operate well into the twentieth century, ranking Wisconsin as a top manufacturer in the agricultural implement industry.

By 1880, Wisconsin's leading industrial products in terms of the value of production were flour and grist mill products, lumber and timber products, leather products, distilled and malted liquors, iron and steel, slaughtering and meat packing, clothing manufacturing, carriages and wagon manufacturing, foundry and machine shop products, and agricultural implements. Industries such as brewing and leather production were located primarily in Milwaukee and along the Lake Michigan shore, staffed by the region's abundant stock of German laborers. The Rock River and Fox River valley communities of Beloit, Janesville, Watertown, and Neenah and Menasha, with their water power resources, became secondary centers of sizeable industrial growth. Neenah and Menasha were second only to Milwaukee among Wisconsin communities in the flour-milling industry. Favored with unlimited power and excellent marketing facilities, the flour mills of Appleton, Superior, La Crosse, and De Pere also contributed to the ranking of Wisconsin as the premier flour producer in the upper Midwest. Other industrial development was scattered throughout the state, from Douglas to Marinette counties in the north to Walworth and Grant counties in the south. Industries as diverse as stoneware and brick manufacturing to fishing and shell button manufacturing developed in the less populated parts of the state.

The turn-of-the-century period was marked by the replacement of out-of-date and outmoded industrial concerns with newer manufacturing pursuits. Wisconsin was eclipsed in the flour industryby Minnesota. New milling technologies utilized in industrial complexes in Minneapolis and St. Paul in the late nineteenth century led Minnesota to become the nation's leader in flour milling. Many of Wisconsin's former milling sites were

available for new uses. The pulp and paper industry, however, was one of the state's major growth industries. By the turn of the century the industry had moved into the northern regions of the state, occupying areas recently vacated by the pine-lumbering industries. While depletion of standing pine in Wisconsin stimulated the decline of the logging and lumbering industry, pulp and paper firms were able to take advantage of overlooked hardwoods in the region. Moreover, in the Wisconsin, Fox, and Chippewa valley areas, paper enterprises occupied many vacated flour-milling sites. Other important "new" twentieth-century industries were automobile and automobile machinery manufacturing, which replaced the carriage and wagon trade, fruit and vegetable processing, particularly in the northern and central Cutover regions, paper and cardboard box manufacturing, and foundries and heavy machinery manufacture.

Wisconsin has passed through three distinct periods of industrial development during the past 150 years. The first was the pioneer or flour-milling period, extending from territorial days through the Civil War era. Flour milling utilized the abundant natural resources for power and generally limited marketing to the surrounding area. Sawmills also became important during this period, but evolved into the second period of industrial growth, characterized by expanded marketing areas and an increasing sophistication in industrial technology and management procedures. Wisconsin's final period of industrial growth was marked by the transition to modern industrialized specialization. Industries such as paper manufacturing and heavy machinery production began to appear. This period, continuing to the present, is characterized by the development of manufacturing enterprises that are capable of offsetting the decline of formerly prominent industries, such as lumbering, in order to maintain Wisconsin as one of the nation's industrial leaders. (Lusignan)

SOURCE

Alexander, J.H.H.
1929 "A Short Industrial History of Wisconsin." In The Wisconsin Blue Book, 1929, edited by William J. Anderson and William A. Anderson. State Printer, Madison.

PROTECTION

Threats to Resources

Industrial development in Wisconsin has gone through many changes since the early years of settlement, and continues to evolve as time, technology and economic conditions change. The single largest threat to industrial resources in the state is the continual expansion and modernization of old plants, machinery and operational systems. Older resources are continually made obsolete by new technological advances.

Many of the earliest industries to be established in the state operated on only a minor scale and their physical plants and factories were of simple design. Industrial growth caused the replacement of many of those sites, or their abandonment for better locations. Many early industries, such as milling and carriage making, which were found to some degree in almost all early communities, eventually centralized in communities where supply and overhead costs could be minimized and operations streamlined. This consolidation and evolution of industrial concerns continued through the nineteenth and early twentieth centuries, creating constant threats to the existence of historical resources.

In more recent times, many Wisconsin industries (brewing, meat packing and milling for example) have relocated to states that are closer to natural resources or major market areas. Others have left the state simply because of a depletion of the natural resources

that supplied their operations. Examples include logging and lumber milling, iron and copper mining, and lead and zinc mining. Each has left a some legacy of physical resources and cultural associations. Some have been reused by other industries, altering considerably their historical integrity, while others have simply been abandoned. Obsolete and without value, these resources have quickly deteriorated and many are no longer extant. In the case of logging, mining and quarrying sites, many have been reclaimed by nature. Industrial machinery has been one of the largest casualties of abandonment. While industrial structures are extant in many communities, obsolete machinery often commanded high prices from scrap dealers or competing concerns, particularly during the two World Wars.

Continual pressure from urban and suburban development has resulted in many older industrial resources being destroyed. Even in rural areas, growing agricultural, tourist, and recreational uses have claimed many resources, particularly in the logging and mining industries. Industries that by their nature required housing in temporary structures are especially subject to rapid decay and removal (fishing and pottery manufacturing, for example).

Waterfront properties (ice harvesting industry, fishing industry, shipbuilding) have been particularly vulnerable due to the vigorous desire of individuals and communities to rapidly develop their valuable waterfront sites. Other water-related resources, such as logging dams and booms, power canals and waterwheels have been destroyed as hazards to navigation.

Waterwheels have been destroyed as hazards to navigation and to fish habitats. In recent years resources along the coasts of Lake Superior and Lake Michigan are threatened by increasingly high water levels.

Despite the fact thatWisconsin is well recognized for its industrial heritage, indistrial properties in the state are often viewed in a negative context based either on their locational pattern, functional obsolescence, or lack of visual attractiveness. Thus, the "old factory" is often judged in a much different light that the "old house."

Survey Priorities

- Rural surveys of the southwestern counties associated with late 19th and early 20th century lead and zinc mining to compliment the surveys of communities undertaken by the Southwest Wisconsin Regional Planning Commission.

- Completion of intensive survey of Kaukauna, centering on industrial resources.

- Thematic survey of extant breweries in the state.

- Thematic studies of Lake Superior and Lake Michigan fishing industries related resources.

- Thematic survey of stone quarrying resources in the Marquette, Green Lake, and Waushara counties.

- Thematic survey of the Milwaukee natural cement industry.

- Thematic survey of properties and sites related to the Lake Superior (including Bayfield and Ashland counties) brownstone industry.

- Intensive survey of iron mining resources in the Mayville/Iron Ridge (Dodge County) and Montreal/Hurley (Iron County) regions.

- Intensive surveys of Oconto and Peshtigo to discover lumber milling resources.

- Thematic survey of eastern Wisconsin lime industry.

- Intensive survey or thematic survey of Sheboygan County to discover furniture-making resources.

- Thematic surveys of the state's major riverway systems to identify industrial resources, including the Fox, Wisconsin and Chippewa River systems.

- Thematic survey of canning industry related resources in Brown, Calumet, Door, Fond du Lac, Manitowoc, Outagamie and Sheboygan counties.

- Thematic survey of resources associated with the sugar beet refining industry. (Potentially associated with an agricultural study as well.)

- Thematic survey of Great Lakes shipbuilding resources, either as a whole or approached by Lake Michigan and Lake Superior regions separately.

- Intensive survey of Two Rivers (Manitowoc County) to locate shipbuilding related resources.

Registration Priorities

- Grain elevators in Superior (Douglas County).

- Iron ore docks in Superior (Douglas County) and Ashland (Ashland County).

- Plummer Headframe (Iron County).

- Industrial buildings related to the Larsen Company of Green Bay and the Landreth Company of Manitowoc and Sheboygan (canning industry).

- Thematic nomination of extant sugar beet refineries.

- U.S. Forest Products Laboratory in Madison.

- Mining related resources identified in the Southwest Mining Era Thematic Survey (Grant, Iowa and Lafayette counties), particularly commercial districts, worker housing and industrial remnants. Known resources include:

  --Dodgeville Smelting & Mining Company slag furnace (c. 1876), Dodgeville Iowa County.
  --Newkirk Lead Mine and pump house facility (c. 1864), Town of Adams, Green County.
  --Andrews Mine, Shullsburg, Lafayette County.
  --Van Matre Brothers Mine (c. 1827-1836), Shullsburg, Lafayette County.

- Pulp and paper related resources in the Fox Valley, including the Fox River Paper Co. in Appleton (Outagamie County), Telulah Mill in Appleton (Outagamie County), Thimany Mill in Kaukauna (Outagamie County), and the residences of C. B. Clark and the Kimberly family in Neenah (Winnebago County) associated with the Kimberly-Clark Paper Company.

- Industrial complex of the G. Heileman Brewing Company in La Crosse, including the former facilities of the Michel, Gund and City breweries.

- Industrial complex of the Lienenkugal Brewing Company of Chippewa Falls (Chippewa County).

- Industrial complex of the Stevens Point Brewery (a.k.a. Stevens Point Beverage Company) of Stevens Point (Portage County).

- Industrial buildings related to the Allis-Chalmers/E.P. Allis Company of West Allis (Milwaukee County).

- Washington Island fishing village (Door County).

- Significant waterfront industrial resources as they are discovered in intensive surveys or as interest in them develops in communities.

STONE QUARRYING AND MASONRY PRODUCTS

Temporal Boundaries: 1850 - present.

Spatial Boundaries: Scattered across the state.

Related Study Units: None

HISTORICAL BACKGROUND

The land area that is now Wisconsin has passed through a long and varied geological history producing an amazing array of geological formations across the state. Rocks from each of the three great geological classes--igneous, metamorphic, and sedimentary--can be found in the state. Quarried for building purposes, monuments, ornamental work, the manufacture of lime, and as paving material and crushed stone, the various rock types indigenous to the region have served a wide spectrum of Wisconsin's needs. The map attached at the end of the chapter indicates the predominant areas of bedrock formation for each of the three main rock types discussed in this study unit--granite or crystalline rock, sandstone, and limestone.

From the earliest days of settlement in pioneer Wisconsin, local stone has been used by residents for building and construction purposes. Until the 1850s, however, very little of the work was done by sizable quarrying operations. Most of the rock was acquired simply from clearing land for farming purposes or from easily accessible surface deposits and was used mainly for foundation or rough wall construction. The 1840 census of the United States noted 17 individuals involved in the mining of "granite, marble, or other stones" in Wisconsin. The total value of their output barely exceeded $960. Brown County took the lead, employing ll workers to quarry local stone. Crawford County accounted for three of these laborers, and Grant and Iowa Counties two and one each (Sixth Census of the United States 1840:Compendium 346-347, 359). Ten years later, the 1850 census recorded a total of 39 workers employed by 12 different firms to quarry stone from Wisconsin sites. The value of production had risen to slightly more than $24,100 (Seventh Census of the United States, 1880: Abstract of the Statistics of Manufacturers, 107). Local businesses and quarrying concerns continued to serve the territorial needs and demands of the expanding state on an ever-growing scale through the Civil War years.

By the 1870s and 1880s, the quarrying of stone had become a major industry within the state, with a growing regional significance. New tools, machines, and quarrying technology made operations highly efficient, and increasing demands for fireproof buildings and permanent structures resulted in the use of more and more stone in the building trades. The 1871 Chicago fire, and the emergence of the late nineteenth century "brownstone era" gave particular impetus to the industry's growth. Wisconsin stone and masonry products soon found new markets across the entire midwest. By 1880, the state contained 46 separate marble and limestone quarries which produced an average of 3.4 million cubic feet of stone annually (approximately $189,320) and employed 600 laborers. Fourteen seperate sandstone quarries were producing about 520,000 cubic feet of stone annually ($37,745) and employing 160 workers (Tenth Census of the United States, 1880: Report on the Building Stones of the United States and the Statistics of the Quarry Industry, 148). Within ten years, the total number of quarries in the state rose to 119, ranking Wisconsin twelfth nationwide. The total statewide production from the area's eight granite, 79 limestone, and 32 sandstone quarries reached $1,264,016, and a total of 1899 laborers were employed (Eleventh Census of the United States, 1890: Mineral Industries, 603-605, 632-635, 647-650).

Except for a precipitous decline in the quarrying of brown sandstone from the state's northern regions, quarry production remained a strong and viable enterprise in the state through the early decades of the twentieth century. Many firms, in addition to operating quarries, had their own skilled craftsmen to process and finish the stone for final use. Eventual discoveries of new stone-producing areas in the nation and the decline of stone construction in favor of concrete and other products gradually led to a decline in the state's production of stone products by mid-century. By World War II, Wisconsin was no longer a major producer of stone products.

The basic concept underlying the efficient quarrying of any stone is the skillful removal of large rectangular blocks with the least outlay of time, labor, and waste. Almost all quarrying operations started at points of natural outcroppings or exposed ledges. The initial step necessary to expose the strata of usable stone for quarrying was the stripping of any soil or timber cover from the site. Once cleared, the stone was ready for sectioning and quarrying with the use of hand tools or by blasting. Eventually, with the introduction of steam-powered and pneumatic tools, the actual stone removal operations became considerably easier and more efficient. Much of the work was dependent upon the type of stone present at the site, whether a soft sandstone, an unyielding granite, or any one of several grades of Wisconsin limestone. The quarry site's depth, stratigraphy, and purity also played important roles. Tall wooden and steel derricks of massive proportions, positioned at the lip of the quarries, were used to lift the stone blocks and carry them to cutting sheds or storage yards located adjacent to the quarry site. Other mechanisms such as inclined elevators and conveyors carried off rubble and smaller blocks. As the quarries deepened, other derricks were often placed on the bottom or on successive ledges. Pump houses sprang up as well to keep water from flooding the quarry floors.

The working yards and cutting sheds of the quarry sites ranged from rough sheds and temporary structures to extensive, open buildings, depending on the size of a site's output and the amount of machinery in use. Many firms processed the stone on site, cutting, dressing, and finishing it for immediate use. Others maintained separate facilities away from the site, to which stone from several quarry sites might be brought for finishing. In some cases, the stone was sold and shipped rough, with finish work done at distant stone yards or on the construction site. Generally, the stone working sheds were large, open structures, often with dirt floors and movable rails to facilitate the handling of the stone. Later facilities might include overhead cranes and winches along with massive automated cutting and dressing machinery.

Among the early tools employed by quarrymen and stone cutters were a wide range of hand tools such as hammers, chisels, sledges, pry rods, gang saws, and dynamite. Steam-powered and compressed-air drills, channelers, and saws replaced hand tools in many quarrying operations by the last quarter of the nineteenth century. Sites utilizing powered machinery also required extensive boiler and engine houses adjacent to the quarries. By the end of the century, huge lathes, diamond saws, and finishing equipment were becoming more common at extensive operations as well. Of course, those firms whose product was mostly paving block, curbing, or crushed stone required less skilled craftsmen and machinery.

Additional structures often found at quarrying sites included simple office buildings, blacksmithing forges to repair and sharpen tools, and the secluded dynamite or explosives shack which played host to various products from gunpowder and TNT to nitroglycerin. The proximity to rail service was also an important feature to profitable quarrying operations. Small-gauge tracks allowed local movement of stone within the site, and regular, main-line service was necessary if the unwieldly products were to be shipped to distant markets. In some areas adjacent to Lake Superior and the Mississippi River system, the waterways supplanted the dependence upon the railroads. As seasonal workers, except for the skilled stone cutters who could work through the winter,

quarrymen often shared bunkhouse or boardinghouse space erected near larger sites during the quarry season.

The following sections will study more closely the growth and development of each of the main quarry types in the state--granite, sandstone, and limestone--as well as their associated production industries.

GRANITE

A vast array of different colored and textured granites were quarried in Wisconsin during the late nineteenth and early twentieth centuries. An igneous rock (cooled from a molten state), granite was quarried most heavily in the north-central region of the state. Ranging in color from red to somber gray and in texture from fine grained to crystalline, Wisconsin granite received perhaps its finest compliment when it was selected for use in the sarcophagi at Grant's Tomb in New York City. The principal producing areas in the state for granite included the communities of Montello, Berlin, Utley, Marquette, Red Granite, Waupaca, Wausau, and Amberg. Many of the hills and ridges in the Fox River area provided the state with its most significant deposits of easily quarried granite, despite being located in an area known primarily for its subsuface sandstone formation.

The first granite quarry in Wisconsin was opened by L. S. Cohn at Granite Heights, Wisconsin (ten miles north of Wausau) in 1880. Granite was discovered at the site as early as 1875, but the area did not secure rail service until 1880, at which time quarrying operations began in earnest (Buckley 1898:89). Soon after work began at Granite Heights, the Montello area in Marquette County started quarrying operations of its own. Seventeen new quarries opened up between 1880 and 1898 in the state, as Wisconsin slowly built up its reputation as a granite producer. Much of the granite quarried in Wisconsin was manufactured into paving blocks and curbing for use in the growing urban communities throughout the state. Only minor amounts of early production went into buildings or monuments. The 1890 federal census noted that over 90 percent of the state's production was going for use in street work, with only 100,000 cubic feet of stone used for building purposes and 240 cubic feet for monuments. Overall, the state's eight quarries (owned by five seperate firms) produced 1,385,600 cubic feet of stone valued at over $266,000 in 1889-1890, ranking Wisconsin seventeenth among granite producing states (Eleventh Census of the United States, 1890: Mineral Industries, 603-605). Various aspects of the industry, from quarrying to stone cutting and finishing employed 478 workers. As the industry developed and granite curbs and paving were replaced by concrete, the manufacture of monuments and tombstones became a much more important facet of the Wisconsin industry. Owing to its internal structure and the small size of most quarrrying sites, little Wisconsin granite, with the exception of that from a few concerns, was ever used in building construction. Statewide quarry production in 1909 reached $1,433,000, as the industry employed almost 1,500 workers to operate its 22 quarries (Thirteenth Census of the United States, 1910: Mines and Quarries, 174-176, 343). By 1915, Wisconsin was consistently ranked between fourth and fifth among granite producing states in the United States (Whitbeck 1915:7).

Among the state's early major producers was the Montello Granite Company, which at one time operated quarries at both Berlin and Montello along the Fox River. Employing an average of 100 laborers since its opening in 1880, the firm supplied a wide midwestern market with building stone, monuments, and paving material. Fully equipped with steam derricks, drills, lathes, polishers, stone crushers, and pneumatic tools to quarry and finish the stone, the firm produced monuments for Gettysburg National Park, a memorial to General G. Custer, and the sarcophagi at Grant's Tomb. Several Chicago residences and commercial buildings also sported Montello red granite (Buckley 1898:90-100). Other significant Wisconsin firms from the turn of the century included: the E. J. Nelson Granite Company of Berlin (1886) whose hard, greyish-black stone was employed in the Unversity of Wisconsin's Science Hall building, the Bartlett Building in Chicago, and

numerous upper midwestern cemeteries; the Milwaukee Monument Company of Warren, Wisconsin; the Green Lake Granite Company in Utley (1884); the Waupaca Granite Company (1886) whose quarry, situated on a 100' mound north of the city, shipped extensive amounts of stone to Chicago and Minneapolis; and numerous Wausau firms that operated quarries north of the city that supplied stone for numerous local roadways, cemeteries, and buildings, including the Citizens' National Bank in Stevens Point, the Marathon County Bank in Wausau, and the county courthouse in Wausau (Buckley 1898:100-142).

One of the most extensive areas of quarrying operation in the state was located outside of the central Marquette, Green Lake, Waushara, Waupaca, Marathon County region at Amberg in Marinette County. Served by the Chicago, Milwaukee, and St. Paul Railway, quarry sites along the Pike River and in neighboring areas around the community of Amberg had begun producing a fine gray and red granite in the early 1890s. By the end of the decade, the Amberg area had emerged as one of the largest producers of granite stone for buildings, monuments, and paving in the upper Midwest. Furnished with all of the most up-to-date machinery available for quarrying as well as finishing, the Amberg and Pike River Granite companies served markets from Pittsburgh to Denver and from St. Paul to New Orleans. Among structures that included the area's stone were the 1893 Milwaukee Post Office, St. Gall's Church in Milwaukee, the Park Building in Pittsburgh (1896), and the 1894 Cosmopolitan Hotel in New Orleans. Also used in residences, mausoleums, and gravestones across Wisconsin and the Midwest, Amberg granite found a major distribution point in the city of Green Bay where a number of stone working firms and distributors handled the area's stone. The company's turn-of-the-century Amberg plant was an expansive two-story, wood-frame building adjacent to the rail depot (Buckley 1898:142-156).

With both the abandonment of macadamized roadways in favor of concrete and asphalt and the end of railroad expansion in the state (the railroads had used granite in much of their roadwork and bridging), the manufacturing of monuments and tombstones became more important to the state's granite industry in the twentieth century. During the 1920s and 1930s, Wisconsin maintained an average of 20 quarries in production. It was not until the late 1940s and 1950s that the industry experienced a steady decline in the number of firms operating in the state. Among two of Wisconsin's twentieth century leaders in the manufacture of memorials were the Stotzer Granite and Marble Works in Portage and the Anderson Brothers and Johnson firm of Wausau. Both firms started operations in the late 1890s and went on to become major producers of Wisconsin granite memorials. The Portage firm, with its manufacturing shops, offices and salesrooms was one of the state's largest plants by 1915 (Stotzer 1915). Expanding at a slower rate, the Wausau firm became the state's leading producer of memorials by 1945. At this point, the granite quarry operated by the firm at Granite Heights had grown to 275 feet wide, 300 feet long, and over 200 feet deep (Anderson Brothers 1945). The value of statewide production in 1952 amounted to $1,500,000 (only slightly above the 1909 production value) with the Granite Heights and Amberg areas remaining the most active (Natural Resources Committee 1956:107-108). Modern day production in the state is on a limited basis with only three firms noted in the 1983 Directory of Wisconsin Manufacturing.

SANDSTONE

A sedimentary rock created by the natural consolidation of sand over time and under pressure, sandstone forms a considerable portion of the state's bedrock (see Map). Most of the sandstone used in the state for building purposes belonged to the Potsdam formation. Found in the central and south-central parts of the state, the sandstone was usually light yellow or buff in color and ranged from a dense, hard stone to a soft, friable rock. An older sandstone, colored a deep red or brown by iron oxide and commonly referred to as a brownstone, was found on the shores of Lake Superior. This Bayfield and Lake Superior sandstone was much sought after in the late nineteenth century as a rich building stone.

Shipped to areas across the nation, the stone served a broad market until a change of style to light-colored stone in the early twentieth century destroyed its market. The southern sandstones found more of a local market and was used in foundations, piers, bridges, and large numbers of buildings throughout the lower half of the state.

The Lake Superior brown sandstone was found in a thin band which extended six to eight miles from the shoreline of Lake Superior. Clustered in the vicinity of Bayfield and Washburn or scattered along the southern shore to the west, quarrying operations in the region were most productive from 1868 to 1898. The Apostle Islands in particular were composed chiefly of brown sandstone which lay underneath a thin layer of clay. The islands eventually hosted seven seperate operations during the late nineteenth century boom period. The first quarry site in the region was established on Bass Island (Basswood Island) in 1868 by the Bass Island Brownstone Company (Buckley 1898:179). The first stone taken from the site was used to construct the new Milwaukee Courthouse of 1870. The daring use of this "untested" building product in a major commission was a dramatic step in the development of the region's quarrying industry. Milwaukee businessmen and investors and a small number of Chicago interests supplied the majority of the early financial backing and management for the industry. The Chicago interests played an increasingly major role as the city of Chicago rapidly seized onto the use of rich, brown sandstone as it sought to rebuild itself after the disasterous fire of 1871. After an early and prosperous start, however, the quarrying industry fell victim to the economic depression of 1873. Although quarrying operations were carried on intermittently over the next few years from established sites at Bass Island and at Fond du Lac in western Douglas County, the region's quarrying industry did not fully recover until the early 1880s when a second phase of prosperity hit the region. Much of this renewed prosperity could be linked to the emergence of the railroads in Washburn and Bayfield in 1883 (the Omaha Line) (Liftors 1983:4-21).

During the 1880s and 1890s, a host of new quarrying operations developed in the region. On the Apostle Islands, new sites were established on Stockton Island by the Ashland Brownstone Company (1889) and on Hermit Island by the Excelsior Brownstone Company (1890-1891). Several independent quarries were started between 1885 and 1887 at Houghton Point, Wisconsin--situated between Bayfield and Washburn--by the Washburn Stone Company, the Hartley Brothers, and the Prentice Brownstone Company. Along the southern shoreline of the lake, small quarries began to operate at Port Wing (1895) and Amnicon (1886), and at the mouths of the Flag, Iron, and Cranberry Rivers (1889, 1892, 1891) (Buckley 1898:168-220). The early stone quarried from the lake region left for market almost exclusively by ship. With the railroads still some distance away from some sites, lake vessels could dock virtually alongside many of the quarries, loading 600-ton cargoes for direct shipment to distribution points in Ashland, Duluth-Superior, and many Lake Michigan ports. Little dressing or stone-finishing work was done at the quarry site. For the most part, the stone was generally shipped in its rough state and finished at large stone-working operations located at the distribution points. From the distribution areas, the stone could then be sent by rail or ship to markets throughout the region. Ashland, Superior, and Milwaukee, in particular, supported extensive waterfront operations staffed by skilled stone cutters. The arrival of the railroads, however, provided access to new inland market areas and an all-season method of transportation for quarried goods. Both factors increased production levels dramatically.

The quarrying technology employed in the region covered a broad range, from unsuccessful attempts at blasting which tended to shatter the rock into rubble, to hand drilling and animal powered hoists, to state-of-the-art steam channellers and power derricks. Production levels from the various sites also varied widely. While the Apostle Island sites were producing an average of 200,000 cubic feet of stone a year by early 1890, extensive operations on the mainland near Bayfield were producing as much as 600,000 cubic feet annually. The smaller operations along the south shore produced much more limited amounts ranging from 20,000 to 50,000 cubic feet a year. Employees hired

by the larger quarries often numbered as many as 25 during the wintertime and commonly grew to over 100 in the summer during peak seasons (Lidfors 1983:6, 20).

Wisconsin's Lake Superior quarries, which also had their counterparts in Minnesota and Michigan, were significant as early providers of a building material which enabled ambitious young Midwestern communities to compete in style and richness with their eastern counterparts. On a local level, the quarries supplied a ready source of material which transformed much of the architectural character of communities like Washburn, Bayfield, Ashland, Superior, and Duluth. On a broader scale, the quarries also supplied a high quality stone for construction purposes to areas throughout the Midwest, first in Great Lakes port cities, such as Milwaukee, Chicago, Toledo, Detroit, and Cleveland, and later to inland cities served by the railroads, such as Eau Claire, St. Paul, Des Moines, Kansas City, and Omaha (Lidfors 1983:16). Buckley's On the Building and Ornamental Stones of Wisconsin contains a partial list of buildings constructed out of Lake Superior brown sandstone. Among the most prominent may be the 1888 Cincinnati City Hall building constructed of stone quarried from the extensive Prentice Quarry at Houghton Point (Buckley 1898:217-219).

During the 1890s, changes in tastes and construction methods occurred throughout the nation. The 1893 Columbian Exhibition in Chicago was particularly important for bringing a new aesthetic for "white architecture" to the forefront. The heavy, somber nature of brownstone construction slowly began to give way to Neo-Classical designs of light-colored limestones and granites. The advent of skeletal steel and concrete construction also placed brownstone's load-bearing masonry at a disadvantage. The Lake Superior sandstone industry, damaged by the financial depression of 1893 that closed many sites, faced a steady decline in the mid- to late 1890s. By 1898, all of the Apostle Island quarries had ceased operation; by 1905, even the large, mainland sites were closed except to occasional commissions. For the most part, extant features at the sites which are most likely to be found today would consist of only overgrown quarry openings, deteriorated dock components and rail facilities, unused stone and rubble piles, or adjacent worker housing areas.

The light-colored, Potsdam sandstone of the central region of the state was quarried and used locally throughout the second half of the nineteenth century, but it was exploited for shipment in only a few places. Locally, nearly every village or community contained some structure of sandstone construction or utilized the readily available stone for foundation or wall construction. Lying in projecting ridges or ledges, the stone was generally easily accessible, and quarries in Madison, Mazomanie, and Stevens Point were operating as early as the 1850s (Tenth Census of the U.S. 1880, Vol. 15 Mining Industries:88). By the 1890s, when total sandstone production in the state reached 1,146,736 cubic feet annually, the market for Wisconsin sandstone was still generally local. Communities such as Madison, Baraboo, Grand Rapids, and Stevens Point were making extensive use of locally quarried stone in buildings and in building details. Most of the stone in the rest of the state, however, was not well suited for building construction, since it was either too difficult to quarry and work in large amounts or too soft and friable to handle. Stone from these areas was utilized mainly in foundations, roadwork, and bridges, or in rough, rural construction (Buckley 1898:221-254).

Two areas within the Potsdam region did contain extensive deposits of fine dimensional sandstone, and it was these two areas that supported the industry's limited export trade. The first was the Dunnville area in western Dunn County. Located just north of the junction of the Chippewa and Red Cedar rivers, an extensive mile-long escarpment, 10 to 40 feet in height, provided quarrying sites for a series of different concerns starting in 1884. Light buff and gray stone from the region was employed in the construction of the Tainter Memorial Hall at Menomonie; St. Paul's Church in Stevens Point by Wisconsin architects Conover and Porter; the trim of the Hiram Smith Hall at the University of Wisconsin; and substantial buildings in St. Paul and Minneapolis (Buckley

1898:226-228). The second region of extensive quarrying operation was centered around the Ableman area in Sauk County (on the Baraboo River between Reedsburg and Baraboo). Producing some of the strongest and most durable sandstone in the state, local quarries began extracting white and light-colored stone around 1880. Situated adjacent to the lines of the Chicago and Northwestern Railroad, the quarries provided the railroad with much of the building material it used to construct its stations, bridges, and roadbeds. The line also served to deliver area stone to various market areas throughout the state (Buckley 1898:230-238).

Both of the above regions and many of the small, local sites were exploited through the turn of the century. Many of the sites, however, were used only to furnish cheap rubble or rip-rap. Operations at most of the sites never progressed far beyond the most simple of quarrying equipment. Hand drills, bars, sledges, and explosives were the most commmon tools employed, with an occasional steam drill or derrick found at one of the larger sites. The eventual emergence of concrete and steel construction, along with the introduction of Indiana limestones, led to the decreased use of weaker Wisconsin sandstone during the early decades of this century. By 1952, production centered in Clark, Dunn, Portage, and Wood counties and amounted to only $44,000 (Natural Resources Committee, 1956:22). Finely crushed sandstone from certain regions in Wisconsin had also found a market as molding sand in metal foundries by this time.

LIMESTONE

Sedimentary in origin, limestone constituted the largest type of quarried stone in Wisconsin. Found in a broad band across the southeastern portion of the state and along the Mississippi River Valley, Wisconsin's limestone formations are characterized by a wide variation in texture and chemical composition. Officially the stones fall into one of three specific types: lower Magnesian, Trenton, or Niagra formation. Wisconsin limestone was used as a building stone in foundations, piers and bridgework, as a crushed stone for roadwork and macadamizing, and perhaps most importantly, as the central ingredient in the manufacture of lime for building, agricultural, or industrial purposes. The lime manufacturing industry is covered more in depth later in this study unit. Only limited amounts of the stone were ever used as exterior dimension stone on major buildings. This is due to the nature of the local stone, which was often difficult to dress and irregular in appearance, and to the existence of fine building stone from neighboring areas such as Indiana, Michigan, and Minnesota.

The earliest concentrated efforts to use local limestone in the state date to the late 1840s and 1850s. As with other quarried stone, these early concerns did not operate extensive quarries, but rather, exploited local stone on a limited basis either as a source of lime or as a rough building stone. As the state continued to expand in the second half of the nineteenth century and as demands for building materials increased, so did the scale of quarrying operations. The post-Civil War era in particular experienced large gains. By 1890, 79 limestone quarries were operating in the state. Manned by 1,048 seasonal and full-time employees, the quarries produced $813,900 worth of stone, ranking Wisconsin eighth in the value of production in the United States. Over 6.5 million cubic feet of stone was being produced annually for various building products. By far the majority of the stone continued to be used in the manufacture of lime and flux (Eleventh Census of the United States, 1890: Mineral Industries, 632-635).

Production of limestone in the state could be roughly divided into three major geographical areas of concentration, each of which contained its own particular characteristics. The high bluffs of the Mississippi and lower Wisconsin river valleys were dotted with numerous, small quarries producing stone for local use. Much of the stone in the area was difficult to quarry even when clearly visible to the naked eye. The precarious siting of many deposits along sheer cliffs did not allow safe or economical exploitation. Among the more developed sites were operations at Bridgeport, Maiden Rock, La Crosse, and

Trempealeau which produced a fine, high-strength stone which eventually found a substantial market as a superior building stone. Smaller sites at Fountain City, New Richmond, Bluff Siding, Marshland (near Winona, Mn.), Arcadia, Onalaska, Hudson, and Osceola among others, produced a lesser quality stone that was often used in early local buildings or as foundation, bridge, and roadway material. The Bridgeport area quarries had begun producing a light, buff-colored stone in 1855-1856 and were one of the earliest sites in operation in that portion of the state (Buckley 1898:256-262).

Bridgeport limestone, as quarried by such men as Thomas Norton and William Powers, was used in the construction of the second state capitol in Madison; the State Normal School at Madison, South Dakota; imposing structures at Prairie du Chien, such as the St. Joseph, Sacred Heart and St. Mary schools, the prominent Dousman House, and the Crawford County Courthouse; and numerous railroad projects. The Chicago, Milwaukee and St. Paul Railway, which operated a line directly adjacent to the quarries, made use of substantial amounts of the stone in its bridges, trestles, and roadwork construction. Many of the quarries, including the Bridgeport sites, utilized local riverways as a main means of transporting their product to market even after the arrival of the railroads (Buckley 1898:256-262).

A second region of quarrying production began in the northeastern part of the state near the mouth of the Menominee River (at Marinette) and ran southwest as far as the Illinois border, sweeping west across the southwestern counties to the Mississippi River. The stone in this region belonged mostly to the Trenton formation and was quarried as a blue-tinted rock suitable for use in a wide range of building and construction applications. A large number of quarries were operated in different portions of the region, but the amount of stone shipped from the area was relatively small. Instead, the stone found extensive markets in the many urban communities established within the area, particularly in the industrial Fox River Valley area. A series of quarries in the Duck Creek area north of Green Bay provided the region with its main source of exported stone. Opened in the mid-1850s, the quarries maintained a fairly extensive trade well into the turn of the century, mainly due to their access to Lake Michigan and the growing city of Green Bay. Quarries outside Kaukauna, Neenah, Oshkosh, Menasha, and Appleton all supplied the voracious local demands of the growing industrial Fox River Valley area. To the south, local operations at Beloit, Janesville, Waupun, and Afton supplied substantial stone for foundation work and brick trimmings as well as for lime and macadam manufacture.

In the southwestern areas of the state, Mineral Point, Monroe, Darlington, Platteville, and Cassville all supported crude, local operations to supply stone for community use. Hosts of smaller operations were begun and abandoned in other areas of the region over the years as well, each producing stone of various qualities and quantities. The peak period of production for the region was in the post-war years of the 1870s, 1880s, and 1890s, when industrial and urban development in the state and the region was growing dramatically. Operating at various levels, some firms relied on hand tools, while other more progressive firms employed the newest steam and pneumatic equipment and established extensive stonecutting yards and distribution networks (Buckley 1898:280-297).

The final region of production extended as a broad belt starting in northern Door County and running south to the state line. Averaging 40 miles in width from Lake Michigan to the Fox and Fox River valleys, the local stone deposits were commonly high in magnesium carbonate content and proved excellent for the production of lime which dominated the local quarrying industry. Because of its composition, the stone is often referred to as a dolomite, and the bedrock is considered part of the Niagra formation. While a number of firms were involved strictly in the production of building stone, most combined the manufacture of lime and dimension stone for buildings and roadwork into one operation. Often extensive operations, the quarrying sites were located from Sturgeon Bay in the north to Racine in the south and commonly centered near the major commercial centers

which made up the greater portion of their markets. The Waukesha-Wauwatosa region, in particular, became exceedingly renowned for its building stone which is reflected in much of the local architecture. A limited amount of regional stone was also shipped from Lake Michigan ports to other areas of the Midwest. Significant quarrying operations in the area began as early as the 1850s and remained prominent through the turn of the century. The greater Milwaukee area played host to the largest concentrations of early sites. On a whole, the dimension stone portion of the industry declined considerably after the depression of 1893, as imported stone (i.e. Bedford stone) began to absorb a larger portion of the market and as concrete became an increasingly prominent building material. Lime production adopted an even more important role with these reductions in other portions of the industry. Limestone production in 1952 in the state totaled approximately 8,958,000 tons, only 16,175 tons of which was produced as dimension building stone. Lime stone utilized in the manufacture of building lime, concrete and cement accounted for 5,580,000 tons in 1952, and another 1.2 million tons were processed into agricultural lime (Natural Resources Committee 1956:104-110).

MISCELLANEOUS STONE

Insignificant amounts of other non-metal minerals were also exploited across the state at different times. Among them was rhyolite and quartzite at Wausau; basalt in Polk County and Pembine (Marinette County); asbestos in Marinette County; feldspar, used in glass and ceramics, at Wausau; marble from the Grandview area of Bayfield County; pyrite from the southwestern lead region; and talc from Wood County. All found in low concentrations, the above minerals proved too uneconomical for extensive mining. Unconsolidated sand and gravel deposits, a remnant of the area's glacial era, are widely distributed in the glaciated part of the state. Used for various industrial, construction, and roadworking purposes, the materials have been viable Wisconsin natural products throughout the twentieth century. Seldom associated with extensive processing plants, sand and gravel production in the state had reached over 17,600,000 tons annually by 1952, ranking Wisconsin behind only California and Michigan in production (Natural Resources Committee 1956:104-110).

LIME

Calcination, the process of burning limestone to form lime, was known to primitive people as far back as the Egyptians. The Greeks covered their temples with a lime stucco as early as 500 B.C., and the Romans developed a lime plaster as well as an hydraulic lime mortar for use in the aqueducts. The basic process of calcination involves the heating of quarried limestone to a temperature of about 900 degrees fahrenheit. The intense heat dissociates the calcium oxide from the carbon dioxide component of the stone, resulting in a pure lime available for use as a basic ingredient in construction mortar, plaster, whitewash, and fertilizer. Much of the Wisconsin stone quarried for lime production contained varying degrees of magnesium carbonate which produced a much softer lime, and when properly prepared, a much more durable building mortar.

The calcination or burning process of the limestone occurred in furnaces called lime kilns. The earliest lime kilns were simply fashioned by piling heaps of wood and limestone together and igniting the wood. The heat drove off the carbon dioxide (CO_2), leaving lime which had to be separated from the ash. Many of the early Wisconsin settlers prepared lime for mortar and whitewash using this process (Bertrand 1944:399-401). The early supply of limestone was often obtained from newly cleared fields and open outcroppings. By 1850, spurred on by continuing expansion of settlement throughout the state, the manufacture of lime gradually emerged as a prominent industry, as commercial lime kilns developed across the rich limestone producing regions of the state. As demands from builders and farmers grew, commercial manufacturers moved beyond the crude kilns of the early farmers and established expanded production sites, using a variety of permanent kiln forms. The most common kiln configuration was the chimney-like, vertical shaft kiln.

Kilns generally consisted of short, wide, vertical shafts lined with firebrick or some other refractory material and were enclosed by either a steel (later) or stone casing usually of limestone. Fire grates, firedoors, and other miscellaneous fittings were often of cast iron. Small blocks of limestone were fed into the kilns at the top by means of an inclined tramway or narrow-gauge railway. Where a series of kilns stood in line, the length of track might run across the tops of the entire ensemble. The rock was preheated by escaping gases in the upper part of the stack. As it slid down into the major calcining chamber, it was converted to lime by the heat eminating from two or more fireboxes located in the walls near the bottom of the kiln. The "burnt" lime was eventually withdrawn from the cooling chamber at the base of the kiln and was ready for storage, bagging, or shipping. The actual duration of the burning process lasted anywhere from four to 24 hours. At large sites, vertical shaft kilns often operated continuously with stone constantly loaded at the top and finished lime removed from the bottom at prescribed intervals. The size of the kiln and its loads, the specific design of the kiln, and the amount of manpower available all determined the specific operation of a kiln site. The lower portion of the kilns was often enclosed in a long wooden shed to protect the workmen and the lime from the weather, as kilns were often operated year-round.

Minor variations on the basic kiln form depended upon the type of limestone available and the fuel used. The most common fuel used to fire the kilns was local hardwood which proved especially well-suited to Wisconsin's high magnesium lime. Imported coal or gas was used to a lesser extent when it was available cheaply. Proximity of the site to markets and transportation systems also had a direct effect on production. Most established Wisconsin firms manufacturing on a commercial basis in the nineteenth and early twentieth century operated between four to five kilns on a particular site, which was usually directly adjacent to the supplying quarries. Individual kilns often housed multiple burning shafts or chambers for increased production as well. Typical kilns might measure from 25 to 50 feet tall and 15 to 30 feet per side, usually tapering slightly towards the top. Smaller sites, operated by limited producers, were also sometimes set into hillsides with only a single wall projecting from the earthwork. Crude pathways led to the top of the hill for the loading of the kilns. Others still used the mixed-feed process which combined limestone and wood/fuel into a single package burnt all at once. Commonly found on farms and in rural areas, the product was normally used for whitewash or agricultural purposes. Other features typical of commercial kiln sites included storage sheds, rock crushing machinery, offices, waste piles, rail sidings and sheds, company housing, and possibly a hydrating plant. The hydrating plants, found at more extensive sites, simply added water to the crushed lime in order to make it easier and safer to handle in shipping. In later years, during the late nineteenth and early twentieth centuries, more sophisticated mechanical kilns were introduced. Operating on much the same basis as early stone kilns, the newer kilns were simply expansive iron and steel machines for the burning of lime. The rotary kiln, first introduced in the 1890s, was used on a limited basis in Wisconsin as some plants attempted to modernize. The old, verticle shaft kilns did not disappear from the industry, however, and were used successfully well into the twentieth century.

The burning of limestone to form lime for construction and agricultural uses was one of the oldest manufacturing industries in Wisconsin. As such, it spanned a transition from pioneer to highly integrated industrial enterprise. The state's commercial lime industry was concentrated primarily in the eastern counties. Lying immediately west of Milwaukee and over some of the state's most abundant limestone deposits, Waukesha County quickly became the early center of the region's commercial operations, benefiting enormously from the area's access to Great Lakes shipping, the expansion of the Milwaukee railroads, and the growth of the city of Milwaukee itself. By the 1850 census, ten commercial firms existed in the state, employing 34 laborers and producing $25,300 worth of lime. This production was in addition to the production of many local farmers. Lime kilns were infrequent sights in the western regions due to the lack of suitable stone. Private concerns, however, produced small quantities for local use, and Prairie du Chien,

Platteville, Limestone Hollow, Black Earth, Mazomanie, and Madison all had lime kilns in operation during the middle decades of the 1800s (Kanetzke 1969:35-37).

The industry grew continually during the second half of the nineteenth century, experiencing a peak in the expansive years just after the Civil War (c. 1870). By 1892, Wisconsin ranked among the leading producers of lime in the United States. The number of firms operating in the state totaled approximately 40, and production had reached the $514,974 mark (Eleventh Census of the United States, 1890: Mineral Industries, 632-635). Those areas and sites with access to Lake Michigan ports and the ability to ship either by water or rail were the first to expand beyond local markets. The Racine, Waukesha, Sheboygan and Milwaukee areas all dominated the industry and found markets both in and outside of Wisconsin borders between 1850 and 1870. As the railroads expanded and commercial centers emerged in other areas of the state, lime manufacturing operations moved increasingly into the northern counties, especially Fond du Lac, Door, and Manitowoc. Throughout the late nineteenth and early twentieth century, the industry was marked by relatively large-scale operations located in the rich eastern limstone regions that produced for both local and export markets and by smaller private concerns situated across the remaining countryside producing lime for localized building and agricultural use. By 1901, the state ranked seventh in the production of lime in the United States, and from 1907 to 1914, Wisconsin reigned as the third largest producer, behind only Pennsylvania and Ohio. In 19ll, 5l plants were in production in the state, 30 of them in the eastern Niagra limestone region. Employing between six and 35 workers each, each kiln site produced between six and 16 tons of lime a day. While the total production in 1925 surpassed 244,000 tons, the number of firms in operation had actually declined. Dropping to 25 operations, most of the increasingly uneconomical western plants had been eliminated. The era was also marked by the absorbtion of firms by large companies such as the Western Lime and Cement Company and the Standard Lime and Stone Company (Bertrand 1944:399-413).

The Great Depression of the 1920s and 1930s, however, marked the beginning of the Wisconsin lime industry's steady decline. Up to that time, lime had been used primarily in the building trades. Hard times for the construction industry and a dramatic drop in the demand for lime accompanied the Depression. After the turbulent 1930s, new and varied uses for lime emerged, in addition to its construction uses. The paper, glass, steel, and various chemical industries all began to utilize extensive amounts of lime. Wisconsin lime, once highly prized for its magnesium content, however, was not regarded as suitable for many of these purposes. With the increased use of portland cements, area firms found themselves with a product that had become increasingly difficult to market. By 1940, only ll producers remained in the state, and production levels had fallen below 65,000 tons. Among the largest surviving firms were the Rockwell Lime Company of Rockwood in Manitowoc County, which produced l00 tons of lime a day from a modernized facility, and the Western Lime and Cement Company of Milwaukee, which operated plants at Eden in Fond du Lac County and Knowles in Dodge County (Bertrand 1944:411-413).

CEMENT

During its early development, the production of cement and cement products centered around the growing industrial community of Milwaukee. Early supplies of cement, especially the hydraulic or portland cement that was particularly useful in the construction of bridges, sewers, and canals, were shipped west from manufacturers in New York and Louisville, Kentucky. In 1875, however, natural cement rock beds were found along the Milwaukee River near the present Estabrook Park area of the city. Directly afterwards, the Milwaukee Cement Company was founded by Joseph and Henry Berthelet, George Paul, John Johnston, C. H. Orton, and a series of other Milwaukee investors. The firm produced between 23,000 and 400,000 barrels of cement a year from the site until depletion of the local supplies in the early 1900s forced its closure. Up to 1889, the Milwaukee firm was the only producer of cement in Wisconsin and one of the only major

sources of natural cement in the Midwest. Sold in barrels and bags, Milwaukee cement found markets in Chicago, Detroit, Duluth, St. Paul-Minneapolis, and as far away as Omaha and Kansas City. Its most significant market area remained in Wisconsin and the growing industrial city of Milwaukee. Occupying a one and one-half mile stretch of riverfront property, the firm was eventually joined in the 1890s by the Cream City Cement Company, also located on the Milwaukee River, and the Consolidated Cement Company of Fox Point on Lake Michigan. By 1910, with raw supplies fairly well depleted from economically workable area deposits, Milwaukee had ceased major production (Berthelet 1949:28-39).

No longer a major manufacturer of cement, Milwaukee remained a major center for the distribution of bulk cement products produced mainly in Michigan's Upper Penninsula. During the 1910s and 1920s, the establishment of bulk receiving and transhipment facilities for cement and cement products expanded dramatically. In Milwaukee and other major transportation centers, such as Superior-Duluth and Green Bay, bulk products from new, self-unloading, Great Lakes carriers were received at large open dock areas where massive bridge cranes, clamshells, and imposing concrete storage silos were located. Linked to local and inland markets by truck and rail, a number of these facilities also included minor processing facilities that often contained grinding mills, rotary kilns, and power houses to produce cement and concrete products for immediate sale. Among the largest firms was the Huron Portland Cement Company (1907) that established branch sites at Superior, Milwaukee, and Green Bay. The transhipment of raw cement products continued to expand, and by the 1950s, Milwaukee was second only to Detroit in receipt of bulk cement shipments on the Great Lakes (Natural Resources Committee 1956:104-110).

BRICK AND CLAY PRODUCTS

Wherever abundant clay soils were present in sufficient amounts and adequate quality, brick manufacturers usually established local production concerns. In areas of high density, these concerns often expanded beyond local use, as in Milwaukee where the stratified beds of clay along Lake Michigan furnished material for an excellent cream-colored brick. Manufactured on an extensive scale (20 to 25 million bricks annually during the Civil War era), the Milwaukee brick gave rise to the community's title as the "Cream City" (Merritt 1982:29).

Milwaukee began manufacturing bricks as early as 1835, and by 1840, three seperate kilns were operated in the city. The clay obtained from the local bluffs contained a high proportion of lime and sulphur, which in addition to providing the bricks with their characteristic color, made them more durable than the common red bricks. Demand for the high quality, cream-colored bricks expanded their market as far as Chicago and the East Coast by the 1860s and 1870s. In order to keep up with the demands, Milwaukee production sites grew to enormous size. Among the numerous large concerns that located in and around the city's industrial Menominee Valley were the firms of Benoi Finch (1837), the Coldough Brothers, Bond and Hanchett, the Cream City Brick Company, and the Burnham Brothers (1843). The firm of George and John Burnham (later G. Burnham and Sons) rapidly became prominent in the city and by 1880 employed about 300 workers at its ten acre site on the east side of the Menomonee Valley. The firm's production reached annual levels of around 15 million bricks by the 1880s (Western History Society 1881:1505-1507). By the turn of the century, with its local clay supplies nearly exhausted, the Milwaukee brick manufacturing industry began to slowly disappear.

In addition to Milwaukee, brick manufacturing concerns emerged in various communities across the settled areas of the state by the 1850s. Wherever suitable clay was available and local population growth demanded more permanent construction, brick manufacturing soon developed. By the 1850 census, 39 establishments operated in the state, employing 331 workmen and producing merely $128,000 worth of goods (Seventh Census of the United States, 1850: Abstract of the Statistics of Manufactures, 20). Statewide

production continued to increase steadily in subsequent decades. During the expansive era directly after the Civil War, the industry experienced particularly strong growth, especially in the booming Fox and Rock River valleys and along the Lake Michigan shore where abundant clays produced bricks similar to those of Milwaukee. Counties such as Jefferson, Milwaukee, Racine, Rock, and Sheboygan dominated the industry. For many concerns, adjacency to rail or shipping points became an important factor as products began to be exported in large numbers both to outlying areas and to other Midwestern regions. By 1870, production from the state's 79 brickmaking concerns totaled over $500,000, led by Milwaukee and Jefferson counties which accounted for approximately $280,000 (16 firms) (Ninth Census of the United States, 1870: Statistics of the Wealth and Industry, 592, 742-745).

By the turn of the century (c. 1890-1910), the industry reached its peak in Wisconsin as new cities developed, new concerns emerged, and established firms expanded into broader markets. Production of brick and tile in 1900 was recorded by the census at $1,795,993; the state contained 168 major brickmaking concerns. Employment in the industry ranged from 1,500 to 3,000 workers, depending on the season. The areas of Racine, the Fox River Valley and Manitowoc remained the chief centers of production (Twelfth Census of the United States, 1900: Manufactures, pt. 2, 960-961). The post World War I era marked the final stage of the industry's development. In 1909, 108 firms were still in business. But by a decade later, the number had dwindled to 50 and production had dropped to below $1,250,000. The emergence of concrete as a viable building material that replaced brick in many situations contributed significantly to this decline. In addition, the increasing sophistication of brickmaking machinery placed many of the smaller, local yards at a distinct disadvantage in comparison to the larger concerns which had sufficient capital to invest in modern continuous kilns and automatic brick molding machines (Fourteenth Census of the United States, 1920: Manufactures, 1634). At present, the major areas of production in the state are Dunn and Manitowoc counties as well as the Brown, Fond du Lac, La Crosse, Wausau, and Racine areas.

Because manufacturers in smaller communities supplied only local demands, cream-colored or the more common red brick was usually produced at unpretentious sites throughout the nineteenth and early twentieth centuries. The most obvious identifying feature was the extensive drying yards where bricks, stacked on pallets or in piles under crude, protective sheds, were allowed to dry after being molded. Sheds and simple, frame shanties also protected supplies of necessary raw materials, such as clay and sand, which were normally obtained from nearby clay banks and pits by the simplest of methods. The actual molding of the brick, either by hand or machine, might have occured in more permanent frame or brick structures. By the late 1880s, machine-made, pressed bricks provided the building industry with sharper, cleaner masonry units and quickly replaced the older hand struck methods, except in the smallest of plants. In early twentieth century, the perfection of extrusion machines and multi-unit presses for the manufacture of bricks tremendously increased production and helped reduce brick prices as well. After being molded, the bricks were allowed to dry for one to two weeks in the open air to rid them of excess moisture. While most firms utilized outdoor drying yards, protected with temporary wood and canvas sheds, others developed artificial heat dryers, often recirculating hot air from the kilns. The use of artificial dryers meant longer working seasons and fewer problems due to rain or frost.

Finally, the bricks had to be fired in outdoor ovens or kilns (1600-2000 degrees fahrenheit). The kilns existed in many forms and designs, depending on the size of the brickmaking plant and the quality of the products desired. The most common form was the simple updraft scove kiln. Normally found at small yards, the scove kilns required stacking the bricks to be fired on a level site and actually building a kiln around them using both freshly molded brick and older units along with mud. Fires set into arched openings at the base of the kilns continually baked the bricks for a period of seven to 10 days at which point the kilns were completely dismantled and the newly fired bricks were

ready for grading and shipping. Other sites employed more permanent firing structures that consisted of long, rectangular shapes open at one end to allow the loading of bricks and usually covered by a metal or wood roof. Arched openings at the base of the thick walls allowed wood-fueled fires to heat the kiln and bake the bricks. Production from the updraft kilns was not uniform due to uneven heat and the location of the bricks in the kiln.

A number of sites also used down-draft kilns. Round or square in shape, these permanent kilns allowed heat to enter at the top and exit out flues at the base that were connected to tall chimneys. By actively separating the fire chamber and the flames from the bricks, a more even heat was achieved, producing a more uniform product. The round kilns appear to have been more common and were often 15-20 feet in height and 20-30 feet in diameter. Large openings in one side allowed bricks to be placed inside. The down-draft kilns were also able to make better use of fuels other than wood to heat the bricks. When available cheaply, gas and oil could be easily introduced in place of shrinking supplies of wood fuel. Continuous or tunnel kilns, utilized by larger firms towards the beginning of the 1900s, allowed plants to operate 24 hours a day. Commonly housed in simple, protective structures of sizable scale, the continuous kiln consisted of a series of interconnected units that were fired at successive intervals. Operating in a continuous cycle, it allowed bricks in one unit to be pre-heated by the flames baking bricks in a nearby kiln unit at the same time that a unit further down was being readied for firing. The later tunnel kilns, which are still commonly used today, actually "pulled" a continuous stream of bricks through a series of heating chambers on a conveyor system. Again, the bricks were subjected to a successive series of heats that dried, heated, and baked the bricks, finally allowing them to slowly cool down to produce the "perfect" uniform brick.

Among other features commonly visible at brickmaking sites were rail sidings, office structures, seasonal housing, grinding/pug mills for preparing the clay and storage areas. The yellow Lacustrine clays of the southeastern portion of the state were not well suited for fire bricks or vitreous products. Clay tile and terra-cotta, although not a large portion of the industry, centered mostly in the central and western areas of the state (Buckley 1901:24-143).

IDENTIFICATION

Resource Types. Abandoned quarries, derricks, cutting sheds, railsidings and sheds, dockfront shipping areas, machine shops, blacksmith shops, powerhouses. Stone working plants, offices, showrooms, monument and tombstone manufacturers, distribution warehouses and cutting yards. Lime kilns, crushing machines/sheds, hydrating plants, offices, storage areas for limestone, wood/fuel and finished lime, small-gauge railways or trams, cooperages, bagging shops. Cement plants, kilns, grinding machinery, open storage docks, concrete and concrete product plants (including c. 1910 concrete block). Brickmaking plants, storage areas, clay pits, pug mills, molding plants and machinery, kilns, cooling sheds, drying yards, machine shops. Owners residences, working housing (often seasonal), quarrying, cutting, manufacturing machinery.

Locational Patterns of Resource Types. Refer to the map for generalized locational patterns based on predominent bedrock deposits. Most quarrying sites were located at the intersection of two prominent rock formations or at natural features that may expose underlying strata, i.e., bluffs, river valleys, ledges, etc. Among the most important man-made aspects of efficient quarry operation was a location with direct access to railroad or water transportation networks. Adjacency to major market areas (urban centers) was also a major feature of early production sites.

Previous Surveys. No in-depth surveys covering the statewide quarrying and masonry products industry exists at this time. The Milwaukee Menomonee Valley Survey (Merritt & Snook 1980), the DOI's Sandstone quarries of the Apostle Islands Resource Management Plan (Lidfors 1983), and the thematic survey/nomination of Lime Kilns of Waukesha County (Radmer 1979), however, do offer limited surveys for specific areas. In addition, two articles by Ernest Buckley for the Wisconsin Geological and Natural History Survey, "Building and Ornamental Stones of Wisconsin" (1898) and "The Clay and Clay Industries of Wisconsin (1901)," give detailed analyses of all extant production sites at the time of their publication and may be of enormous aid in future research.

Survey and Research Needs. Future surveys should study the adjacent areas of a community (if only briefly) to reveal any local suppliers of building and/or masonry products. Research into the limited manufacture of terra cotta is scarce at this time.

EVALUATION

National Register Listings and Determinations of Eligibility

Bass Island Brownstone Co. Quarry (1868), (Basswood Island), Town of La Pointe, Ashland County (NRHP 1978)

Trimborn Farm (limestone), 8801 W. Grange Ave., Greendale, Milwaukee County (NRHP 1980)

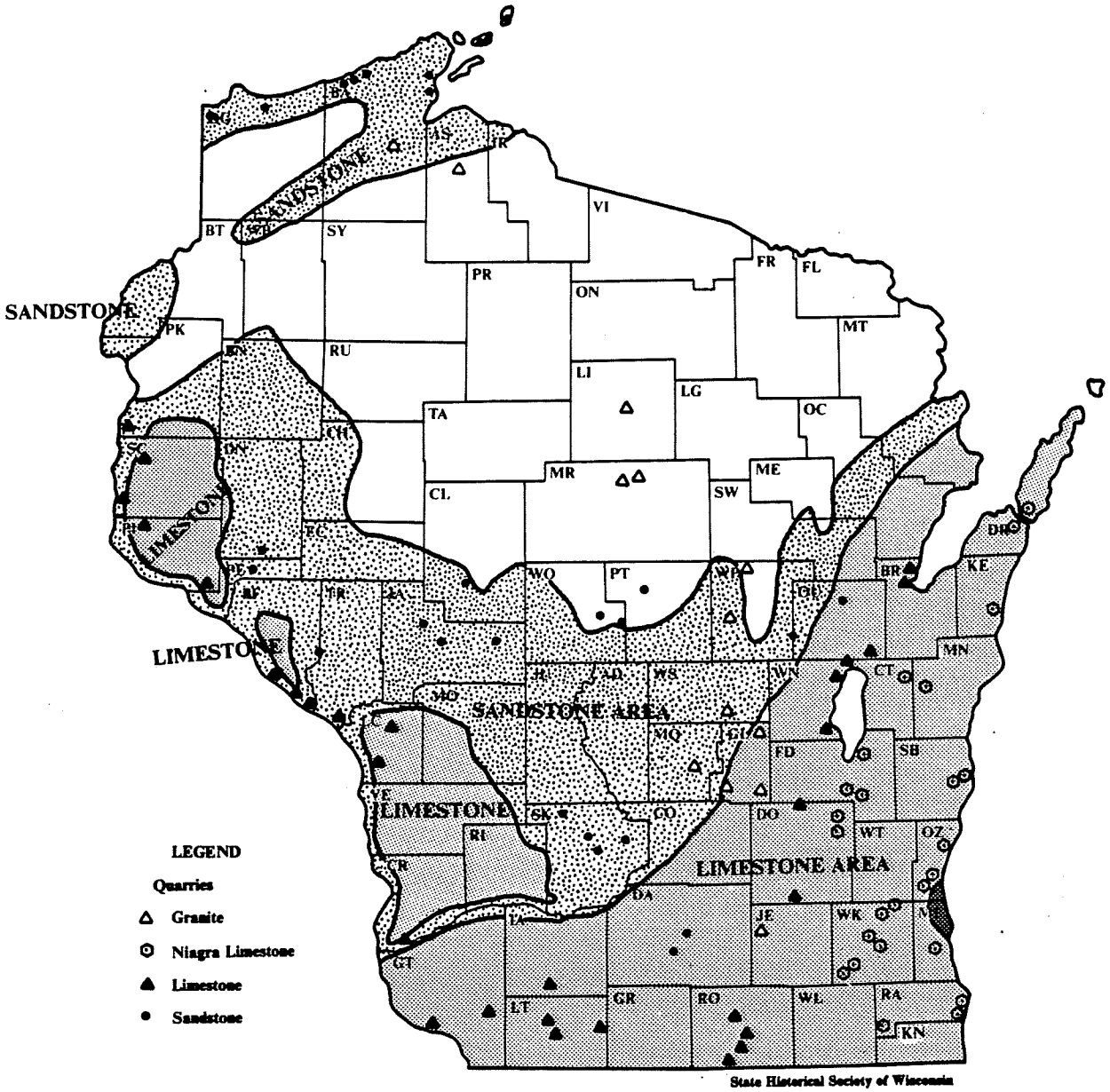
Lime Kilns of Waukesha County Thematic Group (Hadfield Kilns, Pewaukee; Johnston Kiln, Genesee; Mace Kilns, Menomonee Falls; Suxxes Kiln, Lisbon), Waukesha County (NRHP 1982)

Joseph J. Hadfield House (1883), 710-712 N. East Ave., Waukesha, Waukesha County (NRHP 1985, MRA)

Context Considerations. Generally, most of Wisconsin's quarrrying sites now exist as overgrown areas barely visible without sustained searching. Most machinery from abandoned sites was probably removed or sold for scrap during various war efforts, as were the temporary or semi-permanent working facilities. Many small quarry sites may now be used as crushed stone or gravel sites by municipalities. Lime kilns, the most

substantial artifacts related to the industry and built of stone, are more likely to remain intact than any other feature. Kilns should retain their basic form so that one can clearly visualize the production process once involved.

In many cases, due to age, abandonment, or limited use, the sites might best be categorized as archeological ruins and their historic importance to a community or region is important to consider. Most sites will be of only local importance.



Wisconsin Quarries, 1898

Source: Ernest R. Buckley, *Building and Ornamental Stones of Wisconsin*, Wisconsin Geological and Natural History Survey Bulletin no. 6 (Madison, 1898), p. xxii.

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LEAD AND ZINC MINING

Temporal Boundaries: 1690-1930.

Spatial Boundaries: A section of the driftless area in southwestern Wisconsin that encompasses present day Grant, Iowa, and Lafayette counties, and the western parts of Dane and Green counties.

Related Study Units: Territorial government, Winnebago, Sauk, and Fox Indians.

HISTORICAL BACKGROUND

Although today associated with a region best known for its rich farmland, place names of southwestern Wisconsin, such as Lead Mine, New Diggings, Hard Scrabble, and Mineral Point, evoke the riches of an earlier era when local mines produced a significant portion of the nation's lead and zinc from the 1820s until the 1920s. For the pioneer settlers of the region, those mines held the promise of quick rewards, a promise that proved more magnetic than either the fur trade or frontier farming in luring a steady stream of settlers northward up the Mississippi and Fever (now Galena) rivers. With settlement came communities, government, industry, and agriculture, so that when the Wisconsin Territory was created by Congress in 1836, the men and women of the lead region stood at its economic and cultural center.

Wisconsin's lead region forms the largest part (about 90 percent) of the upper Mississippi Valley lead district, a 3,000 square mile expanse of unglaciated terrain in southwestern Wisconsin, northwestern Illinois, and northeastern Iowa. In Wisconsin, the region is centered in Iowa, Grant, and Lafayette counties, extending eastward into Green and Dane counties (Schafer 1932:12). The physical features that delineate the west, north, and east borders of the region are the Mississippi, Wisconsin, and Sugar rivers respectively, important sources of transportation. The southern boundary is formed by the Wisconsin-Illinois state line.

But more important than its rivers, the region is characterized by its geology. Unlike eastern Wisconsin, the lead region is "driftless," and "preserves a large sample of what the rest of Wisconsin as well as the northern and southern United States was like before the Glacial Period" (Martin 1965:82).

In 1854, Edward Daniels, Wisconsin's first state geologist, summarized the importance of the driftless area to the development of lead mining:

> A remarkable fact in the superficial deposits of this region is the entire absence of the drift so abundantly represented over the north-west generally, by boulders, gravel, sands, and clay. So far as my observation extends, not a single boulder of gravel stone can be found over the whole district. Whatever then may have been the agency which dispersed the huge masses of rock, fragments of native copper, beds of sand and gravel, so lavishly over the surrounding country, we know, that by some peculiarity of position the lead region was above its reach. Widely removed as this circumstance may seem from practical matters, it has nevertheless a most important bearing upon the economic value of the district to which it relates. For had it been otherwise the whole surface would have been covered with loose deposits, often of great thickness, burying all indications of the presence of lead veins, rendering discovery exceedingly doubtful, and profitable mining a practical impossibility (Martin 1965:108-109).

Instead, lead ore remained close to the surface, readily accessible to exploitation. In 1862, J.D. Whitney confirmed Daniels' report:

> If we consider the magnitude and universality of the drift deposits in the northern United States, and especially in northern Wisconsin, we shall be more astonished to learn that throughout nearly the whole Lead Region, and over a considerable extent of territory to the north of it, no trace of transported materials, boulders, or drift can be found; and, what is more curious, to the east, south, and west, the limit of the productive Lead Region is almost exactly the limit of the area thus marked by the absence of the drift (Martin 1965:110-111).

DISCOVERY

The presence of lead ore in the upper Mississippi district had been known to Europeans since the seventeenth century. Prior to permanent white settlement, French fur traders discovered Indian "diggings," some of which had been worked by prehistoric peoples. (Indeed, lead has been found at Early Archaic-Contact Period archeological sites throughout the Mississippi and Ohio River Valleys and the Great Lakes region). French fur trader Nicolas Perrot was the first European known to have actively engaged in trading lead mined by the Indians of the region. In about 1690, Perrot established a trading post below the mouth of the Wisconsin River, among the Miami Indians, possibly near the St. John's mine near Potosi (Schafer 1932:27-28).

From that time until the close of the French fur regime, the upper Mississippi mines were the province of Indians and a few Frenchmen who used the lead to supplement the fur trade. When the French withdrew from the Northwest in 1760, Indians such as the Sauk, Fox, and Miami guarded the mines carefully, revealing the locations only to favored traders like Julian Dubuque who travelled north from the Missouri lead district in 1788. After settling on the site of the city that today bears his name, Dubuque obtained permission from the Sauk and Fox Indians to mine lead on the west side of the Mississippi (a grant confirmed by Spanish authorities) (Smith 1973:182-183).

The mines of the region proved profitable. A year after Dubuque's death in 1810, the United States Secretary of War reported that three strikes in the region (worked by about 500 Indians) had produced 500,000 pounds of lead, much of it from Dubuque's mines, "most of which had gone into the British trade" (Schafer 1932:28; Palmer n.d.:11). When Captain John Shaw ascended the Grant River in 1815, he reported Indian diggings near Potosi where the abundant lead was extracted simply by prying it loose with sharpened sticks (Baumann 1939:44). Earlier and later explorers--Zebulon Pike in 1805; Henry Rowe Schoolcraft in 1820--confirmed such reports in their travel accounts.

News of the prodigious Indian diggings "enhanced the reputation of the district and was a major factor in attracting white prospectors to the region after the War of 1812" (Palmer n.d.:12). But settlement was slow, because the lead region was mostly unceded Indian land until the 1820s. (See Wilgus 1927:402 for discussion of early cessions and retrocessions). Not until 1829 did a treaty finally clear the "entire lead region... of Indian title" (a situation made irrevocable by the defeat of Black Hawk in 1832) (Smith 1973:133).

In the meantime, those few American miners "busy in southwest Wisconsin as early as 1819," were, like Jesse Schull, "influential" among the Indians (Baumann 1939:44; Smith 1973:183). But with each Indian cession or "mining strike," popular sentiment pressured for increased settlement, and in 1822, the United States government instituted a leasing system for mining on upper Mississippi frontier which opened the floodgates to settlers.

FEDERAL ADMINISTRATION OF THE LEAD REGION

The development of the Wisconsin lead region was precipitated by a strong demand for lead in the nineteenth century when the mineral was widely used in the manufacture of countless items including pewter, printers' type, pipes, weights, shot, and, most significantly, paint. The War of 1812 had kept British lead off the American market, creating high prices and a stimulus to domestic production. To meet demand, "white lead" factories were established as far west as Pittsburgh and Cinncinati by 1815 (Clark 1955:9). For American manufacturers, the lead fields of Wisconsin promised an important new source of the raw mineral.

Despite heightened interest, however, settlement of the Wisconsin district was not a chaotic rush. Federal laws carefully controlled both the leasing of land and the production of lead. "The idea of the federal government reserving ore-bearing lands from entry and sale, to be developed on a leasing basis is an interesting one," notes Nesbit "because it was actually tried in the upper Mississippi lead region and there only" (Nesbit 1973:107). Previous land laws, including the Land Ordinance of 1785, reserved to the government one third of the production of any mines, but the restriction had little effect and was not included in subsequent general land laws of 1796, 1800, or 1804. But in 1807, government officials (including Treasury Secretary Albert Gallatin) became interested in developing a domestic source of lead while raising revenue to offset the costs of administering the new lands (Nesbit 1973:107).

Under the law of 1807, Congress did not sell ore-bearing lands but issued permits for mining and smelting, collecting ten percent of the processed lead as an "in-kind" royalty. Although the law was intended for the profitable Missouri lead region, miners there strenuously and successfully objected to the restrictions, winning the right in 1827 to privately purchase lead lands. But the emerging upper Mississippi district provided "a ready field for the application of the federal leasing system" (Nesbit 1973:108).

When administration of the law was shifted from the Treasury Department in 1821, the Army's Bureau of Ordinance became responsible for establishing regulations, collecting royalties, and stockpiling the lead at an arsenal in St. Louis. In an initial effort to attract miners to the upper Mississippi, the Bureau advertised in St. Louis newspapers in 1822, offering the privilege of mining a 320 acre tract with rights to timber and stone resources for smelting. In return, the leasee agreed to post a $10,000 bond, employ at least 20 men, and grant the government ten percent of the finished product. "This sober business proposition" was unlike other mining "rushes" of the nineteenth century (Nesbit 1973:108).

Two men answered the initial advertisements in 1822: Moses Meeker, a white lead manufacturer from Cinncinati who travelled with a party of 43 to the Fever River area in 1823, and James Johnson, a Kentucky native who had been operating in the district without a license since 1819 (Nesbit 1973:108-109). But these businessmen-prospectors were the advance guard of a movement which increasingly included more transient miners attracted by news of strikes, high lead prices, and jobs. "The permission to mine on the Fever River induced a stream of miners and adventurers" (Smith 1973:183). To induce the influx and keep the leasing system intact, Lieutenant Thomas Martin, federal administrator of the district, liberalized the system in 1825. He created transferrable prospecting permits that required no bond. In addition, a 10 percent royalty was collected from the smelters who processed the lead rather than from the miners who dug it.

Under the provisions of the policy:

> Anyone wishing to dig had to obtain a permit and agree to deliver his ore only to licensed smelters. This permit allowed a man to stake off a 200 yard square plot. If he had the money, a person could give bond for $5,000 and have the right to work 320 acres. Smelters had to give bond for $10,000 and got the right to use timber, rock, and water resources included on their grants. A

federal tax of 10 percent of the value of all lead produced was collected from them (Clark 1955:7).

The lease policy, in addition to filling federal coffers, "established recognized rights for the miners, and it had the effect of rapidly changing what had been mainly an intruding and a floating population into one fairly permanently settled in favored spots" (Wilgus 1927:40). Travelling up the Fever River from Galena, the first leasees started digging near present day New Diggings, Shullsburg, and Hard Scrabble (today known as Hazel Green). Strikes soon followed near Mineral Point, Dodgeville, Benton, Wiota, Platteville, and elsewhere. The population of the district jumped dramatically from 200 people in 1825 to over 10,000 by 1829 (Nesbit 1973:110; Wilgus 1927:403).

As settlement grew, the leased land spread haphazardly across the district, clustered wherever the diggings proved profitable, often at the site of previous Indian diggings or where "float mineral" indicated rich deposits near the surface. "Thus the mining region east of the Mississippi came to include, generally speaking, all the territory south of the Wisconsin River, west of a line from Portage to Janesville today, and north of the Rock River as it flows southwest into the Mississippi" (Wilgus 1927:403). Chandler's map of 1829 graphically depicted that region as pock-marked with diggings, furnaces, and nascent miners' communities, a patchwork of settlement that would become the first population center of Wisconsin (Chandler 1829: n.p.).

The growth in mining was nothing short of phenomenal. In 1825, 69 permits were issued for the district; the next year, 350 permits were granted. By 1827, the number of diggers had leaped to 2,084 and total Wisconsin production had surpassed that of the Missouri district. By 1829, 4,053 diggers and 52 licensed smelters produced over 13 million pounds of refined lead (Smith 1973:183; Schafer 1932:37). As one observer noted in that year:

> The number of mines at Fever River is increasing rapidly. Such are the inducements to individual enterprise and industry at those mines, that numbers of the most respectable inhabitants of the upper Mississippi are resorting to them, as a source of reward for labor not attainable elsewhere (Palmer n.d.:48).

Clearly, Wisconsin was the lead mining center of America at that date.

Although over production caused a sharp drop in lead prices in 1829 (precipitating a depression in mining which lasted until 1831), by 1836 "lead production began a steady rise, making tremendous leaps in the next three years" (Nesbit 1973:111;Smith 1973:529). By 1840, the Wisconsin Territory produced nearly 50 percent of the total lead output in the United States (Schafer 1932:11). Recognizing the significance of the district, Congress that year published the results of a survey which assessed the region's productiveness. David Dale Owen's survey reported nearly 25,000,000 pounds of lead produced in the territory at the end of 1839 (Owen 1840:43-44).

Even the growth of agricultural settlement did not challenge the dominance of the lead trade at this date. In 1840, 22 percent of Grant County residents engaged in mining and smelting while only 15 percent engaged in farming, a figure typical for the district as a whole (Smith 1973:529). The emphasis in mining was also reflected in the early industrial growth of the district. In the early 1840s, Iowa County, for example, had four grist mills, seven saw mills, and 30 smelting furnaces. Grant County had four grist mills, 12 saw mills, and 20 furnaces. In addition to the mines and smelters, a profitable shot tower was established in 1830 by Daniel Whitney in the Wisconsin River community of Helena (Gregory 1932:I,66; Wilgus 1927:408). "The tower was completed in 1833, and although it changed owners repeatedly, the manufacture of shot was continued until 1861. This enterprise aided in upbuilding the lead region and diverted from Illinois and Missouri much lead that had formerly gone thither" (Kellogg 1919:36).

Lead production continued to increase steadily through the 1840s, reaching a zenith in 1845. Although a decline set in after that year, the region continued to be a major center of lead production through the 1860s. Much of the latter day success was due to the technical skills of the 7,000 Cornish miners who arrived in the lead district after 1830 and formed 20 percent of the region's population by 1850, most settling in or near Mineral Point (Fatzinger 1971:29). Migrating to the Wisconsin lead fields (as their countrymen had migrated to mining frontiers throughout the century), the Cornishmen were attracted by the temptation of owning a mine and readily seized opportunities ignored by Americans, applying their expertise in hard rock mining, water diversion, and explosive powders (Nesbit 1973:116-117).

TECHNOLOGY AND TRANSPORTATION

The tools and techniques of lead mining in the first decades after 1820 were simple and cheap; some miners struck it rich with only $20 worth of equipment (Nesbit 1973:110). With picks and gads (pointed iron bars or spikes), shovels and hand drills, blasting powder and fuses, the miners dug relatively shallow, well-like holes ranging in depth from a few to 50 feet. Because ore lay near the surface and cave-ins and floods posed dangers, miners seldom dug below 40 feet (Clark 1955:6).

The primary operation involved two or three men working together to sink a shaft, with horizontal tunnels dug from the main shaft following the east-west veins of lead. A wooden frame supporting a crank shaft rested above the opening; attached to the crank shaft were ropes which raised the heavy wooden tubs filled with ore and debris. Candles placed along the walls lighted the dark tunnels which honeycombed the lead lands (Fatzinger 1971:16-18). Cave-ins and flooding eventually forced the abandonment of many mines, but in only a few places were pumps installed to lift water out of the mines (Fatzinger 1971:19). An average claim could yield about 150 pounds of ore a day (Nesbit 1973:110). But there were also those, like the miner in Hazel Green in 1824, who "hit block mineral and took out 17,000 pounds in a single day" (Nesbit 1973:110).

Once extracted, the ore was hauled in a raw state to the nearest licensed smelter where the furnace would transform 75 percent of the ore into lead. The earliest furnaces were constructed of log and ash, built in a hole on sloping ground. When ore burned, liquid lead would deposit on the bottom of the hole. By the mid-1830s, however, furnaces were constructed of brick and stone, built in ravines near the diggings or over a small streams (Fatzinger 1971:20-21).

> The water turned a wheel that worked bellows to produce intense heat. Timber for fuel was cut off the hillsides. The ore was broken into small particles and thrown on a large slanting hearth filled with charcoal and wood. As the lead smelted, it ran into a heated reservoir. From there, it was ladled into cast iron molds. The product was a pig of lead weighing 70 pounds (Clark 1955:7, see also Fatzinger 1971:21).

Transporting the pigs of lead to market provided western Wisconsin with early connections to the rest of the nation. From the smelter, the pig lead would be hauled on rough roads or floated on streams to shipping points in the region (like Potosi or Galena). From there, keelboats and, after 1823, river steamers, would carry the shipment down the Mississippi to Missouri where it eventually entered Ohio River traffic or continued south to New Orleans and from there went by ship to the East. (As early as the 1820s, however, some lead trade was carried over the ancient Wisconsin-Fox River route to Fort Winnebago and Green Bay. Daniel Whitney shipped shot from his tower at Helena over the same route in the 1830s, but the waterway was eventually abandoned for lack of sufficient river improvements. See Libby 1895:306-310). But Mississippi River traffic was subject to the whims of nature and middlemen. Changing water levels, fluctuating rates, and the uncertainties of distant markets made such trade unpredictable.

By the 1830s, overland roads to Wisconsin's new lakeshore ports offered a more direct and less expensive route to market. As early as 1836, smelters transported lead to Milwaukee and Racine. Carried on wagons drawn by oxen teams (known as "lead schooners"), the lead was shipped from the ports over the lakes to the "white lead" factories of Buffalo and other eastern cities (via the Erie Canal). In the 1840s, lead schooners were familiar sites, and a sizable amount of lead and shot was shipped that way (Libby 1895:314-316). By 1856, the lakeshore ports were handling more than half of the region's lead production, strengthening the commercial and cultural bonds between the young state's two population centers. The returning wagons brought supplies, store goods, and settlers to the lead district and simultaneously encouraged the development of the intervening agricultural lands (Nesbit 1973:110). By 1857, rail lines connected the lead region to the lakeshore cities and increasingly southwest. Wisconsin was more tightly bound to southeast Wisconsin than to its Mississippi River roots.

FARMING ON THE FRONTIER

Although farming in the lead region was discouraged under the federal leasing system, the depression in lead prices between 1829 and 1831 led to "the practical demise" of the system and encouraged the development of agricultural settlement (Nesbit 1973:111). As the price of foodstuffs and supplies outstripped the profits of mining, diggers cultivated the land for sustenance and cash. When the lead industry rebounded in 1831, the revitalized economy created a strong new market for the products of local farms. Agricultural settlement accelerated after the Treaty of 1829 cleared Indian title and in the wake of the Blackhawk War (1832) when the final barriers to permanent white settlement were removed. The ensuing demand for farmland led to a federal survey of the newly ceded lands beginning in 1831, and a land office--charged with selling only "non-mineral" lands in the district--was opened in Mineral Point in 1834. The first sale took place on November 16, 1835 (Smith 1973:190).

The fertile soils of the southwest proved especially attractive to prospective farmers, and the presence of mines did little to handicap their efforts. Although scattered throughout the region, by 1840 lead mining was "restricted to definitely circumscribed locations" which proved most profitable, leaving 92 percent of district land free for farming (Schafer 1932:94). Schafer noted that "there are certain townships and parts of townships which are so honeycombed with mines as to place farming at a physical disadvantge." These included Benton, New Diggings, Hazel Green, Jamestown, Shullsburg, Platteville, Potosi, Beetown, Glen Haven, Mineral Point, Linden, Dodgeville, and Ridgeway. "In the balance of the mineralized areas the mines are so scattered and occupy so relatively little of the ground as to constitute no particular hindrance to farming." Still other communities within the region, like Wayne, Gratiot, Montello, Fayette, Waterloo, Ellensboro, Moscow, Waldick, Liberty, Lancaster, Little Grant, and Bloomington, are "wholly free of under surface works". At least 15 additional townships in the district "have less than a thirty sixth part of their surface affected by diggings" (Schafer 1932:131-132).

Popular opinion and land speculators like Moses Strong of Mineral Point pressured land office authorities to declare much of the region open for sale, a sentiment that prevailed over the next decade, and even mineral lands were falsely sold for farmland. Miners, too, were happy to see the leasing system pass from the frontier. In 1835, only one-fifth of the lead raised in the district was reported to the Army's Bureau of Ordnance. By 1847, de facto practice became de jure policy, and all remaining lands in the lead district were opened for sale (Nesbit 1973:112-113). After that, the region's agricultural economy grew steadily. During the next decade, farmers outnumbered miners, producing corn, hogs, and cattle on a large scale. By 1860, "the region had come to be recognized universally as one of the best farming districts in the state" (Schafer 1932:163).

THE DECLINE OF THE LEAD MINING FRONTIER

"With the passing of the federal leasing system, the character of the frontier changed to a mixture of agricultural and mining," notes Nesbit "and the mining that remained became more specialized as the surface deposits were worked out" (Nesbit 1973:113). As early as the 1840s, some shallow deposits were exhausted, while others had been worked to the water level where drainage problems became severe. Decline set in rapidly after 1847, and many miners migrated to the booming gold fields of Calfornia or the copper mines of the Lake Superior region (Merk 1916:112; Fatzinger 1971:38). For those who remained behind in the 1850s, mining became a winter supplement to summertime farming (Merk 1916:112).

Decreased production after 1847 was compounded by a national depression 10 years later when many mines in the region were abandoned. Some reopened during the Civil War (to meet wartime demand), and eastern capital and better mining techniques helped restore a degree of productivity to the mines. (In 1862, for example, the abandoned Champion lode near New Diggings was drained and 5,000,000 pounds of ore retrieved during the next four years). But lead mining was in permanent eclipse, diggings were exhausted, and the rising lead prices of the 1860s only masked steeply declining production (Merk 1916:112-113).

COMMUNITY, POLITICS, AND CULTURE ON THE LEAD FRONTIER

The penetration of the lead miners into the prairies and hinterlands of the frontier laid the foundation for a new pattern of Euro-American settlement that lasted well into the late nineteenth century. The arrival of lead miners in southwestern Wisconsin also brought rapid economic developement to the region. Small cities such as Mineral Point, Platteville, Dodgeville, and Shullsburg grew where miners settled, roads for hauling lead were built, and farming began around the mines to provide basic foodstuffs for the mining population and to diminish the need for outside supplies.

For the earliest settlers on the mining frontier, life was difficult and accomodations were often primitive. The first diggers lived in tents during the summer and burrowed, in badger-like fashion, into hillsides and abandoned mining shafts during the winter. But the first rush brought "all classes and conditions of men", including some settlers who had substantial capital. Credit was cheap, mining operations were simple, and "life was full of excitement and change" (Kellogg 1919:35).

Many of the miners, who were often veterans of the Missouri lead mines, came to the district from the mid-South. But the Wisconsin frontier attracted a heterogenous ethnic mix dominated by native Americans but including settlers from the British Isles, Germany, Norway, and elsewhere. And while men outnumbered women, miners increasingly brought their families after 1832. Those who came seeking fortunes often stayed to farm and raise families after the diggings were exhausted (Kellogg 1919:35).

Although the mining frontier was a rough and tumble place, where "drinking and gambling, quarrels and duals were common," the first forms of community life did not lag far behind the first strikes. The signs of community had spread throughout the region as early as 1829. By that date, the region was already home to scattered taverns, farms, and mills (Chandler 1829). As population grew, the demand for foodstuffs and other supplies increased. Provisions (brought north by keelboats and river steamers or overland by oxen team) were sold or bartered at the nearest general stores, while gossip and news were traded at the tavern. Both places served as valuable community centers.

Mining was less isolating than pioneer farming, and small mining villages grew quickly near the diggings. According to a contemporary observer, such communities typically included "three hotels, four saloons, three blacksmith shops and furnace smelters." By 1826, Lieutenant Martin Thomas had platted Galena, the "metropolis of the Fever River lead district." By 1839, the city reputedly had a population of 3,000. Soon after Galena

was platted, Mineral Point was founded at the center of the Wisconsin fields, conveniently located to both Galena and Wisconsin River ports. Designated as the seat of Iowa County by 1830 (which then included the entire lead district) and as the home of the land office in 1834, the community eventually blossomed as the center of the Wisconsin territory. By 1845, it boasted a population of 15,000 (Nesbit 1973:114).

Often a smelter, the most substantial of mining entrepreneurs, became a town founder. William Hamilton, for example, helped found Hamilton Diggings (Wiota) in 1827 and Muscoda in 1836; Henry Dodge founded Dodgeville in 1827; Henry Gratiot established Gratiot's Grove (near Shullsburg) in 1827; John Rountree founded Platteville in 1827. (As the region grew, other cities--Lancaster and Darlington, for example--benefitted more directly from increases in agricultural trade, railroad expansion, or local government) (Schafer 1932:188-208).

As the frontier matured, culture, education, and religion took a place alongside industry and commerce. As Kellogg noted, "a considerable degree of culture was current in southwest Wisconsin during this period. Ladies from the social circles of Paris and London lived here in familiar intercourse. Many private libraries were in the possession of mining operators. As early as 1830, a classical school was started at Mineral Point. To find the beginnings of Wisconsin culture, the historian must study the early days in the mining community" (Kellogg 1919:35).

The first rudimentary educational institution, like the school that smelter William Hamilton started in Hamilton Diggings in 1833, gave way to more substantial efforts like the Platteville Academy, originally chartered in 1839. The Catholic Church benefitted from the ministry of Father Samuel Mazzuchelli who gathered congregations, designed churches, and established schools in the 1830s and 1840s in New Diggings, Platteville, Shullsburg, Benton, and elsewhere. The southern and Cornish miners of the district were receptive to itinerant preachers like Alfred Brunson, the Methodist circuit rider who traversed the district in the 1830s. (Methodism was the favored denomination of many in the region. Smelter John Roundtree, for example, started a Methodist church in Platteville in 1832) (Schafer 1932:193). No doubt it could be said of many of the region's communities what a Presbyterian missionary said of Mineral Point in 1845: "On the whole, the morals of the place would compare favorably with those of most Eastern villages" (Schafer 1932:188).

When the Wisconsin Territory was established in 1836 (embracing the present day states of Wisconsin, Iowa, Minnesota, and parts of North and South Dakota) a large part of the territory's population lived in the lead district (Schafer 1932:59). With numerical strength came political dominance, and the territory's new government (first seated at Belmont) was headed by Henry Dodge, a lead miner and hero of the Black Hawk War, who came to the district from Missouri in 1827 (Smith 1973:185).

Like Dodge, many settlers in the region came from the mid-South, and both heritage and commerce reinforced the Southern orientation of the region in the years leading to statehood. The political structure favored Democrats like Dodge who were appointed to territorial offices during the federal administrations of Democratic presidents Jackson, Van Buren, and Polk (Nesbit 1973:116). When the first territorial legislature convened in 1836 at Belmont (in the heart of the lead region), Iowa County (which then included the entire Wisconsin mining district) dominated the proceedings with 23 percent of the members. Two years later, 28 percent of the legislators came from the district (Nesbit 1973:116; Clark 1955:18). The territory's first Congressional delegate was smelter George Jones of Sinsinawa Mounds (originally of Kentucky), a staunch Democrat with "strong Southern sympathies" (State Historical Society of Wisconsin 1960:195).

Gradually, however, the center of political power shifted eastward, as Yankee farmers settled the prairies of eastern Wisconsin and as improved transportation carried the lead

trade to lakeshore ports. But the eastern Wisconsin differed fundamentally from the lead mining region in its institutions, customs, and practices. These differences were reflected in the political ideas of the two regions and became more apparent during the change from territorial status to statehood. For example, during the drafting of the state constitution, each region advocated its own customs. The people from the lead mining region were primarily southerners who had brought with them the "county" form of local government. The people in the eastern part of Wisconsin had brought with them the "town" form of local government familiar in the northeast. The disputes between the regions were symbolized by the personal and political conflicts between Dodge and James Duane Doty, territorial judge, land speculator, sometime Whig politician, second territorial governor, and congressional delgate. Doty succeeded in moving the permanent capitol eastward to Madison (Schafer 1932:77). When the first state legislature convened in that city, only 18 percent of the legislators were from the southwest, reflecting the dramatic increase in the population of eastern counties (Clark 1955:19). (Interestingly, however, the lead region wielded enough influence to help elect Nelson Dewey, a Democrat from Cassville, first state governor).

THE RISE OF ZINC

Although lead production in southwestern Wisconsin declined after 1847, the region experienced a dramatic and unexpected resurgence in mining activity at the close of the Civil War. "In nothing did Wisconsin give more convincing proof of her prosperity" during that period "than in the mining boom" (Merk 1916:111). The renewed activity was due to several factors. In part, improved technology permitted deeper mining. Moreover, the investments of eastern capitalists accomplished what individuals could not: the reworking of old mines that had been exhausted and the opening of new ones (Merk 1916:113). But mostly the boom was due to increased demand for the region's zinc ores which underlay the lead deposits. Although the region continued to be the nation's principal area of lead production in the late 1860s, by 1871 more zinc than lead was mined in southwest Wisconsin (Fatzinger 1971:52-53).

The presence of zinc deposits in the lead district was observed by David Dale Owens as early as 1839 and was later confirmed in reports by Wisconsin State Geologist Edward Daniels in the 1850s. But zinc was considered a nuisance by early lead miners who threw it away or used it to surface roads. Neither the technology nor the capital necessary to extract the deep-seated ores was available. Nor was transportation available to bring together Wisconsin zinc and the Illinois coal necessary for smelting (a condition, predicted state geologist James Percival, that would not be met before rail lines connected the two regions). As such, zinc was ignored as long as lead was readily available (Fatzinger 1971:44, 46).

But in the 1850s, demand for zinc grew. Used in the manufacture of paint, zinc had several advantages over lead as a pigment. It was generally of higher quality, cheaper to produce, and non-toxic. In addition, zinc was used in the manufacture of brass which became popular by the 1850s. In 1854, two zinc "white works" were operating in the United States - one in New Jersey, the other in Pennsylvania (Fatzinger 1971:43-46). By the close of the 1850s, Wisconsin's zinc resources were first developed, coinciding with the new demand. That such development could succeed "must be attributed in part to the economies of large scale lead mining which made possible the raising of hitherto inaccessible ores. Equally important, however, was the introduction of necessary capital for the establishment of zinc smelters and the application of metallurgical skill to the reduction of ores" (Merk 1916:114).

The state's first "zinc works" was established in Mineral Point in 1859, transforming smithsonite ore (commonly known as drybone because of its resemblance to decayed bone) into zinc. Although only marginally successful, the plant did attract Eastern capitalists to the region who kept a second plant operating from 1863 until 1869 (Merk 1916:114-115).

But the shipment of Illinois coal to the Wisconsin smelter proved too expensive, forcing the works to close by the end of the decade. (See Fatzinger 1971:102-105).

A more significant development to the Wisconsin zinc industry, however, was the establishment in 1859 of a commercially successful zinc works at LaSalle, Illinois. Close to coal fields and zinc mines, the LaSalle works boomed with wartime demand for zinc in munitions production. By the mid-1860s, the firm was among the largest zinc manufacturers in the world. To supply the smelter, Wisconsin smithsonite was shipped from the mines of Wisconsin to Illinois, via the Mineral Point Railroad.

With successful smelting, zinc mining in Wisconsin grew "by leaps and bounds. In 1860, 320,000 pounds of smithsonite were mined. In 1865, this amount had risen to 4,198,200 pounds and by 1872 to 27,021,388 pounds" (Merk 1916:114). After the close of the war, the deeper lying, more valuable sphalerite ore (commonly known as blende or blackjack) was mined successfully. Although more difficult to extract, blende proved to be the most abundant mineral in the region. Over 16 million pounds of blende were mined in 1872 (Merk 1916:114).

ZINC TECHNOLOGY, TRANSPORTATION, AND TRADE

Despite the jump in production, mining technology in southwest Wisconsin remained at an unsophisticated level for most of the nineteenth century. Before 1860, zinc ore was taken from old lead diggings (Fatzinger 1971:69). But even after 1865, when miners sunk shafts exclusively for zinc, the process remained mostly non-mechanical and labor intensive. New techniques were slow to be adopted.

Like lead, zinc ores were extracted by sinking a vertical shaft (seldom more the 100 feet) from which tunnels were dug in horizontal directions. Once dug, men used pick axes to loosen the ore-bearing rock from the face of the walls as they tunneled away from the main shaft. The ore was separated from the waste by drilling and blasting. A windlass over the shaft brought the ore to the surface (Fatzinger 1971:70-72).

But these methods lagged behind deep mining technology elsewhere. Piston drills using compressed air, for example, were used in Europe as early as 1861, and other drills of advanced design were used in the western United States by the 1870s. Even though powerful explosives like dynamite were available, Wisconsin miners used common black powder until the 1890s. Likewise, pumps were rare and water was bailed commonly by windlass and tub (Fatzinger 1971:72-76).

But if zinc extraction relied on older, time tested methods, processing zinc ore required substantial capital and technical knowledge unavailable on a raw mining frontier. While lead was smelted in a local furnace and sent to market as pig lead, zinc ore had to be shipped in crude form to distant smelters because of the complicated process required to reduce the ore. Sapherlite (or blende) was sufficiently rich to ship directly to the smelter, but smithsonite (dry bone) was almost always "roasted" in a small furnace (resembling a lime kiln) before smelting to remove carbonic acid. In either case, zinc production in Wisconsin was dependent upon the expansion of capital and the establishment of smelters and roasters in the area (Fatzinger 1971:97-100).

Another important factor in the development of the zinc industry in the state was the establishment of regional rail lines to transport ore to the smelters. The Mineral Point Railroad first linked the district with the smelters of Illinois, reaching Warren, Illinois (just south of the state line) in the 1850s. In the 1860s, the Dubuque, Platteville, and Milwaukee Railroad carried ore from Platteville to Illinois. In the 1870s, the Galena and Southern Wisconsin Railroad connected the former city with the Wisconsin villages of Montfort, Platteville, and Benton. The Chicago, Milwaukee, and St. Paul Railroad reached Gratiot and Shullsburg by the 1880s (Fatzinger 1871:111-121).

From 1861 until 1890, Iowa County (including the districts of Highland, Linden, Dodgeville, Mifflin, and Mineral Point) was the major zinc mining region in the state (Fatzinger 1971:89). Other notable zinc mines in the late nineteenth century included those near Meeker's Grove, Buncombe, and Benton in Lafayette County and mines near Beetown and Platteville in Grant County (Fatzinger 1971:82-96).

But production of zinc through the late nineteenth century fluctuated according to the market and the national economy. Dropping prices in the late 1870s precipitated a decline in the region's production. The local economy rebounded somewhat the next decade when a new zinc smelter was established at Mineral Point in 1882, providing a "much needed local market for zinc ore" (Fatzinger 1971:123). But the local economy was disrupted again when a national depression in the early 1890s pushed zinc prices to a record low.

ZINC BOOM

The depression of 1893-94 left the zinc industry in southwest Wisconsin reeling. But the decline was prelude to the greatest boom in the region's history. As the nation slowly recovered from the economic downturn, the demand for zinc rose dramatically. The uses of zinc in the late 1890s were "many and varied." Zinc was still used by the paint industry to produce white pigment. The rubber industry "mixed zinc white with gum to manufacture many articles, including slickers used by miners. Rolled sheet zinc was used architecturally in building and roofing. Ornamental room ceilings and walls, moldings, and friezes were stamped from rolled zinc." Large amounts of zinc were used in the plumbing and electrical industries. Zinc was used to produce galvanized iron. But "perhaps the most significant" use of zinc during this period was in alloying it with copper to form brass, a process which grew phenomenally after 1895 (Fatzinger 1971:126-127).

Increased demand led to rising prices. From three and a half cents a pound in 1894, zinc prices rose steadily to over six cents a pound in 1906. In the early 1890s, "jack" rarely brought $18 per ton, but it averaged $28.44 in 1898, continuing upward in the new century (Fatzinger 1971:127). "Between 1903 and 1907, the region experienced the greatest amount of mining activity it has ever known," with production doubling and hundreds of mines and mining companies established (Fatzinger 1971:130). A financial panic in 1907 halted the upward climb briefly (when over 100 companies went out of business), but prices recovered in 1909 (Fatzinger 1971:143, 132). After this date, zinc production grew through the end of World War I.

The most important centers of zinc production during the period were in the southern part of the region, especially near Berton, New Diggings, Shullsburg, Hazel Green, Meeker's Grove, and after 1900, Platteville (home to the prosperous Enterprise and Empire mines). Mining centers in the northern part of the region included Highland, Montfort, Livingston, Mifflin, Linden, and Mineral Point (Fatzinger 1971:134-135). Many of the area's older mines were reopened through the use of deep mining technology. Generally, the zinc mines of these areas were developed outside city limits although some communities like Platteville and Mifflin had mines inside their borders. Commonly, mining firms leased land and mineral rights from a property owner, paying a royalty of ten percent for the privilege (Fatzinger 1971:141). Larger firms, like the Mineral Point Zinc Company, purchased large tracts of mineral lands (Fatzinger 1971:143).

The organizational structure of zinc mining reflected the new scale of operations. Corporations replaced individual entrepreneurs, and regional stock exchanges (such as the Platteville Lead and Zinc Exchange) traded shares in the firms. Most of the new firms were of local origin and short duration. Indeed, "between 1904 and 1907, at least 207 mining companies were incorporated in Southwestern Wisconsin," with an average life of three years (Fatzinger 1971:143). But after 1907, capital from outside the region played a larger role, smaller firms closed, and by 1910, seven major corporations, most with

outside control, dominated the region. These included the Mineral Point Zinc Company (which merged in 1897 with the New Jersey Zinc Company, then the nation's largest producer of zinc oxide), the Vinegar Hill Zinc Company (organized in 1906 and affiliated with the Youngstown Sheet and Tube Company), Wisconsin Zinc Company (organized in 1908 and affiliated with the American Zinc and Smelting Company), the Frontier Mining Company, the Cleveland Mining Company, the Field Mining and Milling Company, and the Optimo Mining Company (Fatzinger 1971:143-145, 179).

Large firms like the Mineral Point works employed hundreds of men, furnished rail lines with heavy traffic, and were the most substantial companies in the region. By the new century, the Mineral Point Zinc Company had expanded to 52 acres, had many furnaces, purchased a local pulp and paper mill to manufacture sulphuric acid, and had a kiln for calcining blende. Thus, the company produced three major products of the zinc industry--oxide, sulphuric acid, and zinc metal (Fatzinger 1971:179-183). In addition, it was served by the Mineral Point and Northern Railroad (opened in 1905) which connected the zinc works at Mineral Point with the mining regions of Linden and Highland in Iowa County (Fatzinger 1971:188).

Unlike smaller scale lead operations, the zinc industry was labor intensive, and jobs were more specialized. In the late nineteenth century, "miners" were assigned to skilled work mostly underground, while "laborers" were assigned to unskilled jobs like shovelling or hauling. In either case, however, the work was less than full time (ranging from six to nine months) and often conducted under poorly lighted and wet conditions with the omnipresent danger of explosions, cave-ins, and fires (Fatzinger 1971:179-181).

By 1890, increased mining operations led to even further job specialization and full time employment. In addition to miners and laborers, new positions were created for mechanics, foremen, firemen, and salaried managers. Conditions, however, remained poor, unions were nonexistent, and benefits were minimal. But in comparison with other industrial or agricultural pursuits, mining paid well and the work was secure. By 1910, the largest companies in the region were even constructing company owned bunkhouses, boardinghouses, and bungalows near the mines to house the expanding work force. (But while miners were housed in crowded quarters, corporate executives, like William Jones of Mineral Point, an officer of the Mineral Point Zinc Company, built elaborate mansions in the cities).

The ethnic complexion of the work force in the early twentieth century was dominated by native born Americans or miners from the British Isles. But an increasing minority of workers were immigrants from southern and eastern Europe, and blacks from Chicago were recruited to the district by larger companies. Perhaps the most distinctive of the area's ethnic communities from the period was the Italian neighborhood that developed in Mineral Point near the zinc works (Fatzinger 1971:192-207).

With substantial new capital, mining technology slowly modernized. By 1906, compressed air drills were in use; mechanized electric shovels were introduced in 1916. Changes occurred in handling ore after it was mined as well. By 1915, ore, which traditionally was hauled by wagon to "jigging" mills (to reduce waste materials), was transported to the mill by inclined tramways. But perhaps the biggest change was the introduction of electricity to mining operations, replacing horse or steam power. The Hazel Green Mining Company was the first to install electric engines to power hoists, drills, lights, and the mill as early as 1903. By 1913, electricity had reached Platteville, Rewey, Livingston, and Mifflin (Fatzinger 1971:155, 159-160, 162-164).

Accompanying the growth of zinc mining and smelting was the development of modern mills, roasters and separating plants to make zinc acceptable to the smelter. Milling consisted of crushing and "jigging" ore to separate the galena, blende, and waste materials. By 1910, nearly every mine in the region had adjacent or nearby mills

(Fatzinger 1971:170-172). But "the zinc coming from the jig mill was intimately mixed" with iron sulphate which had to be removed before smelting. To separate zinc from iron, expensive furnaces (or roasters) were built for roasting (or calcining) ore, changing its physical properties so that subsequent magnetic separation was possible (Fatzinger 1971:168).

After roasting, the ore was processed by a separator "where magnetic oxide was picked out by electromagnets. From there the incompletely roasted and magnetic sulphide particles went to the tailings pipe and the zinc product to the ore bins from which it was loaded on railroad cars for shipment to the smelter" in Mineral Point or to other smelters in Illinois, Missouri, and elsewhere (Fatzinger 1971:174-185). The roasting-magnetic separating process greatly increased the value of the region's zinc ores (including low grade ores previously of little value) and "its importance to the region cannot be overemphasized" (Fatzinger 1971:168).

Several notable roasting and separating plants were constructed in the district in the early twentieth century. The Platteville separator was a unique in the area, utilizing an electrostatic separation process, thus saving the cost of roasting and the loss of zinc and sulphur. Only two other plants in the world were like it: one in Utah, the other in Mexico. The Platteville separating plant was destroyed by fire in 1911 and was never rebuilt (Fatzinger 1971:177). Cuba City had two zinc separating plants. The Campbell magnetic ore separator was built in 1910 and acquired by the Wisconsin Zinc Company in 1913. The other plant was completed by the National Separating Company in 1916 and was affiliated with Vinegar Hill Zinc Company (Fatzinger 1971:178-179). The Wisconsin Zinc Company also owned and operated the Skinner Roaster, built in 1915 by L.B. Skinner. It was located one half mile west of New Diggings. The plant had a large output and was serviced by a branch of the Chicago and Northwestern Railroads (Fatzinger 1971:177-178). The ores processed by these plants were shipped to smelters in Mineral Point or outside the state (especially in northern Illinois).

Decline

With a decline in demand for zinc after World War I and the concurrent rise in the cost of production, zinc mining became less profitable. After reaching a high of $135 a ton in 1918, prices fell steadily. By 1919, fewer than 30 mines in the area shipped ore (down from 80 in 1916). The decline was compounded by competition from the zinc mines of Missouri and the western United States. But the final blow was the advent of the depression in 1929. With that "the days of mining being a major economic factor in the region were gone. The mining industry with its national significance and its importance to the economic well being of the area, and its prominence on the natural landscape was a thing of the past" (Fatzinger 1971:208-209). Zinc mining continued on a limited scale until the 1970s when the last mine in the area closed. (Garfield, Fay, Neville).

IDENTIFICATION

Resource Types. Mines, smelters, badger huts, worker housing, mining equipment stores, zinc smelters, roasting furnaces, slag furnaces, jigging mills, magnetic separators, power plants, storage facilities, shaft houses, mining company offices, bunkhouses, boarding houses, company farms, residences associated with significant individuals such as mine owners and operators.

Locational Patterns of Resource Types. While all of the sites are located in the southwestern counties of the state, the individual mining sites were widely scattered across the region according to the specific locational patterns of ore reserves. Housing for the miners was generally located in close proximity to the mines themselves. In later years many of the larger mining and processing companies erected bunkhouses and boarding houses adjacent to their operation for their workers. Processing plants were generally located outside of the city limits, but in close proximity to major rail connection for ease of transport to and from market.

Previous Surveys. The Intensive Surveys of Lancaster, Potosi/Tennyson, Dodgeville, Belmont and Gratiot; the Intensive Survey of Green County; and the Intensive Survey of Mining Communities in Portions of Lafayette and Grant Counties all provide significant historical documentation concerning the rise and fall of lead and zinc processing in their respective areas. A number of the reports even outline extant resources associated with the lead and zinc mining industries.

Survey and Research Needs. While intensive surveys have been completed in the majority of the major mining communities of the southwestern region, further documentary and field study of the surrounding rural areas, with special attention paid to historic mining locations documented in historic publications should provide additional information into both extant above and below ground resources.

EVALUATION

National Register Listings and Determinations of Eligibility

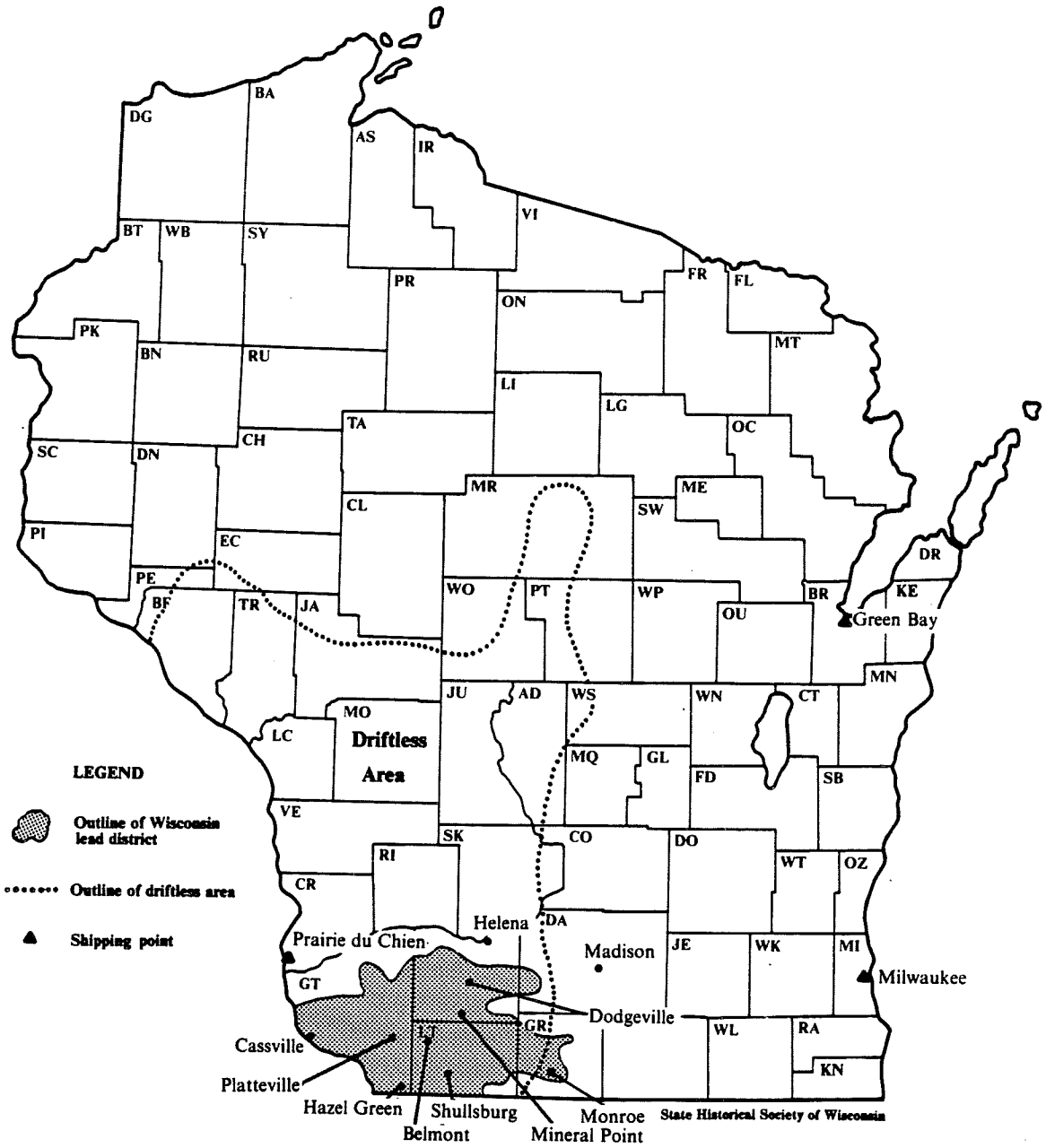
St. John Mine (1700), STH 133, Potosi, Grant County (NRHP 1979).
Mineral Point Hill (1830-55) & View, STH 23, Mineral Point, Iowa County (NRHP 1972).
Pendarvis (c.1835), 114 Shake Rage St., Mineral Point, Iowa County (NRHP 1971).
Mineral Point Historic District, Mineral Point, Iowa County (NRHP 1971).
Shot Tower, (1831-33), Town of Wyoming, Iowa County (NRHP 1973).

Context Considerations. Sites and properties associated with the lead and zinc mining industries will need to be evaluated at both the local level (in order to identify their role in each specific community's overall pattern of industrial development), and in context with the broader patterns of mining development in the region. Sites associated with the earliest periods of mining development will probably be of statewide significance as a result of the industry's enormous role in the early settlement and growth of the region. Historical research should be utilized to clearly document the specific mine's place in overall area settlement patterns.

For processing concerns, especially those associated with the later zinc industry, the integrity of the site is an important factor to take into consideration in the final evaluation process. Although individual components or machinery can be significant on their own, these properties are more accurately evaluated as indutrial complexes. Overall orientation and integrity of buildings should be a serious consideration. Residences associated with

significant individuals involved in the mining industry should be of secondary importance to the actual mining or processing sites if they are still extant and retain sufficient integrity.

Many early abandoned sites will retain few if any above ground resources. Thus historical archeology may provide a significant tool to further future resource identification in the region.



Lead Mining Centers, 1820-1860

Source: Joseph Schafer, *The Wisconsin Lead Region* (Madison, 1932), pp. 92, 94, 184-206.

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IRON AND COPPER MINING

Temporal Boundaries: 1850-1965 (peak iron production 1880-1929)

Spatial Boundaries: Exploitable iron ore deposits existed in five discrete regions in the state: the Gogebic Range centered in Iron County, the Menominee Range in Florence and Marinette Counties, the Baraboo Range in Sauk County, the Mayville District in Dodge County, and the Black River Falls area.

Related Study Units: Water Transportation study units, Railroad Development study units.

HISTORICAL BACKGROUND

The mining of iron ore deposits in Wisconsin was carried out in five distinct areas within the state. Each discrete region possessed its own particular ore characteristics and mining problems. The earliest exploitation efforts occurred in the south-central regions of the state around Sauk and Dodge counties. As limited-scale operations, these mines provided ore to local charcoal furnaces and the growing iron and steel plants of Milwaukee and Chicago. The northern part of the state, along the border with Michigan, provided the state with its most extensive and profitable iron ore reserves. The northern Wisconsin area lay at the heart of the rich Lake Superior iron ore region, which by the turn of the century was providing the bulk of the raw material for the nation's growing iron and steel industry. Unfortunately, Wisconsin did not enjoy the same vast iron fields as did its neighbors in Michigan and Minnesota. While the state did make the most of its limited reserves, its prominence grew in the shipping aspect of the trade as the area became a vital link in the massive Great Lakes iron ore trade. Communities like Ashland and Superior became important ports in the great transhipment process that brought raw ore from the isolated mine fields to the mills of Chicago, Milwuakee, Gary, and Cleveland.

MAYVILLE DISTRICT

The presence of iron ore had been known as early as the 1850s when the first geological surveys of the new state uncovered potential reserves in various parts of the state. Upon publication of the survey results local boosters began to intensively promote the state as a rich iron and copper-bearing region, hoping to draw new capital, investors, and settlers to the frontier region. Jonas (James) Tower of Crown Point, New York, who came to Wisconsin circa 1850, was one of the first to be enticed by the lure of profits from the exploitation of local iron. Tower settled briefly in the Mayville area of Dodge County and along with early residents Chester and E.P. May, and William and Alvin Foster, was among the earliest investors to exploit Wisconsin ore for smelting into iron (Dodge County Bicentennial Committee 1976:4). During the Civil War years, the local mining industry was still in its infancy, supplying ore to local charcoal furnaces and regional manufacturers on a limited basis. By the late 1860s, though, Milwaukee had begun to establish itself as a major iron producer and a cheap, readily available source of iron became extremely important. In 1868-69 the Wisconsin Iron Co. was formed by the investors of the Milwaukee Iron Co., the North Chicago Rolling Mill Co., and the Wyandotte Rolling Mill Co. The firm immediately began large-scale mining operations near the village of Iron Ridge in Dodge County. The first Iron Ridge mines, located about a mile northwest of the village in the Neda area, began producing large quantities of ore for shipment to Chicago and Milwaukee (Dodge County Bicentennial Committee 1976:43).

While annual production from the Dodge county mines prior to 1868 never exceeded more than 7,500 tons, between 1869 and 1872 with the introduction of the Wisconsin Iron

Company's operations, production reached 173,842 tons. In 1871 the Wisconsin Iron Co. alone produced 81,642 tons, only to be topped in the succeeding year by the production of 82,371 tons (Western Historical Co. 1880:566). Along with raw iron ore, pig iron, still manufactured in local charcoal furnaces, was also shipped to the rolling mills along Lake Michigan. Although relatively low in actual iron content, ore from the Mayville District (as the Dodge County area became known) continued to be exploited through the First World War. The prominent Iron Ridge Mine (1849-1892, 1896-1914) finally closed in 1914 after producing a total of 436,000 tons. The Mayville Mine, opened in 1892, was the last operation to close, ending production in 1928 after shipping 2,144,000 tons (Natural Resources Committee 1956:104-105). The mining operations of the Mayville District were casualties of their low-grade ore and the insurmountable competition coming from the rich Minnesota iron fields.

BARABOO RANGE

The first iron ore site to be developed in the Sauk County region was located eight miles west of the community of Reedsburg. The small mining village of Ironton developed around the exposed ore deposits in this western Baraboo Range area. Local efforts were slow in developing the resource until 1855 when Jonas Tower arrived from Mayville and began to mine the local ore and establish the region's first charcoal furnaces. Located in a region dominated by potsdam sandstone formations and scattered limestone outcroppings, the local ore did not contain high concentrations of iron, but much of it was found on or near the surface and early mining proved exceedingly economical. The arrival of the railroads to Ironton in 1877 naturally benefitted the local industry, allowing local products, pig iron, and raw ore to be easily and economically shipped throughout the state. After Jonas Tower's death in 1863, the local mines and furnaces were operated by John F. Smith. The region maintained its limited production from the 1850s until the mid-1880s. By the late 1880s most of the easily accessible ore was played out and growing competition from other areas effectively ended production in the Ironton area (Bohn 1944:311-320).

The mining of iron ore in the Baraboo Range did not end with the closing of the Ironton operations. Exploratory mines in the North Freedom area (southeast of Ironton) had been started as early as 1887 by the Douglas Iron Mining Co. The low-grade, surface ore was used mainly in the preparation of mineral paints (Usher 1914:143). More extensive mining activity did not occur in the area until April of 1900 when W.G. La Rue discovered rich deposits of ore deep below the surface. La Rue, along with local businessmen H. Grotophorst and Benjamin Dean, quickly formed the Sauk County Land and Mining Co. Spurred on by the growing demands of United States iron and steel manufacturers, the first deep-shaft mine for the extraction of local ore was in full operation by 1904. A second mine was begun in 1909 by the Oliver Iron Mining Co. (United States Steel Co.) just a short distance southwest of North Freedom (Cole 1918:33-35). Although ore was mined and shipped from the region over the lines of the Chicago and Northwestern Railroad to plants in Milwaukee and Lake Michigan, none of the area's mining operations proved exceedingly successful. Among the major difficulties that the concerns faced was an over-abundance of ground water which forced a continual pumping of the shafts.The enormous expense of operating deep-shaft mines to produce low-grade ore, and mounting competition from more established mines in Wisconsin, Minnesota and Michigan, forced the closure of most operations in the region by 1925. The region's two most productive sites were the Illinois mine (1904-1916), which produced a total of 315,350 tons of ore during its 12 year operation, and the Cahoon Mine, located about a mile south of the city of Baraboo. Opened in 1919, the 400-foot deep Cahoon Mine produced over 327,680 tons of ore before closing in 1925 and ending the exploitation of iron ore in the Baraboo Range (Natural Resources Committee 1956:104-105).

BLACK RIVER FALLS

Iron ore deposits in Jackson County centered around a butte known as Iron Mound east of the community of Black River Falls. Known to early travelers, the region was exploited by enterprising settlers as early as 1857. The small area's low-grade ore never proved of large importance, however, and never featured greatly in Wisconsin's mining industry (Natural Resources Committee 1956:105).

GOGEBIC AND MENOMINEE RANGES

The 1880s witnessed dramatic changes to the mining industry in Wisconsin. With the opening of the Gogebic and Menominee iron ranges in northern Wisconsin, the nature of iron mining in the state was to be altered forever. The small scale, low-grade concerns operating in the southern portion of the state were quickly overshadowed by expansive mining operations that called for deep-shaft mines reaching as far as 4000 feet below the surface to exploit rich deposits of high-grade ore. The annual production levels from some of the new mines often equaled in a single year the total production of the Baraboo and Mayville districts.

Problems encountered on the isolated northern ranges called for the development of dramatic new mining and transportation technologies. In fact, the development of the entire Lake Superior mining region was a typical saga of the direction of American business in the late nineteenth century.

> The investment of capital in that (Lake Superior region) remote, inaccessible region was evidence of the risks often taken by venturesome Americans. The technological methods devised for handling the freight over its long haul was a challenge to the railroad and shipping magnates. The organization required to control the several operations of mining, shipping, and loading was an example of the efficiency of American methods and of the large-scale operations that later characterized American industry (Oliver 1956:316).

The first boom in the exploitation of Michigan iron ore, from the Marquette Range along the south shore of Lake Superior, occurred in the mid-1850s. Continued exploration in the isolated regions of the Upper Pennisula and northern Wisconsin disclosed vast new deposits in the Menominee Range along the border of Michigan and Wisconsin in the 1870s. While centered around Iron Mountain on the Michigan side of the Menominee River, the natural deposits of the Menominee Range did extend into what is now northern Marinette and Florence counties in Wisconsin. Exploitable iron deposits were first discovered at Florence, Wisconsin in 1874 by H.D Fisher. Work was eventually begun at the site in 1879-80, and 30,000 tons of ore was produced in the first full year of operation (Anonymous, Wisconsin Magazine of History 3:466-467). The small frontier community of Florence quickly flourished. By 1881 railroad lines from the shipping ports of Menominee and Escanaba (C&NWRR) had reached the mines, providing a vital link between the mining areas and the market areas on the shores of the Great Lakes. Much of the ore taken from the deep-shaft mines around Florence was destined for mills in Chicago, Milwaukee, and other industrial centers. The Menominee Range produced a total of about 230,000,000 tons of ore for shipment during its lifetime. The Wisconsin mines, all centered near Florence, accounted for approximately 3 percent of that total production, or about 7,000,000 tons. Operations in the area generally ended around the early 1930s when the depressed economy could no longer sustain the local mining. Most of the mining equipment was removed during the mid-1930s. The Florence Mine reopened briefly in 1953, but closed again after only two years of limited success (Natural Resources Committee 1956:104-105).

The Gogebic Range, a narrow band of iron-bearing rock 80 miles long and one-half mile wide, provided Wisconsin with its most productive iron ore reserves. Extending southwesterly from Lake Gogebic in Michigan to Lake Namekagon, 20 miles south of Ashland, the Gogebic Range (also referred to as the Penokee Range) was noted in state

geological studies as early as the 1850s. Iron ore production on the range did not commence, however, until the 1880s. Increasing demands for iron ore from a rapidly industrializing nation brought about an amazing speculative boom in the area between 1884 and 1890. Scores of miners, syndicates, and investors flooded the region, seeking to exploit the rich ore reserves. Exploratory digs and claims dotted the range, as did temporary communities. By the 1890s, however, the chaotic speculative boom was over and mining on the range had developed into a well organized and business-like industry. The first ore to be shipped from the range had come from the Colby Mine near Bessemer, Michigan. The second ore shipment was to be from Wisconsin and the Germania Mine (1885) in Hurley. Unlike the Michigan ore, which was sent by way of Marquette, the Hurley shipments utilized a new transportation route by way of Ashland, Wisconsin, the most convenient and useful harbor (Natural Resources Committee 1956:104-105). (See "Transportation" below).

Although almost two-thirds of the Gogebic rock formation lay in Wisconsin (53 miles), two-thirds of the marketable ore in the range was located on the Michigan side of the border. The largest area of production in Wisconsin remained centered around the communiites of Hurley and Montreal, which quickly developed into thriving mining towns. The deep-shaft mines of the Gogebic range, largely owned by eastern steel corporations, operated at peak production through the 1920s until the Great Depression forced many sites to close or reduce operations. The mining of ore picked up once again with the wartime demands of the 1940s, and between 1946 and 1956 annual production from Wisconsin's mines averaged 1,450,000 tons per year, or one-fourth of the total production on the range. The post-war production in Wisconsin centered around two major mining operations, the Montreal Mine at Montreal and the Cary Mine at Hurley. The Montreal Mine, opened in 1886, was the second largest producing mine on the range and one of the deepest iron mines in the world at 4,335 feet. When closed in 1962, the underground mine had shipped 45,933,767 tons of iron ore. The 3,350 foot Cary Mine (1886-1965), last operated by Pickands, Mather and Co., was the last of the Gogebic producers to close, having produced over 18 million tons of ore in almost 80 years of use (Natural Resources Committee 1956:104-105).

DECLINE IN PRODUCTION

The general cause for the decline of production on the Gogebic Range was not the lack of ore but the increasing costs of mining the ore from tremendously deep shafts, especially when compared to the costs of production from Minnesota's open pit mines and imported ores from South America. As is true for sites across the state, much ore still remains below the surface, but economic factors prohibit its mining, although large areas are still under long-term lease to steel and mining companies. The only active metal mine now in operation in Wisconsin is the taconite facility of the Jackson County Iron Company outside of Black River Falls. A subsidiary of the Inland Steel Co., the mine began production of taconite pellets (65 percent iron) from the area's low-grade deposits in 1969 (Evans 1981:5).

While northern Wisconsin never produced iron ore on the scale of its Lake Superior neighbors Minnesota and Michigan, the area did provide sufficient production to help rank the state fifth behind Michigan, New York, Pennsylvania and Minnesota on the value of ore produced as early as the 1890 census (Eleventh Census of the United States, 1890: Mineral Industries, vol. 7:1-30). Seventeen individual mines in the state, employing 1,817 laborers, had produced over $1,840,000 of ore according to the census. From 1880 to 1890 alone, Wisconsin had seen a 2,163 percent increase in tonnage, mainly as a result of production in the state's northern regions. The numbers continued to grow even greater throughout the next several decades until the dramatic economic occurrences of the 1930s.

TRANSPORTATION

In addition to the mining operations, a second commercial enterprise developed in the Lake Superior region, centered around the transportation of ore from mine to market. Iron ore railroads, designed solely to serve the needs of newly emerging mining regions, quickly established and began immediate service to shipping ports like Escanaba, Ashland, and Menominee. Wisconsin with its central location emerged as a central figure in the iron ore transhipment network. In 1889 Ashland, Wisconsin was second only to Escanaba, Michigan in the shipping of iron ore on the Great Lakes. The Milwaukee, Lakeshore, and Western (later the Chicago and Northwestern) Railroad's two ore docks and the pioneer Wisconsin Central's 1884-85 dock handled over 2,174,550 tons in 1890, accounting for 21.8 percent of the ore shipped through the Great Lakes. Marquette, Michigan and Two Harbors, Minnesota were ranked third and fourth respectively (Eleventh Census of the United States, 1890: Mineral Industries, vol. 7:1-30). Within five years, the Superior-Duluth harbor began to play an even more significant role, propelled by shipments from the newly opened Mesabi and Cayuna iron ranges of Minnesota. The most visible features of the transhipment network were the massive wood, steel, and concrete ore docks that commanded the harbors at Superior and Ashland. Up to a half-mile in length, the engineering marvels allowed ore-laden trains to run out over the lake on trestles, unloading the raw iron cargoes into hundreds of hopper shaped bins underneath. From the storage bins, long wood and steel-lined chutes delivered the ore to waiting ships that carried the iron to Great Lake port cities on the lower lakes. Superior, in particular, featured a series of four interconnected docks built between 1902 and 1928 that were acknowledged as the largest single iron ore transhipment facility in the world when completed.

TECHNOLOGY IMPROVEMENTS

The technology associated with the iron ore industry changed dramatically from its early days. With the development of the Lake Superior mining region at the end of the nineteenth century, the miners, who had been mostly Englishmen and Scandanavians, no longer climbed up and down slippery ladders, but instead, were lowered in steel cages powered by steam and electricity. Steam and electicity also propelled the tram cars that supplanted the wheelbarrow in taking the ore to the shafts. Steam shovels took the ore from stockpiles and loaded it onto waiting cars. Rock drills replaced the picks and shovels of the earlier days, and hoisting machinery carried the heavy loads. Lake transportation was expedited by the development of bulk freighters, and wooden ships were quickly replaced by iron and steel vessels. Among the most extraordinary of the new designs was that of the "whaleback" created by Captain Alexander McDougal of Superior. Some of the characteristics of the mining landscapes were: engine houses to power the hoists and lifts; offices; vast tailings (waste) piles; ore storage yards; rail loading areas; machine, electrical and blacksmith shops; locker and shower facilities; worker housing; characteristics of ownership/management, including factors that stimulated development of planned communities; and the typical headframe that marked the entrance to the mine with its imposing height.

COPPER MINING

Deposits of copper were exploited by early Wisconsin inhabitants long before European travelers ever appeared in the region. The primitive hunters and gatherers of the Old Copper Complex mined extensive areas along the Lake Superior and Lake Michigan shores. However, modern mining techniques used by early European settlers to Wisconsin did not prove as fruitful. Geologial reports and surveys beginning in 1841 outlined rich deposits of copper in the Ontonagon region of Michigan's Upper Penninsula. The news brought hosts of hopeful prospectors to the region, and by the mid-1840s the areas around present day Ontonagon, Houghton and Keweenaw counties were in the midst of a speculative boom. Many of the miners who ventured into the isolated region were Cornish and Welsh settlers from southwestern Wisconsin who had tired of the laborious work in the Wisconsin lead mines. Despite continual searches for Wisconsin deposits, the most

lucrative mining areas remained in Michigan. The early lead mining region around Mineral Point also saw a brief flurry of excitement in the 1840s, as copper fever gripped the upper Midwest. That area, however, produced only 1.5 million pounds of hard fought ore and the local industry soon faded.

The search for copper was revived in the 1860s with the publication of new reports that outlined favorable areas of copper-bearing rock in the lower Fox River Valley and in Douglas County. Brief speculative booms soon brought prospectors and mining syndicates to both areas, and renewed interest in the lead mining regions of the state. Exploratory pits, trenches, and shafts in Douglas County were started by various concerns at locations like Copper Creek, 13 miles south of Superior, Amnicon, and Brule, as well as along various creeks and rivers in the area. All of the deposits eventually proved meager in relation to the rich and easily exploitable ores of northern Michigan. Copper was present in Wisconsin, but not in grades or quantities sufficient enough to sustain operations or return a fair profit on investments. By the end of the Civil War, copper exploration and exploitation in Wisconsin had faded from view except for isolated activity.

IDENTIFICATION

Resource Types. Abandoned mining sites, including open pits, trenches, caves, outcrops, deep-shafts, and smelting furnaces. Abandoned mining locations and equipment, including engine houses, headframes, electrical, machine and blacksmith shops, crew facilities, rail lines and loading areas, iron ore storage areas, pumphouses, tailing piles, machinery storage sheds, animal stables. Associated resources including worker housing communites, bunkhouses, "mining towns", mining equipment manufacturers and retailers, mine owner residences, mining superintendents' residences, rail lines, ore docks, ore storage areas.

Locational Patterns of Resource Types. Resources associated with the iron and copper mining industries are located in only limited areas of the state, in or around the site of exploitable ore deposits. Superior and Ashland contain significant sites related to the transshipment phase of the industry.

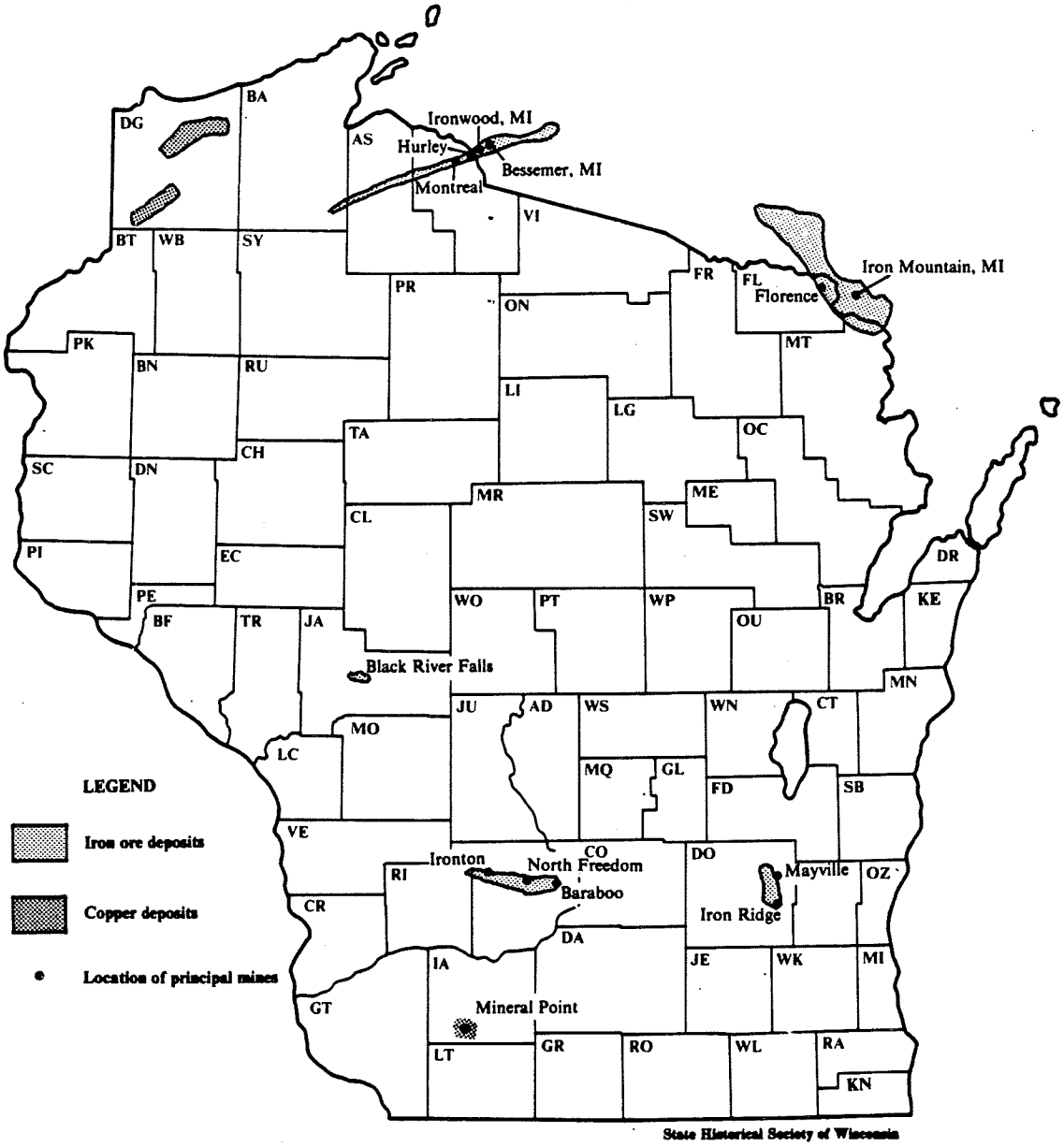
Previous Surveys. No extensive surveys of extant mining sites exist as of May 1, 1984. The Ashland and Superior Intensive Surveys do provide data on the local transhipment facilities for iron ore, however.

EVALUATION

National Register Listings and Determinations of Eligibility

Whaleback Carrier Meteor (1896), NW tip of Barker's Island, Superior, Douglas County (NRHP 1974)
Montreal Company Location Historic District, Montreal, Iron County (NRHP 1980)

Context Considerations. Individual structures and mining sites must be evaluated in relation to both the local importance of the operation and its broader statewide position within the industry. The particular features of a site should relate to the general understanding of the operations of the mine and/or the community around it when it was in production. Most abandoned sites have been cleared of all machinery, however, and may exist only as barely visible scars on the landscape.



Areas of Iron and Copper Mining, 1845-1945

Complied by Paul R. Lusigman

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LOGGING AND LUMBER MILLING

Temporal Boundaries: 1830-present (chief exploitation and production years: 1870-1910).

Spatial Boundaries: The major concentration of logging and lumber milling was in the northern half of the state, in an area generally bounded by a line running from Green Bay to Portage (Columbia County) and northwest in a sweeping arch to the St. Croix River. Included are the major valleys of the Menominee, Wolf, Wisconsin, Black, Chippewa, and St. Croix Rivers.

Related Study Units: Tanning and Leather Processing, Farming the Cutover, Water Transportation, Railroad Development, Milling, Pulp and Paper.

HISTORICAL BACKGROUND

The logging and lumber industry in Wisconsin reshaped the environment and landscape of the state and provided a livelihood for a significant portion of the region's population during the nineteenth and early twentieth centuries. Even today the industry remains important, particularly in the northern half of the state. By the late 1800s, Wisconsin was one of the premiere lumber producing states in the nation, and for a period of over 30 years (c.1890-1910), lumber and timber products led the state's developing industrial economy by a large margin. Yet the rise of Wisconin's lumber industry was not an overnight development.

As long as the path of settlement on the frontier hugged the forest areas, no extensive trade in lumber developed. Rural settlers erected their homes of roughly hewn timbers and logs and their fences of simple rail; the village dweller received all the lumber he required from the primitive sawmills that sprang up in every partially urbanized community. As villages grew into towns and then into cities, local supplies of wood began to vanish, and settlers found it increasingly necessary to secure lumber from more remote areas.

The American frontier was sweeping across the country and beyond the Mississippi River by the early 1800s, opening up the great treeless prairies of the west to settlement and creating a demand for lumber greater than ever before. The fertile plains were well suited for agricultural development, but furnished little wood to settlers for building farms and communities. Fortunately, stretching across the northern reaches of Michigan, Wisconsin, and Minnesota was one of the most abundant forest areas in America, providing a situation "truly made for men of vision and enterprise". On the one hand was a seemingly inexhaustible supply of building timber, and on the other a seemingly endless expanse of treeless plains destined for settlement (Fries 1951:4-5).

Consumed by the voracious needs of the growing frontier population, the limited stands of timber in the middle Mississippi Valley had virtually disappeared by 1840. The great northern forest of the upper Midwest was estimated to contain approximately 100,000,000,000 board feet of commercial lumber. In Wisconsin, the true forest region lay almost entirely north of a line stretching from Manitowoc to Portage, then northwest to the falls of the St.Croix River. The southern edge of the region was predominantly a hardwood forest, from 35 to 50 miles wide, only five percent of which was pine. North of that was a mixed belt of various hardwoods and conifers. Finally, along the headwaters of the Wolf, Menominee, Wisconsin, Chippewa, Black, and St. Croix Rivers stood a

growth of dense, well-scaled conifers, the choice resource of the forest.

The number of adventurous lumbermen operating in the Great Lakes forest region increased steadily, especially after news of the area's potential reached the established logging areas of the East. As in the eastern regions, the first sawmills were small affairs, usually capable of meeting only limited regional demands, but they were the nuclei from which an immense industry developed (Fries 1951:5).

It was almost exclusively the extensive stands of white pine that interested the lumbermen of Wisconsin in the early years of the industry. Light and easily workable, the wood was ideal for building purposes and was easily transportable by water, an abundant resource in Wisconsin. Because of the early preoccupation with pine logging, Wisconsin's northern woodlands became known as "the pinery".

Due to the advance of ancient glaciers, the region was served by an almost ideal transportation system of lakes, streams, and rivers. Aside from the pine timber itself, the waterways of Wisconsin were perhaps the most important factor in the early and sustained growth of the industry in the state. Reinforced by heavy snow melts in the spring, the water provided the essential transportation networks. At various intervals they also supplied ideal water-power sites for mills and factories and log storage opportunities. Finally, because they tended to flow out radially, linking up with either the Great Lakes of Superior and Michigan or the Mississippi River, the deep inland recesses of the state were connected directly to the great lumber markets of the East and the West. The natural waterway systems and the extensive watershed areas of the state served to divide Wisconsin's timberland into six significant and individual districts: the Green Bay and Wolf River districts in the northeastern part of the state (including the Menominee, Pestigo, Oconto, Wolf, and Fox Rivers), and the Wisconsin, Black, Chippewa, and St.Croix districts in the northwest (see map) (Fries 1951:7).

EARLY YEARS: 1830-1870

Despite its obvious potential, lumbering was only a minor activity of Wisconsin's first settlers. Throughout most of the 1830s, logging was carried out on a small scale, despite the growing demands of the nearby prairie regions of Iowa, Illinois, and southern Wisconsin. It was not until the 1840s that lumber production began to exceed fur trading and lead mining as the leading commercial enterprise in the territory. The early dearth of lumbering activity was due in part to the lack of working capital and skilled labor, both of which were essential to the growth of trade in the north woods.

Among the pioneers of the lumbering industry in the state between 1810 and 1840 were men like Jacob Franks in the Green Bay area, Colonel John Shaw on the Black River, James Lockwood on the Chippewa, Daniel Whitney on the Wisconsin River, and numerous others. While none of these men could be termed industrial giants, they did serve the vital role of demonstrating the exploitive potential of Wisconsin's woodlands. A large impetus to the continued growth of the industry was the acquisition of the northern timberlands from the Indians through a series of treaties in the late 1830s that fully opened the northern regions to development. In addition, business depressions in the eastern pineries and the gradual exhaustion of other lumbering areas by mid-century had caused many skilled and knowledgeable eastern lumbermen to seek new areas of exploitation in the West. They brought two important factors with them: working capital and skilled laborers. Virtually all of the early lumber barons to make their fortunes in Wisconsin, including P. Sawyer of Vermont, Isaac Stephenson of Maine, and Orrin Ingram of Massachusetts, had learned their trade in the eastern pine regions of the United States (New England, New York, Pennsylvania) and Canada. Much of the early labor force working the timberlands had also learned their skills in the eastern pineries. This group included many French-Canadian woodsmen, eventually joined by waves of Scandinavian, German, and Irish immigrants who all found their way westward (Fries 1951:11-13).

Although still besieged with obstacles, such as distance from supplies and markets, limited transportation, and unimproved waterways and road systems, the lumber industry began its first period of truly steady growth and development in the middle decades of the 1800s. Together with agriculture, the lumber industry had become the new backbone of the regional economy by 1850; it had surpassed both the fur trade and lead mining. Because of its greater accessibility to the early settlement areas of the region and its wealth of resources, the Wisconsin River forest district was the first to be exploited on a large scale. Despite the economic panic of 1837 that depressed business for a number of years, the late 1830s proved a boom period for the upper Wisconsin region. By 1839, mills occupied almost every available waterpower location as far north as Big Bull Falls (Wausau), and development was swiftly moving northward. In 1840, settlers in market centers along the lower river area utilized approximately 6,250,000 board feet of Wisconsin River district lumber. The next season they used over 7.75 million board feet, and by 1842, 8.5 million board feet. By 1847, 24 mills were annually producing 19.5 million board feet, which was worth about six dollars per 1,000 board feet. Less than three years later, a total of 47 mills were in full operation, and over 2,000 men were employed in rafting logs and lumber on the river. By the mid-1850s, production ranged between 95 and 125 million board feet per year. By 1857, the capital invested in the Wisconsin River district amounted to six million dollars, and the value of the region's product was nearing four million dollars annually. The almost phenomenal growth continued through the Civil War, and by 1872 the annual output of Wisconsin River district companies totaled over two million board feet (Fries 1951:17).

By the Civil War period, other lumbering districts were being utilized as well, outstripping the Wisconsin River region in production. The length of the Wisconsin River and its numerous rapids made rafting and supply transportation an expensive undertaking. New lumber capital was invested in more profitable forests among the Green Bay and lake-shore districts of northeastern Wisconsin. In 1846, Green Bay had only two mills of any size. Another was located at the mouth of the Menominee River, and several others were scattered in isolated locations throughout the area. The total investment amounted to only a little more than $50,000. By 1854, however, the estimated output of the Green Bay district ranged between 57 and 135 million board feet. By 1865, shipments from the region totalled 200 million board feet of lumber, in addition to substantial amounts of shingles, lath, and other products. On the Wisconsin side of the Menominee River 300 million board feet of lumber per year was produced by the beginning of the 1870s. Among the leaders of the district's lumber trade were Isaac Stephenson, who arrived in Wisconsin in 1846, Daniel Wells, and N. Ludington (Fries 1951:17-18).

The region around the Wolf River was also becoming established as a major lumbering district by the late 1840s. As early as 1836, Oshkosh was receiving lumber supplies from two small government mills built for the use of the Brotherton and Stockbridge Indians. By the mid-forties, several other small mills were established and quickly proved the potential of the Wolf River district. There were two fairly substantial sites at Fond du Lac (1844); another was located at Oshkosh (1847). The intense rivalry which almost immediately sprang up between the two areas continued for a number of years. By the 1850s Fond du Lac, which reportedly built one of the first steam-powered mills in northern Wisconsin (1846), was marketing about seven million board feet of lumber annually, mostly to neighboring farmers in the rapidly growing region. Moreover, the city's proximity to Sheboygan made accessible the massive markets of Chicago, Milwaukee, and Racine, and its superior rail connections to southern Wisconsin and northern Illinois far surpassed those of early Oshkosh.

The City of Oshkosh, however, quickly took advantage of its superior location near the source of supply and adjacent to bountiful storage, rafting, and waterpower sites. In addition, the community was in a strategic position from which it could ship its product by way of the projected Fox-Wisconsin canal to Mississippi markets, by way of Green Bay to

Lake Michigan markets, or along the Rock River to southern Wisconsin. By 1860, Oshkosh supported 25 lumber dealers and manufacturers from four mills had been constructed in 1852. It also supported several sash, door, and blind factories. By 1866, about 50 mills were in full operation in the city, and production had risen to 85 million board feet of lumber, including eight million shingles and approximately 14 million lath. The entire Wolf River district was producing some 180 million board feet of lumber annually by the 1870s, a rise from approximately 30 to 40 million board feet in 1854 (Fries 1951:18-19).

The Black River area began its development as a lumbering region in 1839, shortly after the final Indian claims to the region were settled. In that year, Jacob Spaulding and Robert and Andrew Wood left Prairie du Chien to establish a mill at Black River Falls. Four years later, three million feet of lumber was being sent down the river to market. By 1847, 13 mills were in operation along the river and its tributaries, and over six and one-fourth million board feet were being processed. La Crosse, strategically sited at the confluence of the Black and La Crosse Rivers and the mighty Mississippi, became the natural focal point for the regional lumber trade. The city's first mill was erected in 1852, and within the year 10 sawmills, three shingle mills, and a sash factory had been built, allowing area promoters to declare that La Crosse was one of the largest lumber marts on the upper Mississippi. By 1855, 14 steam-powered mills within a four mile area of the city's boat landing were producing 50 million board feet of lumber. Stimulated by the continual growth of the Mississippi lumber trade, the Black River district continued to prosper, and by 1872, it was manufacturing over 300 million board feet annually (Fries 1951:20).

The St.Croix district, which was a combination of Wisconsin and Minnesota operations, was producing 8 million board feet of lumber by the early 1840s. Growing rapidly, production reached 160 million board feet in 1855, and by 1864, a total of 600,000 dollars had been invested in logging in the far northwestern region of the state. Almost 1,400 men were employed in the woods cutting timber and moving it to mills on the Mississippi. The Wisconsin side of the river produced more than 100 million board feet in 1872, and communities like St.Croix Falls and Hudson developed sizable milling operations (Fries 1951:21).

But it was the Chippewa River Valley, containing one-sixth of the pine timber west of the Appalachians, that quickly became Wisconsin's most important and productive logging region. Milling and logging began in the region with the construction in 1828 of James Lockwood's on the Red Cedar River. Acquired in 1846 by John H. Knapp, this mill and others that were rapidly established in the region increased local production from five and a half million board feet in 1843 to 75 million board feet by 1855. Despite an economic crash in 1857 that stalled expansion for a short while, the region continued to develop its resources into an extraordinary industrial base. In the decade between 1860 and 1870, the annual timber cut from the Chippewa district increased from 60 million to 436 million board feet. In 1853, Knapp formed a partnership with Dubuque lumberyard owner Henry Stout. The resulting firm of Knapp, Stout and Co., based in Menomonie, approached its work aggressively. The company invested and reinvested enourmous amounts of capital into new timber lands, new mills, and new machinery throughout the region. As a result, the operation was purported to be the largest of its kind in the country by the second half of the nineteenth century (Fries 1951:21).

The preceding sections have dealt primarily with the growth of the lumbering industry prior to 1870. For the most part, this period reflects the early or first growth of the industry. The post-war years, with a rapid shift of immigration to the west, the extraordinary growth of the midwestern railroads, and increasing industrialization of the nation, marked a new stage of development of the industry. This stage eventually elevated lumbering to the large-scale industry that lasted as long as the timber lasted.

LOGGING AND LUMBER OPERATIONS

The logging and lumber milling industry involved a whole series of widely diverse but interconnected operation and operators. In the early years, many of the procedures were handled by independent concerns. But as the scale of the industry grew, lumbering operations became increasingly integrated. Among the various parties involved in the industry were: the original land speculators who purchased vast areas of largely unexplored timber land for use or resale to other milling or logging concerns; the logging contractors who purchased stumpage rights and cleared the timber to ready it for shipment downstream to the mills; the driving company owners who set up systems of dams and booms for driving the logs down river to the production mills; the sawmills owners who purchased the raw timber and processed it into various products, including rough lumber, shingles, and lath; the owners of large rafting operations that transported the rough lumber from mills to finishing yards and distant markets; and the wholesalers and retailers who distributed the final products to their vast consumer markets.

LOGGING CAMPS

An important factor contributing to the success of a lumber company was its starting point, the logging camp. The efficient organization and operation of a camp, frequently under arduous circumstances, could determine the success or failure of an entire lumbering operation. Before railroads were available, all logging operations were done in winter when ice and snow facilitated the transportation of logs from the stump to the riverbank. In the spring, the logs were floated from the riverbank to downstream mills. The first efforts at a new campsite, however, were carried out in the fall when the necessary logging roads, branch trails, and camp buildings were constructed.

Before 1860, logging camps were small and primitive affairs. A single building often provided sleeping, eating, and cooking quarters for the entire crew. Expediency and economy dictated the construction forms which almost uniformly consisted of low, log structures with shake roofs. Inside, open fires in a sand enclosure provided heat and a small cooking area. The men slept either on the floor or in rough wooden bunks. The only other structures located at a camp site might be a stable and an equipment shed. As logging operations expanded, particularly with the advent of logging railroads, the camps became more extensive and permanent. In general, the plan of the sleeping quarters remained the same. The building itself, however, was enlarged, and more efficient stoves replaced the open fire. One of the most common building forms used well into the twentieth century was a long, low log structure with beamed exterior walls. The living quarters were located in one end and the cooking/dining areas in the opposite end, seperated by an open, roofed passageway called a dingle. More than one cabin was necessary to house all of the men. The stables were expanded to include areas for oxen, horses, and various sleds, wagons, and other road equipment. Small company stores, or wanigans, where crew members could obtain clothing, tobacco, or other personal items also appeared in many camps. By the late nineteenth century, the average camp included a blacksmith shop, carpentry and sharpening shops, a granary, haysheds, an office/foreman's quarters, separate mess halls, and various subsidiary storage and equipment sheds (Fries 1951:24-25, G.L.A.R.C. 1982:45).

Logging roads were equally important to the efficient operation of a lumber camp. The supply road, or "tote road," was the only connection between the camp and the outer world; complex networks of local roadways ensured quick and smooth movement from the cutting sites to riverways. Carefully planned and graded roadways were marked by skidways at various intervals. These skidways facilitated the loading of logs dragged from the cutting sites onto heavy sleds for carrying to the streambed. The skidways were simply long timbers set into the ground at an angle and braced to allow the rolling of logs up onto the sled or rail cars with greater ease. During the 1870s, the process of "icing" the roads became quite popular and added immensely to the efficiency of operations. In

the fall, before the ground froze, two ruts were carefully gouged into the roadway. When freezing weather arrived, water was poured into the grooves from a tank carried over the road on a sleigh or wagon. After the water froze, a single team of oxen or horses could haul incredible loads with ease - some loads were 20,000 to 25,000 board feet (Fries 1951:26-27).

Another structure apparent at the logging camps was the holding dam, built to ensure that there would be sufficient water in the spring to effectively float the logged timbers to the lower mills. In later years, much of the dam work was done as a cooperative effort among the various camps or logging companies that operated upon a particular stream or in a specific area.

By the time winter snows arrived, the camp foreman had secured his full logging crew and was ready to effectively tackle the forest timber. Before the 1860s, the ordinary logging crew seldom consisted of more than 12 to 15 men. By the 1880s, however, it was common to observe camps of at least 60 men, and in some areas, as many as 100. Each man, from the foreman and camp cook to the chore-boys and road-tenders, had his own well-defined duty. In addition to those men who worked strictly in the woods--the so-called "lumberjacks"--most camps also employed skilled blacksmiths, carpenters, clerks, and supply men (Fries 1951:27).

THE LUMBERING PROCESS

Over the years, numerous changes in the tools and techniques utilized in the lumber industry were implemented. In the half century between 1850 and 1900, almost everything connected with the trade increased in size and efficiency, but the introduction of the logging railroads was among the most important developments. In a short time, the railroads revolutionized logging practices across the state. They allowed for year-round operations and ended the dependence on waterway access; they also promoted the logging of previously ignored hardwoods. Both the temporary, narrow-gauge roads and the larger, standard-gauge lines affected the industry. Besides a few main trunk lines and some abandoned roadbeds, however, few features of the logging railroads remain in the northwoods. As soon as one timber area was exhausted, the trackage and equipment was pulled up and laid down in another timber region.

After the timber was cleared from a logging site in the winter, the logs were moved to a central milling site in the early spring. As soon as the spring sun began melting the river ice, the logs which had been carefully banked and marked along the shoreline were readied for driving downstream. Driving conditions, which varied from one stream and river system to another, greatly influenced the location of lumber mills and, subsequently, the pattern of urban development in the various lumbering districts. Along the Wisconsin River, where driving was often made difficult by shallow stream beds, sand bars, and other obstructions, the mills were built as closely as possible to the areas of logging. Where driving was easier, as on the Wolf, Black, Chippewa, and St.Croix Rivers, the manufacture of lumber became much more centralized. Thus, Oshkosh, LaCrosse, Eau Claire, Chippewa Falls, and the Stillwater/Hudson region developed into important milling centers in their respective districts (Fries 1951:41).

There was a certain disorderly order to the spring drive. For the most part, the logs were left to float downstream, carried by the swell of the spring snow melt and with little interference until they reached the milling sites. Skilled rivermen traveled with the logs to both ensure smooth and continual movement and to gather up stranded or jammed logs. In some areas, man-made features were erected to aid the transportation of timbers downstream. Constructed of heavy timbers, gravel, and earth, the flooding dams, holding ponds, and flowages could create an artificial rise in the water level to compensated for low rainfalls, mild winters, or particular waterway characteristics. (The dams were constructed in many forms, too numerous to discuss in this study unit. They varied from

crude, temporary installation to sophisticated, permanent riverway improvements).

Each mill was also required to construct sorting works adjacent to its facility where logs could be separated from those of other mills. These private sorting works, however, often proved inadequate to handle the peak seasonal drives, and confusion and conflict at the downstream milling sites was common. Due to their temporary nature, sorting works and many smaller dams and waterway improvements are not likely to be extant (Fries 1951:41-43).

BOOMING AND IMPROVEMENT COMPANIES

In the early years of the industry, each owner erected flooding dams and put his logs into the stream at his own discretion. This practice often led to dramatic complications for other concerns operating in the same area. The same was true for operations at the sorting works at the downstream end of the drive. With the tremendous growth of the industry during and after the Civil War, many companies quickly realized the value and economic potential of establishing some form of central organization of the lumbermen on a given river. "Booming and Improvement" companies could facilitate the handling of logs on the drive, and aid in the building of booms, or obstructions where the logs could be held and distributed among their rightful owners. The companies could provide for the construction and maintenance of flooding dams, the removal of dangerous obstructions to safe driving, and the gathering of stray and stranded timber. As early as the 1850s, lumbermen on a few logging streams had organized booming and improvement companies on a small scale similar some in New England. By 1870, virtually every logging district in the state had its own booming and improvement company (Fries 1951:48-49).

The Wolf River Boom Company was officially organized in 1857, and by 1880 the company was maintaining over eight miles of receiving booms near Oshkosh. It also had extensive sorting works in Lake Poygan, and a total of over 40 dams on the upper river area. On the Wisconsin River, the Little Bull Falls Boom Company emerged in 1852; by the end of the decade the Wisconsin River Boom Company had been formed. By 1879, the two companies were in charge of booms near Wausau that could handle 30 million board feet of timber. The Black River Improvement Company, established in 1864, and the Menominee River Boom Company, which operated on the Wisconsin-Michigan border, handled over eight billion board feet of logs between 1868 and 1894. The Chippewa River district, although plagued by quarrels and disagreements, eventually played host to two of the largest concerns in the region: the Chippewa River Improvement and Log Driving Company and the Mississippi River Logging Company (Fries 1951:49-51).

In later years, with the growth of milling sites on the Mississippi, many booming and improvement companies assumed the additional function of preparing large log rafts for mills downriver in southern Wisconsin and Minnesota, Iowa, Illinois, and Missouri. It was a policy that provoked much dissention from Wisconsin milling concerns and, ultimately, precipitated the industry's most serious internal conflict--the Beef Slough War. The pitched legal and physical "war" pitted Chippewa Valley milling concerns against those operating on the Mississippi River that wanted to gain control of logging production from the rich Chippewa Valley watershed. The Mississippi River concerns involved in the conflict were the Beef Slough Manufacturing, Booming, Log Driving, and Transportation Company and the Mississippi Logging Company. They tried to control all logging operations on the upper Chippewa by purchasing large tracts of northern timber, and bypassing the booms and mills at Chippewa Falls and Eau Claire in favor of a massive sorting and rafting works at the slackwater Beef Slough at the mouth of the Chippewa River, one of the largest such booming works in the world at the time. The heated confrontations between the two groups, which ranged from armed confrontationsat Eau Claire and the Beef Slough to armchair battles in the legislature and the courts, lasted from 1868 to 1870 before finally being resolved. The most important result of the "war," however, was Frederick Weyerhaeuser's arrival to Wisconsin. His Mississippi Logging

Company brought skilled management and seemingly unlimited capital to the state and changed the local logging operations in the region to a major interstate industry (Rosholt 1980:168-179).

The type of boom utilized by the industry was either a jam boom, designed to stop the logs in their passage and to retain them until they could be handled by the mill, or a sheer boom, which was used to divert moving logs from main channels into jam booms or other sorting works. The jam boom was made of strong timbers stretched rigidly across a channel and buttressed with piles or stone filled cribs. This form of retaining boom was often erected at the foot of an island, making one side into a storage pocket. From the pocket, logs could be easily diverted to appropriate sorting and holding areas according to ownership. In its most common form, the sheer boom contained a series of movable rudders or fins that allowed the movement of the boom in and out of the streambed in order to allow for passing traffic. Two Eau Claire lumbermen, James Allan and Levi Pond, first developed the prototypical fin boom in about 1861. At some of the larger concerns, the entire boom works often stretched for miles along portions of the river shoreline (Fries 1951:52-53).

LUMBER MILLS

Once the logs made were safely downriver, it was the saw miller's turn to take control of the lumber production process. While most of the efforts detailed so far required the exhaustive efforts of skilled hand laborers working at isolated sites, the saw mill was a fully mechanized process. The continual development and improvement of milling, cleaning, and transport technology did much to improve the production levels of Wisconsin's logging and lumber industry.

Chicago on Lake Michigan and St. Louis on the Mississippi were the largest and earliest centers of finished lumber milling and distribution for Wisconsin goods. As settlement increased in the vast treeless prairies of the trans-Mississippi region and as railroads continued to open up new markets, burgeoning new river towns up and down the Mississippi became receiving and distribution points for Wisconsin lumber. Among them, La Crosse was one of the most dynamic communities located on the Wisconsin shoreline. Traffic from the Black, Trempealeau, Chippewa, and upper Mississippi Rivers arrived at La Crosse, as did several rail lines. Combined with the city's aggressive business atmosphere, La Crosse became a major focus of lumber distribution.

In many of the Mississippi River towns independent lumber wholesalers assumed full responsibility for the final milling, sale, and distribution of the sawed lumber rafted to their area. For most Wisconsin mills and logging companies, their interest ended when the lumber wholesales took over. Many expanding companies, however, soon realized the value of owning and operating their own finishing mills and wholesale/retail distribution yards outside of the logging regions. By the mid-1870s, most large mills that shipped lumber down the Mississippi also operated yards at points on the lower river for marketing their goods. This was another step in the increasingly monopolistic attitude of the lumbering industry in the late nineteenth century.

TYPES OF SAWS

The earliest sawing of lumber in Wisconsin was probably done by the slow and tedious handhewing and whipsawing processes. Whipsawing (or pitsawing) involved two men, one positioned above the log and the other below it, in a pit or depression over which the log was laid. Using a six to eight foot saw, the men laboriously worked their way through the stationary timber, producing at best only 100 to 200 feet of lumber a day. While this process might have proved adequate for the earliest settlers of the region, it became obvious that if the exploitation of the state's forest was to become a major economic enterprise, faster, more efficient, mechanized processes were necessary.

Due to the region's abundant water supply, a power source was readily available for use by the expanding industry. The first mechanically operated saw used in a Wisconsin mill was the frame or sash saw. Powered by a waterwheel, the blade of the sash saw was housed in a stationary wooden framework and was connected by a system of rods and shafts to the power source. Traveling in an up and down motion within the frame, the blade cut into the logs as they were moved along a log carriage. Other names for the frame saw included: gate saw, up-and-down saw, and muley saw. One version of the frame saw, the gangsaw, involved the mounting of several saw blades on a single wood or metal sash or framework so that several boards could be cut from a single log at once. Because of its weight and sawing friction, the gangsaw, which was developed much later than the simple sash saw, required a tremendous amount of power, making it impractical in some instances. Thus, a gangsaw was likely to be found only in the more sizable milling concerns. The frame or sash saw was the most common saw utilized in Wisconsin's early commercial mills, both in the southern portions of the state and in the northern pineries between about 1830 and 1860 (Fries 1951:60-64, Apps 1980:89-92, Rosholt 1980:213223).

The next major step in the development of milling machinery was the circular rotary saw, which was patented in England in 1777 but not brought to the United States until after the War of 1812 when it was introduced to eastern mills. Spinning like a huge wheel, the rotary saw sliced into the logs that were forced edgewise against the teeth located in its rim. Few early Midwestern lumbermen knew how to operate the saw efficiently and effectively, and its adoption progressed slowly. Not until the late 1850s and 1860s would it come into general use in the Wisconsin pineries. Once introduced, however, the circular saw quickly proved its value, as mills immediately exhibited greatly increased production levels. In addition, at most sites no increase in power production was necessary. Circular saw technology continued to improve in the next several decades, but the process still retained one major drawback. The thick iron and steel saw blades of the circular saw cut one-fourth to one-half inch kerfs (slits) when sawing, transforming a considerable portion of the raw timber into useless sawdust. The problem was not a major concern during the 1860s and 70s when timberland still appeared inexhaustible, but it attracted much more attention by the 1880s as the woodlands began to disappear, causing the value of standing timber to continually rise. Even though improved circular saws and gang saws were introduced and used by a number of firms, the real solution came with the introduction of the band saw (Apps 1980:89-92).

Invented in England in 1808, the band saw was not utilized commercially in this country until 1872, primarily due to the difficulty of manufacturing a suitably strong, yet thin blade that could withstand the strains of constant use. The band saw consisted of an endless strip of steel about fifteen inches wide and fifty feet long with teeth in one edge. Passing over two wheels like a pulley belt, the saw provided a continuous cutting action and produced very little waste. By the 1890s, all of the major commercial sawmills in the state were employing band saws. In many cases, the older circular saws were relegated to the sawing of course logs. In smaller mills scattered across the state, the long lasting and dependable circular saws remained a more permanent feature (Apps 1980:89-92). Besides sawing machinery, additional milling improvements that emerged during the nineteenth century included: more efficient carriages and conveyors to transport the logs to the saws, log washing machinery, debarking machines, cylinder planes, and a host of devices designed to manufacture shingles, lath, and shakes. A number of the machinery designs were invented by Wisconsin lumbermen.

POWER SOURCES

The power sources employed by Wisconsin sawmilling operations were improved during the nineteenth and early twentieth centuries. The majority of the early, mechanized mills in the state used simple verticle waterwheels of the overshot, breastshot, or undershot

type, depending on local water conditions. The most efficient and popular form was the wooden overshot wheel, which was mechanically feasible in areas with a comparatively high "head" of water. All of the water wheels transferred the power from the wheel to the saw and carriage assemblies by way of a heavy metal crank. Powerful enough to provide the necessary energy to run the mill machinery of early sawmills, the water wheels required extensive maintenance and were useless in the winter or at times of high backwater. After about 1850 when the turbine was introduced, most of the mills operating on water power quickly adapted to this new form of water power. Powerful, reliable, easily maintained, and efficient, the metal turbine wheel remained a visible feature in Wisconsin saw mills through the turn of the century. Even with the introduction of steam power in the 1860s, the economical, water powered turbine remained a popular power source in many areas of water rich Wisonsin (Fries 1951:62-64).

The steam engine of the 1860s had a tremendous impact on the industry, notably because it meant that sawmills no longer had to locate on waterfronts. Freed from a dependence on water, year-round production was possible. In addition, much more powerful machinery could be used, and many mills grew to a tremendous size. Some operated on three different floors within a single structure. While isolated steam-mills were established in the late 1840s and 1850s in Wisconsin, the majority of commercial sawmills built after 1860 were powered by steam. Many previously water powered mills were also converted to steam. One positive aspect of steam powered sawmilling was the ability of the boilers to run on readily available sawdust and milling wastes. An 1869 invention by a Chippewa River firm automatically carried sawdust directly from the milling area to the boilers. With the steam engine also came the smoke stack and an increased threat of fire. In larger cities and milling centers, the dangerous potential for disastrous conflagrations led many firms to install private fire protection systems with vast water mains, hydrants, and sprinkler systems. They also organized and equipped volunteer fire crews.

By the 1900s, electric motors were beginning to make headway in some sawmilling areas, replacing both steam and water power systems. Water power remained economical to some small mills, and isolated camps retained a strong reliance on steam power. Yet the majority of Wisconsin's major milling centers eventually turned to full electric power.

MILL MACHINERY MANUFACTURING

Wisconsin supported a number of machinery manufacturing concerns that were closely related to the lumber industry. One of the most extensive manufacturers and suppliers of equipment and machinery to milling plants in Wisconsin and the rest of the upper Midwest was the giant Milwaukee concern of E.P. Allis. Beginning production in 1847, the firm continued to operate a saw milling department until the 1930s. Other large machinery manufacturing firms in the state were the J.I. Case Company in Racine and the McDonough Manufacturing Company in Eau Claire (Apps 1980:90).

Industry production reflected the vast increases in efficiency and economy made possible by the expanding array of new machinery and equipment in the second half of the nineteenth century. Prior to 1860, the average Wisconsin mill produced about 50,000 board feet of sawed lumber in a 12 hour day. Just ten years later, mills were commonly producing one to two hundred thousand board feet a day, and the average annual production ranged between 30 and 60 million board feet. Reaching a climax in the 1880s with the perfection of the band saw, lumber production at Wisconsin's largest mills, Weyerhauser at Chippewa Falls and Knapp, Stout, and Co. at Menomonie, reached totals of 250 to 300 thousand board feet a day (Fries 1951:64-65).

The total number of saw mills in operation in Wisconsin in 1880 was 704, a rise from 476 in 1860 and 278 in 1850. The production value during these respective years was

$17,952,348 in 1880, $4,377,880 in 1860, and $1,218,516 1850 (Tenth, Eighth, and Seventh Census of the U.S. 1880, 1860, 1850).

RIVER TRANSPORTATION

Before the railroads made significant inroads into the northern pineries, few mills seasoned or finished their product before sending it to market. For the most part, the early sawmills produced only rough lumber, realizing that the transportation of finished lumber by water invariably damaged the finished goods considerably. From the early mills, the region's rivers and lakes still provided the cheapest and most convenient means of getting lumber to market. By 1850, great lumber rafts floated on all of the major inland streams and along Lake Michigan. The process continued well into the turn of the century. Unlike the often chaotic movement of raw timber from the logging camps to the mills, the shipment of sawn lumber was more highly organized. Methods of rafting and raft construction varied according to the width and velocity of the riverway and the market destination, but most milling firms erected protective rafting sheds in which large floating rafts, built completely of newly sawn lumber, could be constructed. The largest rafts were used on the Mississippi River, also the site of the largest rafting works. Prior to 1860, the largest of the Mississippi rafts contained from three to five 100 thousand board feet of lumber. By 1865, some rafts were carrying as much as one million board feet, and in 1870, a Chippewa Falls mill sent to St. Louis a raft carrying two and a half million board feet, enough to build a village of a 125 houses. Such a raft might take up to three to four acres. During most of the 1870s, the average raft contained from three-fourths to one and one-half million board feet. Reports in 1895 noted a single colossal raft of seven million feet of lumber on the Mississippi River (Fries 1951:67).

Until the mid-1860s, the rafts floated downriver by the natural current of the streams. By 1873, however, over 70 steam boats were engaged in towing (actually pushing) lumber rafts to market on the Mississippi alone. At its peak, Wisconsin's lumbering industry engaged more than a hundred private and company owned towing vessels.

On Lake Michigan and Lake Superior, the methods of transporting lumber to the vast market regions of Milwaukee, Chicago, and points east were slightly different. Although rafting was still used in some areas, lakeboats - sailing ships and steamers - were more often employed and loaded with as much as 250,000 to 1,500,000 board feet of lumber each. In later years, as steamers and bulk carriers increasingly replaced the outmoded sailing vessels, many schooners and clippers were used simply as barges. Stripped of their sails, they were and towed across the lakes by tugs. Among the more significant Great Lakes shipping ports were Superior-Duluth, Ashland, Marinette-Menominee, Green Bay, and Sturgeon Bay (Fries 1951:70-71).

THE IMPACT OF RAILROADS

Of all the technological advances and industrial changes in the lumber industry, none compares to the revolution effected by the introduction of the railroads to Wisconsin's northern pineries. Beginning in the late 1860s and increasingly in the 1870s and 1880s, the growth of the railroads enabled the lumber industry to exploit the hardwood resources and to develop new markets. They also aided in speeding the processes of production and marketing, and released the lumbermen of the upper Midwest from their dependence on the always uncertain elements of weather and nature. For example, in 1871 the Chicago and Northwestern Railroads extended their line, which had connected Oshkosh to Green Bay since 1860, to Menominee. Thus the entire eastern pinery district was provided access to western markets and eliminated the necessity of shipping by way of Chicago. The Wisconsin Central completed a line between Milwaukee and Ashland in 1877, and soon smaller branches were connecting Portage, Green Bay, and a host of Wisconsin River mill towns to the main trunk line. Similarly, the Green Bay and Minnesota Railroad began to lay a line across the entire state from Green Bay to the Mississippi (Clark

1956:15-17).

Saw mills quickly sprang up all along these routes as lumbermen sought to take advantage of the new opportunities. In addition to other benefits, the railroads made it easier to get both men and supplies into the woods. Consequently, the lumber and logging industry was able to swing into year-round production, as it was no longer necessary to depend as heavily on the spring drive, winter logging, or the seasonal rafting of sawn lumber. Moreover, pine lands once too remote from driving streams were rapidly brought into production, opening vast new areas of the north woods. The railroads also made possible the transportation of small, portable sawmills directly to the sources of raw timber in the woods. In the late nineteenth and early twentieth centuries, small, steam powered mills were often moved from one site to another as operations shifted from depleted logging areas to new locations (Clark 1956:15-17).

As a result of the advent of the rail lines, larger mills could start producing finished lumber and rough sawn goods. Planing mills, drying yards, and kilns to dress and finish rough lumber became common features in both the yards of many established concerns and in nearby independent operations. No longer concerned about water damage to finished products, the milling concerns used the railroads to ship their goods directly to the consumer. From the mills, finished goods were sent from Wisconsin to markets in Minnesota, Iowa, Missouri, Illinois, and Kansas, and also to more distant markets such as Nebraska, the Dakotas, and Texas (Fries 1951:88-92).

Despite the advantages of rail transportation, the rafting of logs and lumber was not completely abandoned. In areas such as the lower Chippewa Valley that facilitated easy movement, for reasons of economy many concerns still preferred to utilize the natural waterways on occassion, particularly when rail rates were exorbitantly high. Thus, rafting remained at least a small part of the industry until the end of large scale operations in the state.

Encouragement for the expansion of the railroads, which were extensive consumers of lumber products, came from many sources. The state legislature, local governments, businessmens' associations, and the lumber companies all offered substantial incentives to the companies to expand. In fact, many Wisconsin lumbermen became stockholders in various railroading concerns. Others organized their own local railroads to link up with major trunk lines and to head deeper into the pineries.

THE ORGANIZATION OF LUMBER OPERATIONS

Almost without exception, the earliest lumber companies in Wisconsin were owned by individuals or as partnerships during and just after the Civil War. When more and more capital was required to operate a successful sawmilling business, corporations became increasingly more common. Generally, eastern money constituted the economic foundation of Wisconsin's early concerns, but increasingly it was supplanted by investments from successful Chicago and Mississippi rivertown businessmen such as John H. Knapp (Fort Madison, Iowa), Henry Stout (Dubuque, Iowa), and Frederick Weyerhaeuser (Rock Island, Illinois).

As the industry expanded and firms became increasingly larger - acquiring more timber land, establishing boom and river improvement operations, developing new transportation systems, and establishing subsididary mill and distribution sites - a monopolistic tendency characterized much of the Wisconsin lumber economy. One by one, most of the small companies were crushed by the expense of buying the modern machinery necessary for successful competition, either absorbed or frozen out by larger concerns. While the small company never disappeared entirely, larger corporations came to characterize lumbering in the region. Corporations like those of Knapp and Weyerhauser, which controlled almost entire river valley regions, clearly led the industry (Fries 1951:122-126).

While enlarging the scope of their logging and milling operations, many companies also found it economical to diversify into various associated enterprises. Many companies operated grist mills, farms, and pork-packing establishments to supply the needs of their workcrews. Camp stores and dry goods establishments prospered both in the isolated logging areas and in the mill towns, many of which were more like company owned communities. Boarding houses, residences, foundries, machine shops, wagon shops, and warehouses all supported the mill sites and added to the company's economic hold on the northwoods.

The enlargement of production and firm size throughout the industry was also supported by the development of loosely formed lumber associations and trade organizations. Coming together in hopes of mutual benefit, the various associations developed uniform grading systems, established employment bureaus, and set codes of practice. Even more importantly, however, they attempted to establish systems to maintain production quotas and fixed prices by which they could all profit by gaining better control over market fluctuations. Among the groups to form in Wisconsin were: the National Association of Lumbermen (1874), Chippewa Valley Lumbermens' Exchange (1875), Lumber Manufacturers Association of the Northwest (1882), Mississippi Valley Lumbermens' Association (1891), Wisconsin Valley Lumbermens' Association (1895), Lake Superior Lumber Manufacturers' Association (1900), and the Northern Pine Manufacturers' Association (1906). Despite continual efforts, the competitive nature of the industry negated most of the activities of these associations (Fries 1951:129-138).

Many lumbermen garnered additional power by becoming major political forces in their areas. Local politics were often controlled by the lumber interests, particularly where they were the keystone to economic stablility in an area. Other concerns supported extensive lobbying efforts, owned large circulation newspapers, or promoted their own political candidates. In some cases, the lumber barons themselves sought and attained political offices both in the state and federal legislatures. Philetus Sawyer of Oshkosh, Isaac Stephenson of Marinette, Thaddeus Pound of Chippewa Falls, and William Price of Black River Falls were all men of "lumber money" who held seats in Congress during the late nineteenth century (Fries 1951:221-225).

WORKING CONDITIONS

While the mill owners and lumber barons wielded great power and business acumen, the actual work of logging, hauling, milling, and distributing the industry's products was in the hands of common laborers with little political awareness and even less control over their situations. During the 1830s, virtually all of the woodsmen employed in the early Wisconsin lumber trade had been French-Canadians, many of whom had abandoned the local fur trade or had migrated from Canadian lumbering centers. Particularly adept as rivermen, the French voyageurs were eventually supplanted in the 1840s and 1850s by experienced New England and Eastern lumbermen and later by large numbers of European immigrants. The 1880 census noted a total of 3,810 workers in Wisconsin's woods: 1,805 native born Americans, 915 British-Americans, 473 Scandinavians, 275 Germans, 147 Irish, 89 British, and 106 natives of other countries. A large proportion of the woodsmen, especially the seasonal logging crews, were transients. Many were local farmers in search of winter employment, while others simply moved continually from one job or logging camp to another. Until about 1900, the Wisconsin lumber industry employed more laborers in the mills and woods than any of the state's other manufacturing enterprises. From just over 2,000 workers in 1860, employment reached its peak in the early 1890s at well over 20,000 men. Twenty-five percent of all industrial workers in the state in 1889 were employed by the lumber companies of the region (Fries 1951:204-206).

Despite their numbers, the Wisconsin lumber industry employees never really enjoyed the

best working conditions. Isolated in distant logging camps or living in company owned towns, the men were at the continual mercy of the mills, which usually used the due-bill payment systems, deferring payment until the end of the season. Other devices used to maintain control of employees included company stores and restrictive contracts. Trade and labor union groups did not engage in any extensive actions in the sawmilling centers of the Midwest until the late 1880s, and the fiercely independent lumberjacks in the field did not organize until the 1900s. The 1880s, however, were marked by a number of strikes. Working hours were the first item of contention, with workers seeking an end to the 13 hour day in favor of a ten hour day. Pay and safety quickly followed as the laborers' major concerns.

The lumber industry was by far one of the most hazardous of Wisconsin's industries. Early machinery featured few safety devices, and the arduous work in the logging camps and on the rivers commonly took their toll. In many growing communities, the logging firms and their employees were the first to push for the establishment of a local hospital. By the 1890s, the renewable-ticket principle proved a common form of hospital injury insurance in many camps and mill towns. A ticket costing approximately 10 to 12 dollars entitled a workman to all medical care required during the course of the year. Other organizations and fraternal societies also developed over the years to aid the logger and the woodsman in his financial, social, and political life. These groups included the Independent Order of Foresters, the Modern Woodmen of America, and Woodmen of the World. Generally, life in the sawmill town was like that in any other small frontier community. It featured unpretentious buildings, crude amenities, and an often rough and unruly atmosphere that might slowly develop more respectablility with the introduction of diverse business and industrial pursuits such as the case in La Crosse and Eau Claire. On the other hand, many communities simply disappeared with the end of large scale lumbering in the area (e.g. Elton and Shanagolden-Woodcountry).

DECLINE OF THE LUMBER INDUSTRY

At the dawn of the twentieth century, the fate of many mill towns and lumbering operations was becoming questionable. Since lumbering operations began in the northern pinery, production had increased steadily, except for during minor depression periods. From an estimated cut of around 200 million board feet in 1853, annual output from Wisconsin' pineries had risen to about 1.25 billion board feet by 1873. By 1892, it reached a maximum of well over four billion board feet. The last decade of the nineteenth century, however, signaled the beginning of the end of the industry. By the turn of the century, the voracious appetite of the American consumer for wood products and the wasteful practices of Wisconsin lumbering operations had nearly exhausted the region's white pine reserves. In 1897, skilled forestry experts estimated that the northern Wisconsin timberlands would scarcely maintain the industry in its present form for more than 10 years. Faced with elimination, the industry's were forced to revise their future plans and methods of operation.

Long before the white pine ceased to be a marketable Wisconsin product (the last sizeable stands of white pine were cut during the 1930s) the industry underwent a series of dramatic changes. One of the most significant was the decision to use lower grades of timber and to use hardwood timber on a large scale. Whereas earlier logging operations had gone into areas with only the most suitable and profitable timber, leaving the smaller timber, poorer quality woods, and hardwood stands behind, new operations cleared areas of almost all useable timber and even revisited areas already cut over. As early as the 1870s, the harvesting of hardwoods, including cedars and hemlock, had begun to assume a growing role due to the demands of the state's growing furniture, paper, and tanning industries. During the 1890s, however, the use of such woods began to achieve sizable proportions in the state. Of the total approximately 3.4 billion board feet of lumber cut in 1899, over 958 million feet was composed of hemlock and hardwoods. By 1906, the total had topped more than a billion board feet. The hemlock cut in 1907 alone was estimated

at approximately 786 million board feet. Of course, the railroads played an invaluable role in the logging and processing of hardwoods because most hardwood logs could not be floated on riverways without sinking (Fries 1951:239-241).

As the twentieth century progressed, maple and oak displaced pine as the chief timber cut for lumber purposes in Wisconsin's northwoods. Still, despite a newfound source of marketable lumber, Wisconsin could no longer support an industry of the scale permitted by unlimited pine reserves. At the beginning of the twentieth century, 1,033 sawmills were in operation in Wisconsin, and the state was still the foremost producer of lumber in the U.S. But just five years later, Wisconsin had slipped to second place, behind Washington state. By 1925, the number of mills in the state had dropped to 234, and the industry was no longer even the most productive in the state, a position it had held from 1890 to 1920. The total cut in 1939 was one-tenth that of 1899, and through the 1940s and 1950s, it remained stabilized around 400 million board feet annually (National Rsources Committee 1956:86-92). Aspen, fir, and hemlock have become the staples of the pulpwood industry that dominates the state's limited forest industry today.

With the decline of the state's rich forest reserves, many Wisconsin lumbermen began securing rights to timber lands in the South and on the Pacific coast. In fact, by 1910, many local concerns were starting to cut and mill timber in the Pacific Northwest while still maintaining their Wisconsin operations. In addition, as the industry declined, northern Wisconsin's lands were increasingly promoted for agricultural use by logging companies seeking to sell their useless but taxable cutover lands. Localities that hoped to halt the exodus of people and captial from the region and state leaders who hoped to promote new areas of growth promoted the land for agricultural purposes. Some area, blessed with rail access and firm economic foundations, survived as retail and distribution centers. Others developed new industries to boost the economy, and still others simply shrank to small rural communities (Fries 1951:240-250).

Land use policies regarding conservation achieved a new status with the disappearance of the once vast timber reserves of the state. Various methods of industrial conservation had been outlined as early as the 1870s, but the profit wary lumbering concerns were, for the most part, unwilling to wait 50 years for the reforestation of cutover lands, particularly with virgin western and southern forests still exploited. Most of the efforts at forest conservation in Wisconsin were were implemented by state agencies and federal programs, such as the C.C.C., and resulted in the creation of state and county forest reserves.

The northlands of Wisconsin no longer hold the vast pine forests of 150 years ago, and most of the features of the lumber industry that ruled the economic fortunes of the area have either been removed or abandoned. Today, the logging and lumber industry is in a new phase of development, with the conservation and reforestation of timber land just as important as the exploitation of standing timber. The pulp log has become the most important product of today's controlled lumber industry.

IDENTIFICATION

Resource types. Logging camps - living quarters, dining halls, repair shops, blacksmith shops, stables, wanigans (company stores), offices, log landing, tote roads, rail corridors, hauling roads (almost all of the resources associated with the logging camps of the northwoods are of an archeological nature and may require different methods of evaluation). Driving streams - landings, dams, holding ponds, stopping places (inns, taverns), sorting booms, canals. Sawmilling sites - saw mills, planing mills, shingle mills, lath manufacturers, power houses (water wheels, turbines steam engines), hot ponds, holding ponds, kilns, tramways, drying yards, sawdust and waste storage areas, bark processing yards, rail lines, office buildings, boarding houses, hotels, worker residences, company town historic districts, company stores, rafting works, dock areas, distribution/wholesale-retail yards, homes of people prominent in the lumber industry, company grist mills and farms.

Locational Patterns of Resource Types. Early logging and milling sites depended on water for power and transportation and thus were always located along major waterway and river systems. Steam power and railroads relieved some of that dependence, yet most sites still remained in close proximity to the state's major inland and lakefront waterways.

Previous Surveys. While most intensive survey reports detail the development of some form of sawmilling within the community, only the Outagamie and Brown County Industrial Sites Report and the Eau Claire Survey detail any extant sites. In addition, two reports written by the Great Lakes Archeological Research Center Inc. (see bibliography) for the Nicolet and Chequamegon National Forests detail the existance of above ground and archeological sites relating to the logging industry and provide extensive histories of the industry and the types of sites..

Survey and Research Needs. An abundance of research material detailing the Wisconsin lumber industry is available, although much of it has not been analyzed. The role of the small, rural, or independent mill remains less well documented.

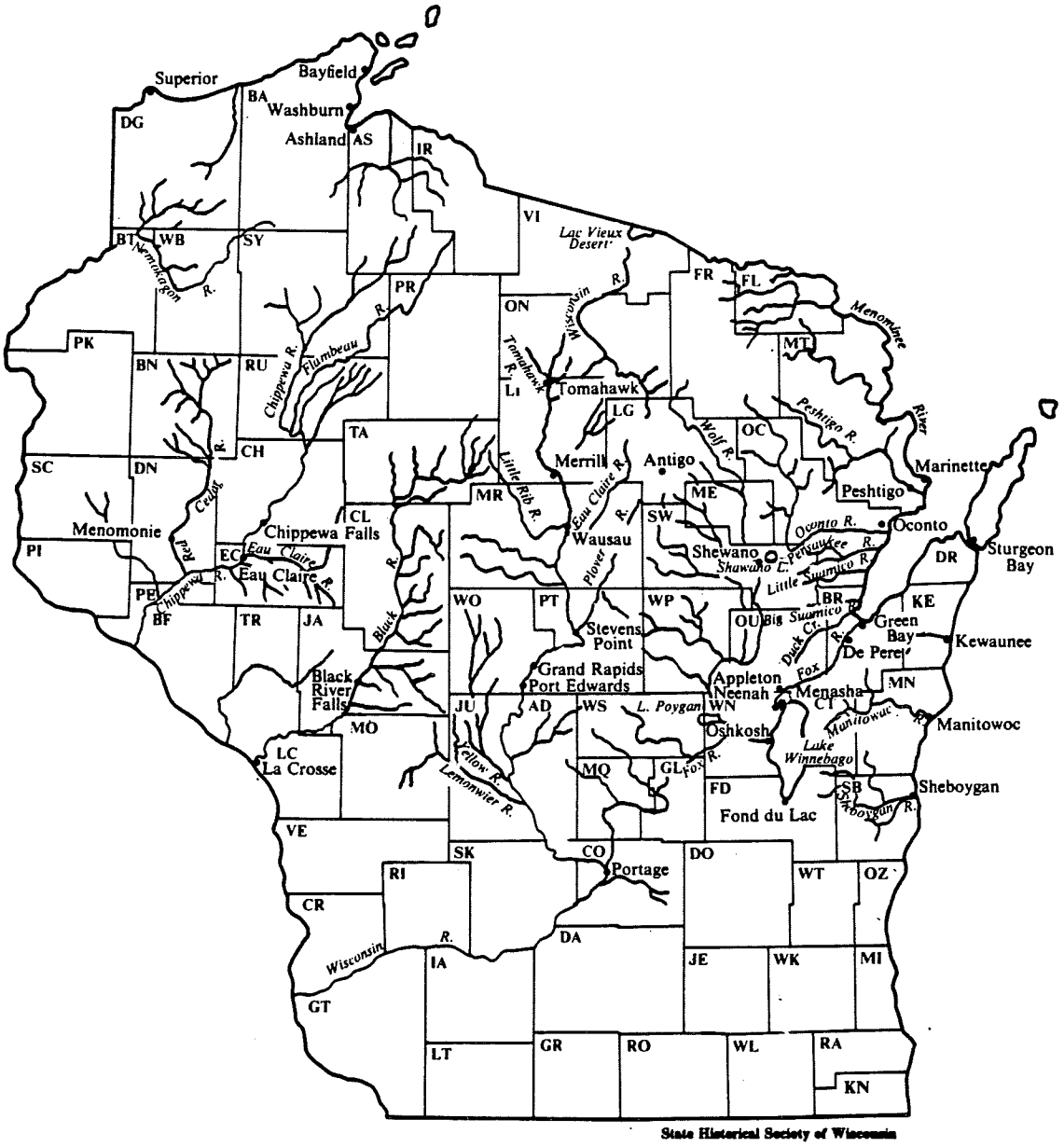
EVALUATION

National Register Listings and Determinations of Eligibility

Kaiser Lumber Co. Office (c.1905), 1004 Menomonie St., Eau Claire, Eau Claire County (NRHP 1983, Eau Claire MRA).
Flanner-Steger Lumber and Land Co., camp six and seven, Nicolet National Forest, Laona vicinity, Forest County (DOE 1980).
Flanner-Steger Camp no. five, Nicolet National Forest, Laona vicinity, Forest County (DOE 1980).
Holt and Balcom Logging Camp no. 1 (1880), Town of Lakewood, Oconto County (NRHP 1978).
Holt and Balcom Lumber Co. Office (1854), 106 Superior, Oconto, Oconto County (NRHP 1976).
Round Lake Logging Dam, Town of Fifield, Price County (NRHP 1981).
North Wisconsin Lumber Co. Office (1889), Florida Ave., Hayward, Sawyer County (NRHP 1980).

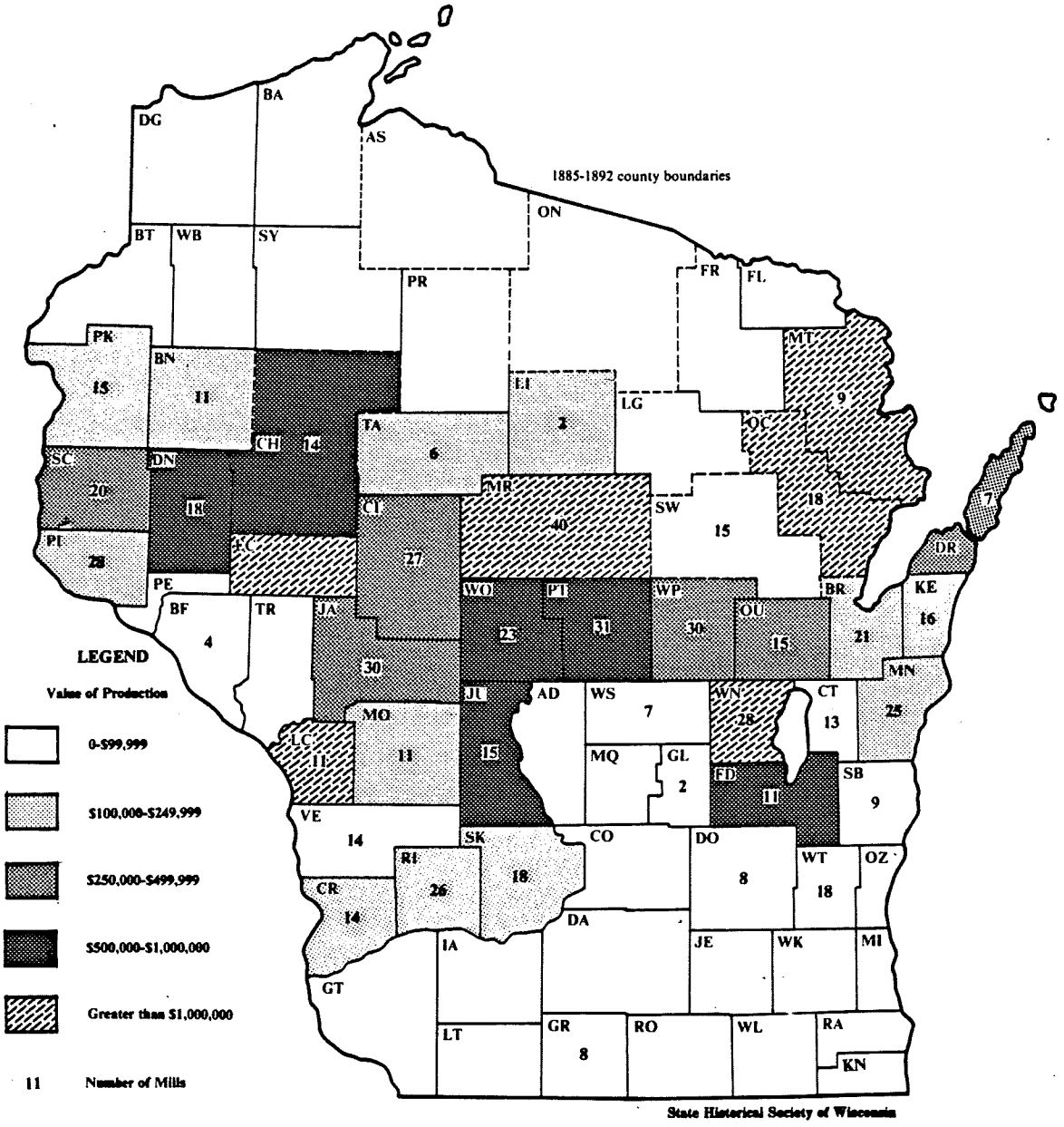
Context Considerations. Most resources found extant should be evaluated in terms of their local significance. Important factors to keep in mind during the evaluation process are: geographical location (water system, market area, resource supply area, etc.),

company or individual identification, lumber era (pioneer, railroad, electric, etc.), scope of operations (single plant, one of many company sites), extant equipment, scale of production, and/or subsidiary resources. Individual sites and resources were often part of extensive operations covering vast areas, and the particular sites should be evaluated in this context (e.g. only remaining resource of a company or of a particular river system, only remaining resource of its type, etc.). Sites may also exist in highly deteriorated form and might need to be addressed as archeological resources, thus introducing additional context consideration (see G.L.A.R.C. 1982 in bibliography for more information).



Major Lumbering Districts of Wisconsin

Source: Genivera Loft, *The Evolution of the Wood-working Industries of Wisconsin* (M.A. Thesis, University of Wisconsin, 1916), Plate 1



Value of Production for Wisconsin Sawmills, 1880

Source: *Tenth Census of the United States, 1880: Vol. VIII, Industry,* pp. 371-378.

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Many northwoods newspapers carried stories about regional logging and lumbering operations during the nineteenth and early twentieth centuries. Among the most prodigious were: the Eau Claire Daily Telegram and Free Press, the Shawano Journal, the Green Bay Press Gazette, the Oshkosh Northwestern, the La Crosse Chronicle, and the Chippewa Herald. Important journals include the Northwestern Lumberman, published in Chicago between 1873 and 1898 and Forest History Association of Wisconsin Proceedings, published in Wausau between 1976 and 1983.

PULP AND PAPER PRODUCTION

Temporal Boundaries: 1848 - present, peak development years: 1872 - 1910.

Spatial Boundaries: Prior to 1870 Milwaukee and the Rock River Valley. Starting in 1870 production sites began to concentrate in the northern Fox, Wisconsin, and Chippewa River Valleys, particularly in Outagamie and Winnebago Counties.

Related Study Units: Logging and Lumber Milling.

HISTORICAL BACKGROUND

The art and science of papermaking achieved great success in Wisconsin. From a meager beginning in Milwaukee around 1848, the industry eventually grew to become Wisconsin's third largest industry by 1948, employing over 26,000 workers at 57 separate mill sites (Howard 1948:4). In Wisconsin, the paper industry had all of the basic essentials necessary for efficient production: an abundance of pure water, readily available raw materials, a stable power supply, skilled labor, and ready access to good markets. During its extended development, the Wisconsin pulp and paper industry changed dramatically in manufacturing processes, products, markets, and organization.

The fist discovery of the art of papermaking is attributed to the Chinese, who had processed scraps of silk into paper by 105 A.D. From China the slow, time-consuming process found its way to Japan, Europe, and eventually the New World. William Rittenhouse, a German-born immigrant, brought the technique to America in 1690, opening a small mill near Germantown, Pennsylvania (Clark 1956:3). The industry continued to push westward with the expansion of the American frontier during the 1700s and the early 1800s. The Mid-Atlantic and New England region remained the major center of early paper production. Paper manufacturing began in Wisconsin in 1848 with the establishment of the state's first paper mill in Milwaukee. Built on the west-side of the young community along the Menomonee River (now the Water Street Bridge), the two and one-half story brick mill produced about 100 reams of newsprint paper a week. Owned and operated by Milwaukee businessmen Ludington and Garland, the small firm supplied rag paper to Milwaukee's growing number of publishers and printers, as well as to concerns in other areas of Wisconsin and in Chicago. Operating with an average staff of 10 workers, the firm changed hands and sites several times during the next few years, and was destroyed by fire in 1869. The destruction of mills by fire appears to have been a rather frequent occurrance in the industry (Howard 1948:6).

Rags, straw, and waste paper were the main ingredients of the paper produced in the Milwaukee plant. Cotton rags had been the mainstay of the paper-making industry for centuries and rag peddlers pushing their carts from house to house in populated areas were a common site. Well into the early nineteenth century the international trade in rags was still quite extensive. The United States imported over 44.5 million pounds of rag stock in 1858 alone (Clark 1956:5). Increasing demands for paper products, however, made supplies of the raw material harder and harder to acquire.

Mill operators and owners constantly searched for new ingredients for use in the manufacture of paper. Straw and hay were introduced into plants by the 1830s and proved to be a relatively satisfactory material for rough paper products such as newsprint and wrapping paper. Many of Wisconsin's early manufacturers utilized a mixture of cloth, straw and various grasses to produce their marketable paper products. In the early nineteenth century a number of new paper making machinery was introduced, revolutionizing what had been a tedious, labor-intensive process. Machines like the

Fourdrinier and cylinder greatly increased paper production and lowered costs. The Fourdrinier had initially been patented in France in 1799 by Nicholas Robert, but was perfected in England by Henry and Sealy Fourdrinier in about 1805. George Dickenson's cylinder machine was introduced in 1809 and quickly became a mainstay of the industry. The Fourdrinier remains the basic papermaking machine in use today. After the War of 1812, the European machines became widely available in the United States and handmade paper making became an obsolete industry. The Ludington and Garland plant in Milwaukee proudly featured the most up-to-date machinery, including two steam engines and a large paper making engine/machine (Clark 1956:3-5).

During the Civil War newsprint became an increasingly scarce commodity. As a result, in the early 1860s several Milwaukee publishers joined to form the Wisconsin Paper Company and operated a mill on the south side of the Milwaukee River. Like the Ludington and Garland mill it was destroyed by fire in 1867 (Lawson 1909:273). A straw-paper and board factory began production along the Menominee River near Grand Avenue in the mid-1860s. Operated as Ernst Prieger and Company, the mill ended production in 1875, ending Milwaukee's early papermaking industry (Howard 1948:6).

The second Wisconsin location of a paper manufacturing industry was Beloit. In 1856 the Beloit Paper Company of T. L. Wright and S. T. Merrill began production of paper on the banks of the Rock River using rags and rye straw. Five years earlier Wright and Merrill had established a mill on the Rock River at Rockton, Illinois. In 1868 the Beloit Paper Company merged with the Rock River Company, which had established a paper mill in Beloit in 1858, and formed the Rock River Paper Company. Employing 50 men and 30 women and boys, the company utilized 15 to 18 tons of rye straw and six to eight tons of rags per day (Howard 1948:7). The women and children were usually hired to sort and clean the rags as they arrived at the mill. After failing in 1885, the Rock River Paper Company mill was replaced by the Beloit Box Board Company. Still in operation in 1983, the firm reportedly utilized circa 1891 machinery, possibly the oldest presently in use in the United States (Beloit 1983:NP). Beloit, located adjacent to substantial waterpower resources, supported two other firms during the 1800s: the Beloit Straw-Board Company and the F. N. Davis Manufacturing Company (1875), the latter maintaining mills in Cologne, Germany, and London, England, for the production of building paper, paper carpeting, paper pails and barrels, and waterproof boards (Howard 1948:7).

By 1880 Beloit was producing over $195,000 worth of paper goods a year, but the city's real contribution to the industry was in the manufacture of papermaking machinery, in which it took a dramatic lead (Tenth U.S. Census 1880:371-378). Orson E. Merrill, whose brother Sereno operated the Rock River Paper Mill, organized a machine shop to repair local papermaking equipment in 1858. Eventually, he and George Houston to formed the Merrill and Houston Iron Works, which quickly became a major manufacturer of paper machine parts and equipment in the Midwest, supplanting the early factories of New England. The Merrill and Houston firm was the forerunner of the present-day Beloit Corporation/Beloit Iron Works which still manufactures machinery and equipment for the pulp and paper industry. Due to a powerful supply of waterpower, extensive railroad connectionsand aggressive management, Beloit became a center of paper machinery production by the turn of the century, shipping equipment throughout the world (Howard 1948:55). (For more information on machinery manufacturing refer to the final section of this unit and to the Metal Industries study unit.)

J.H. Crombie began operating a small paper mill at Whitewater, northeast of Beloit, in 1860. The Whitewater Paper Company, manufacturing print paper, tea paper, and brown wrapping paper from local straw and rags, remained in business until the 1890s. Capacity at the typical two-story brick mill, which employed between 15 and 30 men, rose from 3.5 to 15 tons a day during the period of its operation. Two short-lived concerns, one in Fond du Lac, the other in Sparta, also manufactured rag and straw paper. The Fond du Lac firm began operation in 1873 and lasted two years, burning down in 1879. In

Sparta, John Mather began operating a small straw mill in 1864. From 1871 to c.1883, the small, 20-man factory was operated by Oran I. Newton and supplied approximately 6,000 pounds a day of straw-paper to local markets (Howard 1948:7).

From its early start in the southeastern corner of the state, the paper industry moved quickly northward into the Fox River Valley. There, in the communities of Appleton, Neenah, Menasha, and others, the industry was firmly established as a thriving economic enterprise. The valley was ideal for the establishment of industrial operations, evidenced by the large number of flour and saw mills that had located in the area. Lake Winnebago formed a natural reservoir for the necessary freshwater, essential to the paper industry as a source of power and in the actual papermaking process. Transportation to market via the Great Lakes was convenient, and railroad connections to the commercial centers of Milwaukee and Chicago were made early. Most importantly, when the industry began its dramatic shift to the use of groundwood and wood pulp in the late nineteenth century, the rich reserves of the northern Wisconsin forests were close at hand. The introduction of pulpwood processing into the paper industry, while aiding the development of Beloit's machinery production concerns, was the major cause of the decline in paper production in southeastern Wisconsin, where natural softwood supplies were not as readily available in sufficient quantity.

Appleton was the first community in the Fox River Valley to begin manufacturing paper. In 1855 three eastern paper manufacturers, G. N. Richmond, C. P. Richmond, and Thomas Richmond, arrived in Appleton and began the erection of a mill at a site along the Fox River. The Richmond mill, which produced a course grain rag paper and a straw wrapping paper, was destroyed by fire in 1859 but was quickly rebuilt. By the mid-1860s it was producing $75,000 worth of goods annually, which was approximately four tons a day (Lawson 1909:274). Because of the success of their operation, the Richmonds were able to entice a number of skilled laborers from papermaking centers in Massachusetts and Connecticut to the region, assuring an important supply of trained craftsmen for the growing industry. The Neenah Paper Mill began operations in Neenah in 1865-1866. Organized by a stock company of local business interests, the "old red Neenah mill" became the most successful and profitable of the region's early mills. It called widespread attention to the possibilities of the industry in northern Wisconsin. Operated for a number of years as Smith and Van Ostrand (1868-1874), the mill was eventually purchased by Kimberly, Clark and Company, an aggressive firm which later became one of Wisconsin's largest producers. The original mill building was removed in the 1890s to make way for Kimberly-Clark's new facility (Howard 1948:8-10). The early mills of Appleton and Neenah utilized cloth rags as the basic material in their paper products, acquiring the material from local sources and from Milwaukee and Chicago.

Until 1870, paper manufacturing was still considered a secondary industry in most Fox River communities, behind flour and lumber. One of the most significant years in the growth of the paper industry in Wisconsin was 1872, the beginning of a boom in the establishment of paper mills due to the introduction of new wood pulp production technology. In 1872, two Appleton businessmen completed the first groundwood pulp mill in Wisconsin, utilizing the hemlock timber discarded by area lumber operations. The German process of making usable pulp by forcing a block of wood against a grindstone cooled with water had been adopted by the United States after the Civil War. The pioneer Appleton operation proved successful and offered a solution to the constant difficulty of maintaining adequate raw material supplies. The movement of wheat flour production west of the Mississippi and of lumber operations deeper into the northern Great Lakes region had a definite impact on the area's manufacturing climate, forcing many local industrialists and investors to seek new business ventures. Many area flour millers, who had begun to feel the drain of western competition, converted their valuable millsites to paper production. Other manufacturers in the region quickly adopted the pulpwood process, and new mills were soon established throughout the Fox River Valley. By 1882 at least 20 new paper companies had begun operating in the valley and employment soared to over 2,000 workers (Clark 1956:7).

Among the newly established concerns was one started by John Kimberly, Charles Clark, Frank Shattuck, and H. Babcock along the banks of the Fox River in Neenah. With an initial investment of $30,000 in 1872, Kimberly, Clark and Company purchased a former flour milling site and established the Globe Paper Mill, the first step in their rise to prominence in the industry. The story of Kimberly-Clark's development is characteristic of the "boom era" of paper manufacturing in the state, both in its scale and swiftness. By continually expanding their site, purchasing the former Smith and Van Ostrand mill in 1874, and by converting from rags totally to wood pulp processing, the firm increased their investment to over $400,000 by 1880. The company soon included mill sites in Appleton. From one mill and 40 employees in 1872 producing solely newsprint, the firm grew in 10 years to include four mills employing 140 workers producing diverse line of paper products (Kimberly-Clark Corp. 1948:7-19). Over the next 10 years it grew even more. Valued at $1,500,000 by 1888, the firm owned and operated the Globe, Neenah and Badger mills at Neenah; the Atlas, Vulcan, Tioga, and Telulah mills at Appleton; a newsprint mill at Niagara, Wisconsin; a mill at DePere; and was in the midst of creating the company town of Kimberly (Lawson 1909:277). In 1892, alone, the firm employed over 700 laborers and produced more than 3.5 million dollars worth of paper products, making the Neenah-Menasha-Appleton area the Midwestern center for paper manufacturing (Adams 1982:11-12).

Other paper manufacturing firms that were started in the post-war era included two on Neenah, the Patten (1874) and Winnebago Paper Company (1874, becoming the Bergstrom Paper Company in 1905), and several in Menasha: the Menasha Paper Company (1876), the George Whiting Paper Company (1882), the Gilbert Paper Company (1887) and the John Strange Paper Company (1888). The buildings that housed the early mills were of various sizes and materials. Many of the earliest sites were usually of wood frame construction. As the industry expanded and machinery grew more sophisticated, larger and more permanent sites were established. By 1880 brick and stone construction was almost universally accepted except for small outbuildings. Fire protection and the ability to sustain heavy, vibrating loads were important dictates of building design. Concrete and steel played increasingly important roles after the turn of the century. The design of extensive paper mill complexes was often placed in the hands of trained industrial engineers. One of the leading paper mill architects/engineers of the period was A. B. Tower of Holyoke, Massachusetts, who in the 1880s did extensive work for Kimberly, Clark and Company in Wisconsin, among others. In the early twentieth century the engineering/contracting firm of C. R. Meyer and Sons of Oshkosh played an equally important role in the Fox River Valley. Commonly of utilitarian design, the numerous interconnected buildings that made up a complex were designed to work as an efficient machine. In some instances, however, certain highly visible or commanding elements were treated to special architectural embellishments, such as decorative window detailing or ornamental stonework. The most characteristic form associated with paper milling complexes is the long, linear building, two to four stories in height with a low roof (sometimes saw-toothed), and an abundance of windows. Almost always sited as close to water's edge as possible, the mill complexes are clearly dominated by tall smokestacks and adjacent hydro-electric-steam turbine powerhouses.

The growth of the papermaking industry continued in the Fox River region throughout the late nineteenth century and as the industry grew new technological developments evolved to replace older methods and augment production capabilities. Many affected plant design. Among the most significant developments was the introduction of chemical processes for the conversion of wood chips into usable pulp for the making of paper. Introduced in 1875, chemical processing was instituted on a large scale in Wisconsin mills by the 1880s and 1890s. Paper made by this new process, which cooked the wood under pressure in chemical baths of soda, sulphite, or sulphate, was much stronger and finer than that made from ground wood or rags and allowed for a greater diversity of paper products. Independent and factory-owned pulping mills, separate from paper mills, were

often established to supply raw pulp to the paper manufacturing mills (U.S. Pulp Producers Assoc. 1955:4-17) (see the "Process" section at the end of this unit for more information).

Paper manufacturing at Kaukauna was begun in 1872 by Col. H. A. Frambach, who erected the Eagle Mill along the Fox River falls in the community. After being rebuilt due to an 1881 fire, the mill passed through several different hands. Col. Frambach also erected the Badger Mill (1886-1897) in Kaukauna and the Niagara Mill on the Menominee River in northern Marinette County (later taken over by Kimberly-Clark) (Lawson 1909:278). By 1886 there were three paper or pulp mills between the navigation canal and the north channel of the Fox River in the community, three pulp mills on the island and two mills on the waterpower canal in south Kaukauna (Mulholland 1902:1). Perhaps the most innovative and dynamic of Kaukauna's paper manufacturers was that organized by Oscar Thilmany in 1883. Originally established as the American Pulp Company by the German-born Thilmany and three Milwaukee investors, the firm was officially renamed Thilmany Pulp and Paper Company in 1889 when Thilmany became sole proprietor. The large mill was known for its production of diversified and innovative paper products, including the first tissue paper manufactured in Wisconsin, produced by the firm in 1885 (Lawson 1909:278). The company was also one of the first to institute sulphate pulp processing for heavy kraft paper manufacturing in the United States in 1911 (Betz 1983:16). By the turn of the century, the firm emerged as the largest of Kaukauna's papermaking concerns and is today the only one of the city's seven major pulp and paper firms to survive.

At Appleton, in addition to the Kimberly-Clark mills and the pioneering ground pulp operations, firms like the Appleton Paper and Pulp Mills (nee Ames Pulp Company, 1875), the Patten Company (1881), and the Fox River Flour and Paper Company (1883) utilized major production facilities. Reorganized as the Fox River Paper Company in 1887, the latter concern eventually acquired controlling interest in most of the community's early mills (Howard 1948:18). Farther to the north at Green Bay and DePere a number of smaller manufacturing concerns were established. Babcock and Shattuck, early founders of Kimberly-Clark and Company, established a mill of their own at West DePere in 1892. Later becoming a division of the American Writing Paper Company of Holyoke, Massachusetts, the property was eventually reorganized as the Nicolet Paper Corporation. Papermaking in Green Bay was initiated by John Hoberg who moved his entire steam-powered plant from Kaukauna to Green Bay in 1895. The Hoberg Paper mills were followed into the city by the Northern Paper Company (c. 1901) and the Fort Howard Paper Company, among others. A number of small machine shops which produced and repaired manufacturing equipment were also organized (Howard 1948:24-26).

Toward the end of the nineteenth century, the industry again became active in Milwaukee, although in a much altered form from its pioneer days. In 1898 the Milwaukee Lace Paper Products Company was organized to make paper and board containers. Four years later the Hummel and Downing Company was formed to produce similar items (Clark 1956:8).

As paper mills expanded in response to mounting market demands, papermen were increasingly attracted to the rich forest resources and waterpower sites of the Wisconsin and Chippewa River Valleys. The first paper mill on the Wisconsin River was erected in 1886 by Neenah businessman George Whiting and Frank Steel of Appleton at Centralia, about three miles south of Wisconsin Rapids. In addition to the Centralia Pulp and Power Company, Whiting also organized two mills south of Stevens Point, near the junction of the Wisconsin and Plover Rivers. Around these two 1890 mills (eventually known as the Whiting-Plover Paper Company) the small working community of Whiting eventually developed (Howard 1948:10-12). In 1890 former Nekoosa lumberman John Edwards organized the John Edwards Manufacturing Company with several area investors. Within

six years the firm was operating two separate paper manufacturing plants at Nekoosa and Port Edwards. These two mills, together with the earlier Centralia Pulp and Power Company and several lumber concerns with large timber holdings in the state, were consolidated in 1908 under the name of Nekoosa-Edwards Paper Company, which subsequently became one of the state's leading twentieth century producers (Howard 1948:24). Wausau and Rothschild to the north also became centers of large-scale paper and pulping operations, hosting firms such as the Wausau Paper Mills Company (1899) and the Marathon Corporation (1909) which eventually operated mills in Ashland and Menasha as well. During the latter part of the nineteenth and early twentieth centuries the former lumbering communities of Wisconsin Rapids, Rhinelander, Tomahawk, Mosinee, and Merrill all became Wisconsin River paper mill towns.

Further to the west, on the Chippewa River, the Eau Claire Pulp and Paper Company began operations in 1882 and by the mid-1890s production exceeded 30 tons of newsprint a day. The company changed its name and remodeled its plant several times during the early twentieth century, before becoming part of the Pope and Talbot Paper complex. The Park Falls Paper and Pulp Company began operations in 1895 on the Flambeau River and mills soon were established at Cornell and Ladysmith as well. Other river communities, such as Niagara (Menominee River), Marinette (Menominee River), Peshtigo (Peshtigo River), Oconto Falls (Oconto River), and Shawano (Wolf River), supported mills of varying size in the early 1900s (Clark 1956:8-12).

Many Wisconsin firms changed ownership and management control during the first two decades of this century. As a result several large, well-organized firms emerged from a period of consolidation, in which many independent companies had been forced to sell out their holdings. More centralized management of forest lands and diversified production were outgrowths of the consolidation. By 1905, 130 mills were operated by 52 companies in the state. Employing over 6,000 workers in theforests and manufacturing plants, the industry produced $26 million worth of goods annually, ranking eighth among Wisconsin's manufactured goods. On a national level Wisconsin stood third in paper production in 1910 (Clark 1956:8). Twenty years earlier, the state had only employed 1,613 workers to produce $4,200,000 worth of paper products and the industry ranked only twelfth in the state, and Wisconsin fifth in the nation (Eleventh Census of the U.S. 1890:820).

In the early twentieth century, innovations such as the sulphate process and automated machinery were accompanied by new obstacles, notably the increasing scarcity of suitable pulpwood and growing foreign competition. The question of the future supply of wood for pulp had become a pressing concern of the industry. By 1910 Wisconsin mills were using approximately 350,000 cords of hemlock, balsam, and fir annually, and the state's limited reserves would last only a few more years without conservation. This scarcity forced many Wisconsin firms to seek other areas of potential supply, and companies began extensive logging and timber operations in the western regions of Oregon, Washington, Montana, and Minnesota. Substantial amounts of softwoods were imported from Canada, as well, much of which was rafted across Lake Superior to the Ashland railroad. Industrial researchers attacked the problem by developing means of utilizing various native hardwoods, previously thought unsuitable for paper processing.

Beginning in the early 1900s, the concept of scientific reforestation was becoming known. Extensive research and field studies were carried out to devise methods of "repopulating" Wisconsin's devastated woodlands to provide for future raw material supplies. The Nekoosa-Edwards Company was one of the first companies to develop experimental tree farms and nurseries for reforesting large areas. The company's Woodlands Department, organized in 1925, was recognized as the first industrial program for scientific forestry management in the Great Lakes region. Between 1926 and 1966 the department planted over 33 million new trees (Nekoosa-Edwards C, Fact Book 1966:n.p.). By the 1930s and 1940s, many companies along with the federal government, were implementing reforestation programs that have continued to the present.

Central to the research and development aspects of timber conservation and product design were two institutions: the Forest Products Laboratory, established in 1910, in Madison and the Institute of Paper Chemistry established at Lawrence College in Appleton in 1929. Now operated by the U.S. Department of Agriculture, the F.P.L. is the oldest and largest wood research laboratory in the world. Both of the research and training facilities have proved to be invaluable to the state's papermaking industry and are now nationwide in their scientific scope. As a result of new industry demands, each papermaking company also established laboratory and research facilities (Wisconsin Trails 1962:22).

The development of the Forest Products Laboratory came about ostensively as a result of increasing economic pressures resulting from the decreased forest supplies at the turn of the century. In the first decade of the 1900s, the Forest Service, a branch of the U.S. Department of Agriculture proposed the establishment of a national centralized wood-testing laboratory. Seven major American universities competed for the facility, including the Universities of Michigan, Minnesota and Illinois, Purdue University, Cornell, and Yale. In 1909 the Forest Service decided in favor of the University of Wisconsin. The most decisive factors in Wisconsin's favor were Madison's location in close prximity to rail lines and easily accessible to America's timber regions, and the University's excellant reputation for scientific research. The University agreed to provide a suitable building and site, while the Forest Service was to supply the technical staff, test equipment, and materials, and make the lab and personnel available to university graduate students (NRHP Nomination - Old U.S. Forest Products Lab, 1985).

The Forest Products Laboratory was the first, and for several years, the only institution in the world concerned wholly with the investigation of wood, wood products, and their adaptation to diversified fields of use. Prior to the establishment of the lab, the United States government lacked adequate means for investigating the underlying problems in the use of forest products. The centralized character of the Forest Products Lab allowed for in-depth research into the problems of wood utilization as well as facilitating the exchange of information between Forest Service scientists and private industry. Eight division were brought together in the building. Previously located in different parts of the country, these divisions included wood preservatio, timber testing, wood chemistry, wood physics, engineering, pulp and paper, pathology and wood distillation.

In its over 75 years of service the Forest Products Lab has tackled the experiments in just about every conceivable application of wood and the myriad products that come from wood. Without the FPL plywood in its present form would not have been developed, nor would many kinds of paper, fiberboard, rayon, adhesives, and plastics. Without the efforts of the Lab much of the southern lands now vital to the paper industry would be eroded and profitless. In 1932, the Lab moved from its original location in the heart of the campus to a new and expanded facility located on the western edge of the University where it remains today; still a vital part of the school and the nation's wood-products industry (Wisconsin Trails: 1962 pp. 20-22, National Register Nomination-Old Forest Products Laboratory, 1985).

The Institute of Paper Chemistry in Appleton has striven to provide scientific training in the pulp and paper making processes at the graduate level for over 50 years. The Institute's research center has historically sponsored research in both theoretical and practical fields. Connected with the Institute is the Dard Hunted Paper Museum (Wisconsin Trails, 1962:22).

Prior to World War I, American paper mills were turning out incredible amounts of newsprint to supply the nation's growing demands. Over 50 percent of Wisconsin's total production was devoted to newsprint. Canadian paper mills, however, greatly expanded in the early twentieth century, and with the lifting of federal tariffs on Canadian paper

products in 1911, the stiff competition from across the border threatened to collapse much of the Wisconsin industry. Fighting for survival, Wisconsin papermakers quickly attempted to shift production to new and different paper products. Chemists, physicists, and engineers worked on the development of new products, processes, and machines. In a dramatic turnaround, Wisconsin mills went from heavy newsprint and course wrapping paper products to specialty production. Major product lines included lightweight paper, tissue papers, glazed, glassine, and serum-resisting papers, toilet tissue, absorbant wadding, napkins, crepe, insulating papers, blueprint and mimeograph stock, and high quality writing and printing papers. Today Wisconsin remains one of the nation's leaders in the production of these specialty papers. In the post-World War I period, scientifically controlled production finally replaced the nineteenth century craftsmen traditions (Clark 1956:10; Wisconsin Trails 1962:21).

Forced by legislation and the need to economize operations, the post-Depression papermaking industry was characterized by a concern for the efficient and functional reuse of industry by-products. Where once chemicals, contaminated water, and pulp by-products were simply disposed, usually into nearby riverways, modern economic and environmental realities made conservation practices an important part of plant operations. Production of new road sprays, feed products, artificial vanilla flavoring, pesticides, dye stuffs, and gypsum boards were all results of by-product research, leading to the evolution of substantial subsidiary industries in the state. The period after the Depression was also marked by the emergence of large, multi-national firms and conglomerates, including the Kimberly-Clark Corporation, the Marathon Division of American Can Company, Consolidated Papers, Inc., St. Regis, Mead, Proctor and Gamble, Thilmany Pulp and Paper Company, Scott Paper, and the Nekoosa-Edwards Paper Company.

ASSOCIATED INDUSTRIES

The manufacture of papermaking and pulp machinery quickly became a major industrial pursuit in the state during the post-Civil War era. As the paper industry prospered, many machine shops and heavy equipment plants grew up practically side by side with the paper mills. The pioneering concern of Merrill and Houston in Beloit (later the Beloit Iron Works) was one of the first major manufacturers of papermaking machinery in the state. Even after Beloit ceased to be a major papermaking center, the city's fine waterpower location and transportation network served the machinery manufacturers well and the Beloit plant emerged as a worldwide supplier of papermaking equipment. Some other companies prominent in the early years of the industry are describe below.

Other areas also became manufacturing centers. The City of Appleton became a major supplier of equipment from the 1870s. The 1857 blacksmith shop of Crosby Ketchum had been among the earliest suppliers of equipment and repair services to local paper mills. By 1887 the firm had grown to include a foundry, large machine shops and assembly areas. and an extensive engineering and design department. In that year the company changed its name to the Appleton Machine Company. The Valley Iron Works (1900), the Appleton Wire Works (1896), the Wisconsin Wire Company (1900) and the Appleton Woolen Mills (makers of papermakers' felts) were all located in Appleton, producing various industry-related items.

The small machine shop of David Hudson and Alexander Sharp in Green Bay had started as a manufacturer of sawmilling machinery in the 1870s. With the establishment of paper mills in the Green Bay area, the firm quickly began manufacturing papermaking equipment, among which was the first napkin folding machine ever built in the United States The papermaking industry in the Fox River Valley included other companies: the C. A. Lawton Company, DePere; the Paper Converting Machine Company, Green Bay; Alwin Manufacture Company, Green Bay; and H. G. Weber and Company in Kiel, among others. In Wausau, the 1883 sawmill-machinery firm of D. J. Murray became a major

paper-machinery manufacturer by the turn of the century. In Milwaukee the state's premier machinery manufacturer, the E. P. Allis Company later, Allis-Chalmers, also produced a line of heavy equipment, such as barkers, pumps, digesters, and dynamos, for use in the paper mills (Howard 1948:55-58).

The state's machinery manufacturers were not only producers and repairers of equipment. Many were also inventors and designers of such equipment. A number of firms supported extensive research and development departments, all of which added to their industrial prominence.

PROCESS

Although the papermaking industry has been subject to great advances in technology and product design, the basic papermaking process has remained the same since it was first introduced to Wisconsin in 1848. Simply stated, paper is made by placing millions of strands of cellulose fiber on a moving screen, usually of fine wire, suspended in water. As water is drained through the screen, the fibers intertwine to form a thin mat, which when squeezed, pressed, and dried by hand or machine becomes the finished paper. Most of the cellulose fiber is currently obtained from wood pulp, but the early industry relied on recycled rags and cotton cloth to provide the basic paper fibers. Rags were gathered from various sources and brought to storage houses at the paper plants where they were sorted and cut into small pieces, often by women and young boys. To ready the fibers for processing, the rags were run through a machine called a "devil" which beat them and removed much of the dirt. The rags were then boiled in a lime bleach solution for several hours after which they were once again fed into a machine that beat them, cut up the stock, and prepared the fibers for the forming machines where they were processed into paper.

As paper technology and production advanced, rag stock grew scarcer and substitute materials were sought. Straw and grasses were used at first, but by the mid-nineteenth century, wood pulp technology was increasingly in popularity. The wood pulp process reached Wisconsin in 1871-72. The processing of timbers into wood pulp for use as the basic ingredient in paper goods was done by two different methods. The first utilized in Wisconsin was the groundwood process, in which pulp logs were forced against rough grinding stones cooled by water. After grinding, the groundwood pulp was sent to beaters and mixers where alum and rosins for sizing, clay for surface finishes, and other additives were introduced with water. The pulp, often 99% water, was then ready for the paper machines. The mechanical or groundwood process was the cheaper method and yielded the highest return because, as the cellulose and other elements were ground together, little of the log was lost. The result, however, was usually a course grade of pulp fiber commonly utilized in newsprint, containers, and wrapping papers. The second method of pulp processing was a chemical procedure in which the wood's cellulose fibers were removed from the lignin binder by cooking the wood in chemical baths for extended periods.

For both wood pulp processes, the initial steps were the same. The eight-foot pulp logs were prepared for debarking and cleaning by soaking in holding ponds, often located outdoors and fed with heated water. The logs were then sent through large cylindrical debarkers to remove the outer bark. If the chemical process was used, the logs were sent to a chipper, where razor-like knives cut the wood into small chips. The chips were then sent to large digesters to be "cooked." Huge, upright pressure-cookers, the steel digesters were often up to 60 feet in height and 20 feet in diameter. Most companies had a long line of these digesters to maintain continual production and to produce various pulp types according to individual paper requirements. The "cooking" process in the digesters was performed by a combination of chemical agents and steam at very high temperatures. The various chemicals utilized included an acid sulphite (first introduced c. 1874), soda (salt), or an alkali sulphate, depending on the type of paper product desired. Most of the

finer papers were produced by the sulphite process. The chemicals were usually imported to Wisconsin from outside plants. After the thick, pulpy mass had cooked sufficiently, it was removed from the digesters. The lignin and chemicals were removed to be processed into various by-products or, earlier, dumped into local riverways. The cellulose pulp was then bleached and passed through several washings to assure clean fibers of uniform size. While the chemical process produced only one ton of pulp from two tons of wood, the end product produced a much finer and stronger paper. In the twentieth century, semi-chemical processes were developed that utilized the best features of both pulping methods.

The manufacture of pulp during the late nineteenth and twentieth centuries was carried out by both independent concerns, which sold their product to various papermakers, and by the papermaking companies. Although many paper manufacturers had pulping mills erected directly adjacent to their paper mills, others preferred separate facilities located closer to the source of wood supply and accessible to the mills by railroad. The chemical pulping process in particular was also extremely odorous. The raw pulp could be shipped to the mills either in a liquid state or thickened into thin sheets called laps that could be mixed to form the watery pulp at the mills.

The actual manufacture of paper is carried out by a machine called the Fourdrinier. Patented in 1799, the Fourdrinier has remained the basic papermaking machine in the industry to the present. Much altered, expanded, automated, and redesigned, the machine still functions in basically the same way. The liquid pulp (90-99 percent water) is poured onto a vibrating wire mesh belt at the "wet" end of the long narrow machine. Much of the water content is lost through the screen and the agitating belt mixes and intertwines the cellulose fibers. From the vibrating screen the mixture is automatically picked up and sent through various cylinders that steam and press out more water. Finally, a series of heavy smooth rollers, often called calenders, iron the paper and give it a smooth surface. At the "dry" end of the machine, which can be anywhere from 30 to 300 feet long, the paper is wound onto large rolls ready for shipping or cutting into desired sizes. A noisy and hot operation, the papermaking process called for extensive ventilation of the work area, along with sufficient drainage systems to carry away the excess/recyclable water. The Fourdrinier, although the central machine, was not the only one used for forming paper. Various cylinder machines and presses were also utilized, depending on the product. In addition, paper that was to go into boxes, cartons, tissue, glassine, tape, or any one of a vast array of other specialty products, may have gone through various subsequent processes or steps.

IDENTIFICATION

Resource Types

Paper Mills. Dams, reservoirs, waterpower/hydroelectric plants, storage warehouses (rags, wood, pulp, chemicals, paper), engine rooms and boiler houses, bleaching houses, mixing rooms/buildings, pressing rooms/buildings, fourdrinier houses, finishing rooms/buildings, shipping areas, office buildings, machine/blacksmith/repair shops, laboratories.

Pulping Plants. Receiving/storage yards, holding ponds, debarking equipment, wood grinding/chipping equipment, digesters and "cooking" houses, bleaching rooms/buildings, washhouses, lap houses, by-product refineries and storage areas.

Associated Resources. Labs, research and development facilities, tree farms and industrial forest reserves, office buildings, owners' residences, worker residences and communities, bag, box, and carton manufacturing plants, distribution houses, paper and pulp machine manufacturers.

The earliest sites were usually of wood frame construction. As the industry expanded, larger and more permanent sites were erected. By 1880, brick construction was relatively universal except for small outbuildings. Fire protection and the ability to sustain heavy, vibrating machine loads were important factors. After the turn of the century, concrete and steel construction was used increasingly.

Locational Patterns of Resource Types. The largest single factor determining the location of pulp and paper mills was the availability of abundant and stable fresh water supplies. All Wisconsin plants were directly sited along major riverways, providing both power for the mills and water for the production of paper. Also of importance, particularly to the early mills, was access to the reserves of northern Wisconsin timber, which could be brought to the plant by wagon or rail. All major sites were tied by rail to raw material and market areas.

Previous Surveys. No statewide survey has been conducted to identify the region's extant pulp and paper facilities. Individual surveys for the communities of Neenah, Beloit, Wausau, Eau Claire, Kaukauna, and the industrial survey of Outagamie and Brown Counties, (Abrahams 19--) provide information on identified resources (see bibliography).

Survey and Research Needs. Continued survey of the state's major papermaking centers is needed, but attention should also be addressed to the smaller, isolated plants across the northern portion of the state, in order to better assess their role in the industry. Attention should also be given to the multitude of subsidiary concerns associated with the industry.

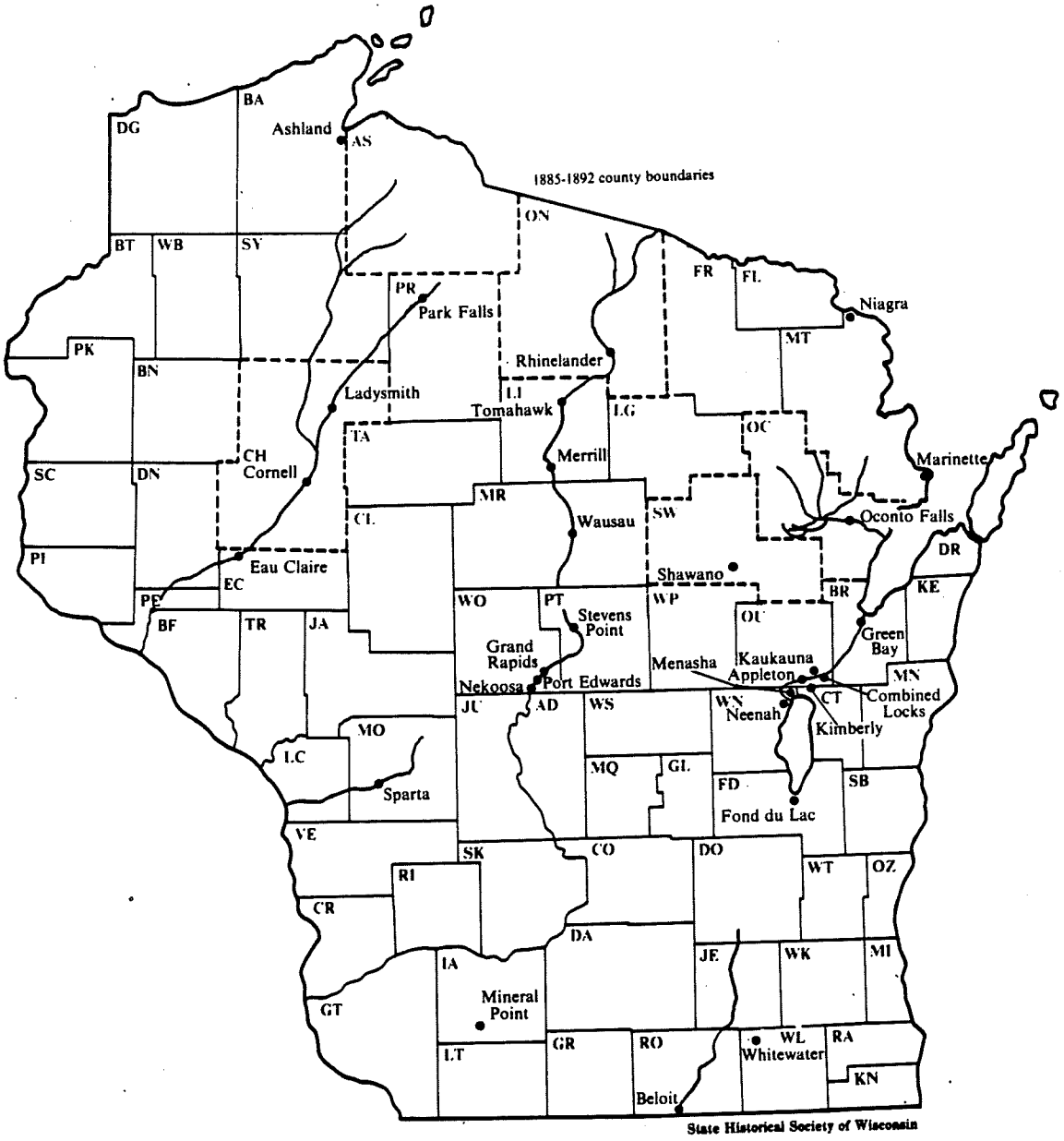
EVALUATION

National Register Listings and Determinations of Eligibility

Appleton Wire Works, 600 S. Atlantic St., Appleton, Outagamie County (DOE 1982)
Norman Brokaw House (c.1886), 714 Grignon St., Kaukauna, Outagamie County (NRHP 1984; MRA)
Havilah Babcock House (1883), 537 E. Wisconsin Ave., Neenah, Winnebago County (NRHP 1974)
Franklyn C. Shattuck House (1890-93; 1905), 547 E. Wisconsin Ave., Neenah, Winnebago County (NRHP 1978)

Wisconsin Avenue Historic District, Neenah, Winnebago County (Kimberly, Clark, Shattuck, Babcock Residences) (NRHP 1984)

Context Considerations. Resources associated with the pulp and paper industry must be evaluated in relation to the company's entire operation. Certain structures in a complex were subsidiary in function and must be considered in that context. These facilities may take on more significance, however, if more primary structures are no longer extant or are extensively altered. The physical integrity of the entire site is an important consideration in a process-oriented industry as papermaking. Information regarding the technological or economic impact of a particular company or plant may be of value in determining eligibility and significance on a local, state, or national level. Although major facilities are usually of local significance, the importance and prominence of the industry may warrant state or national significance.



Wisconsin Pulp and Paper Mills, 1880-1910

Source: Compiled from: Lockwood Trade Journal Co., *Lockwood's Directory of the Paper and Allied Trades* (New York, 1880, 1894-95, 1906, 1911).

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WOOD PRODUCTS

Temporal Boundaries: 1830-present (peak production era: 1870-1910).

Spatial Boundaries: The manufacture of finished wood products occurred in scattered locations throughout the state and generally followed the path of advancing settlement. The largest producers tended to center primarily in the eastern regions of the state, particularly along the Lake Michigan shore and in the Rock and Fox River Valley areas. Building material manufacturers (sash, door, and blinds) were often more scattered and more closely associated with the large northern lumber companies and/or expanding urban centers.

Related Study Units: Logging and lumber milling.

HISTORICAL BACKGROUND

The manufacture of finished wood products was conducted on a small scale almost as soon as the logging of timber began in Wisconsin. Skilled craftsmen who produced such items as sash, doors, blinds, furniture, cabinetwork, barrels, and a vast array of household articles were commonly associated with local sawmills that operated small custom shops to serve the demands of a local market. As the settlement of the upper midwest advanced, these specialized woodworking concerns increasingly were transformed into independent factory operations. Marketing opportunities began to expand significantly after the Civil War, and wood product manufacture rapidly became a major facet of Wisconsin's statewide economy. By the late nineteenth century, with the logging and lumber industry booming, Wisconsin had emerged as a leader among the producers of wood products in the United States. Wisconsin finished goods were shipped to east coast markets, to the southern United States, and to the expanding western frontier. Even though lumbering operations began to decline dramatically after 1910 due to the depletion of marketable pine timberland, producers of finished wood products were able to survive by using the discarded timber and inferior wood left behind or overlooked by avaricious lumber companies. Many Wisconsin woodworking concerns experienced continued industrial growth until the Depression era and war in the 1930s and 1940s. The following discussion examines the growth and development of various aspects of the wood products industry in Wisconsin.

FURNITURE PRODUCTION

Furniture manufacturing was one of the most extensive aspects of the wood and lumber products industry in Wisconsin during the nineteenth and early twentieth century. Throughout most of the late nineteenth century, Wisconsin was among the top 10 states in furniture production in the United States. Cities like Sheboygan, Milwaukee, and Oshkosh became reknowned for their particular products. In addition to supplying the needs of westward expansion by supplying furniture to the expanding frontier areas, Wisconsin producers found markets in eastern and southern communities across the United States. Due to its location in the heart of the upper midwest's forestland belt and on the Great Lakes transportation network, Wisconsin furniture manufacturing remained a prominent contribution to the regional economy well into the middle of the present century. In its heyday at the turn of the century, Wisconsin had over 250 furniture factories in operation and ranked among the top six states in annual production. Milwaukee, with its fine transportation networks, skilled labor pool, and central location, served as the major center of production and sales.

Most of Wisconsin's earliest settlers brought furniture with them or made their own crude furnishings for themselves. In larger communities such as Milwaukee and Racine, settlers were often able to purchase furnishings manufactured in established eastern factories and shipped west via the Great Lakes. Within a very few years, however, Wisconsin settlers were able to buy the products of local cabinetmakers, many of whom were frontier craftsmen who combined furniture making with other occupations. In the 1840 census, Sheboygan County supported nine such small cabinetmaking ventures. Racine County had seven, and Milwaukee had eight; Dane and Brown counties had two each, and Rock County had one. The total value of production in 1840, however, was only $6,900 (Sixth Census of the U.S., 1840:357).

More and more small factories began to emerge in the southern half of the state in the following decades, many concentrated in the areas near the Lake Michigan shore. The stimulus of new innovations in both machine technology and transportation continued to encourage increasing development in the industry. More importantly, however, Wisconsin had both the essential natural and man-made resources necessary for the effective manufacture of furniture. It had abundant wood, a plentiful supply of labor (a good deal of it German), water to float logs and to power machinery, and access to both nearby and distant markets. From the rough beginnings of the 1830s and 1840s, when skilled craftsmen produced a limited stock of custom items, the Wisconsin furniture industry had grown to 147 firms by 1860.

At this time, a sharp division between the small, local workshops and the increasing number of larger factory operations was beginning to emerge within the industry. This growing division between hand-crafted and machinery processes continued as furniture manufacturing realized its most productive era in Wisconsin over the next several decades. Steam engines began to replace water power and railroads were spreading throughout the state, bringing wood to the factories and carrying finished furniture to retail markets by the end of the Civil War. The adoption of methods of mass production during the second half of the nineteenth century led increasingly towards specialization within the industry. As a result, many of the workshops that originally engaged in general cabinet making were increasingly replaced by factories that manufactured a limited range of products such as upholstered parlor furniture, bedroom furnishings, chairs, commercial wares, cabinets, or coffins (Darling 1984:3-5, Woodhouse 1984:56).

Propelled by the post-Civil War boom, furniture production topped $1,585,000 by 1870. A total of 196 firms were in operation in the state, and employment in the plants had to 1,863 workers, including 151 women and children. The majority of the women and chilren were employed in the finishing and packing operation of the plants or as errand runners. Wisconsin's most productive centers of manufacture continued to be the Lake Michigan communities of Milwaukee, Sheboygan, and Manitowoc. Further inland, the Rock and Fox River valleys and the Lake Winnebago area also played important roles in the development of furniture manufacturing. Various furniture concerns emerged in Appleton, Oshkosh, and Fond du Lac as well as in the more southern cities of Watertown, Jefferson, Fort Atkinson, and Whitewater. All of these factories reached their maturity in the 1870s, 1880s, and 1890s (e.g., Appleton Chair and Bedstead Co. in Appleton, Northwestern Furniture Co. in Fort Atkinson, Wisconsin Manufacturing Co. in Jefferson, and Buckstaff-Edwards Co. in Oshkosh) (Wisconsin Business Directory 1870-1890).

Chairs became a speciality product in Wisconsin. The 1870 census noted four independent manufacturers whose only product was chairs. One Dodge County firm reportedly employed 201 men to produce $30,000 worth of chairs (Ninth Census of the U.S. 1870:742-745). Sheboygan became the center of Wisconsin chair manufacturing. With the first chair factory established in 1868, the city quickly acquired the moniker "chair city." Along with the pioneer concern of Captain Watson Crocker, many other chair companies, as well as a host of other diverse furniture producers, emerged in the

city during the late nineteenth century. Among the chair manufacturing firms were the Phoenix Chair Company, the Sheboygan Manufacturing Company, the American Manufacturing Company, the Sheboygan Chair Company, and the George Spratt Chair Company. In 1880, Sheboygan chair firms earned $354,240. In other areas such as Manitowoc (earning $266,000) and Jefferson (earning $198,000), chair manufacturers strove to match Sheboygan's production level (Tenth Census of the U.S. 1880:371-378, Wisconsin Business Directory 1879-1885).

Statewide furniture production continued to rise until the turn of the century, reaching levels of $2,176,900 in 1880, $3,616,517 in 1890, and $8,721,800 in 1900. During this period, the industry remained among the 15 leading industrial enterprises in the state, and Wisconsin consistently ranked among the top national producers. In addition to Wisconsin's own major lumber and manufacturing centers' efforts, the city of Chicago also played an important role in the growth of the Wisconsin furniture industry. A significant midwestern center for the production and sale of furniture in its own right, the city was a vast consumer of Wisconsin goods as well as a major distribution center for Wisconsin products throughout the late nineteenth and early twentieth centuries (Alexander 1929:31-39).

During the period from 1870 to 1910, factory sites took many different forms. Small shops and factories offering specialized custom work to limited clienteles still existed, but they were relinquishing most of their handicrafted operations for more mechanized processes by the late nineteenth century. Most large concerns of any scale operated from large scale factory sites. These extensive complexes were often located along a major waterway or lakefront area and possessed direct access to rail transportation. Within the manufacturing complex, sufficient area was necessary for receiving, storing, and seasoning lumber. Similarly, space was needed for the erection of planing mills, powerhouses, fabrication and assembly shops, finishing shops, offices, and shipping warehouses. Larger sites were often tied by a network of shortline rails or interbuilding tramways that facilitated inhouse movement, particulary as processing took on more and more of an assembly line approach. Many urban factories included fabrication, assembly, and sales areas in one or two adjacent structures. Often in these factories the lumber and individual components had been milled and turned in distant plants and then brought to the factory for final assembly and finishing (e.g. carving, painting, staining, upholstering). The lower floors of the typically four to five story building were devoted to sales and display areas. While many factory buildings were of wood construction, the majority of the larger, late nineteenth century plants, especially those in urban areas, were built of brick or stone. These rather substantial buildings were usually designed solely for utilitarian purposes and emphasized heavy timber construction.

The marketing of products from Wisconsin manufacturers was handled directly by the factories through troops of salesmen and company representatives or by retailers and jobbers who purchases goods from the plants. While most furniture was built from hard or soft woods, non-wood materials were also introduced at various times. A twisted paper fiber, an inexpensive substitute for the popular wicker fibers, was used by a number of Wisconsin concerns, particularly in the Milwaukee area. Metal components became a more common feature of early twentieth century design. The twentieth century and the electric age ushered in a host of other new products, including refrigerators, radio cabinets, and phonographic stands.

By 1910, 63.8 million feet of lumber were being used annually in Wisconsin's factories. A number of these factories were in the more western lumbering regions of the state--Eau Claire (Pioneer Furniture Company, Phoenix Furniture Company), Chippewa Falls (Chippewa Falls Furniture Company), La Crosse (Tillman Furniture) and Superior (Webster Chair Company). In the last era of prosperous furniture manufacturing's last era of prosperity, from 1905 to 1915, approximately 114 mills were in production, and the total value of the state's furniture output reached over $18,656,000. A combination of

factors eventually brought the industry into a state of decline beginning in the early nineteenth century and accelerating during the 1920s and 1930s. Economic depression, the exhaustion of native hardwoods, high labor costs, and unionization all played vital roles in the decline. As a result, furniture manufacturing began to move to the southern states. Due to the Great Depression, the Second World War, and growing southern competition, Wisconsin had lost most of its older furniture making concerns by the 1950s. The companies that survived, through modernization and adaptation, commonly concentrated efforts on a limited line of products such as office, children's, hospital, or contract furnishings. Many former funiture manufacturers, which had turned to wartime production during the 1940s, continued heavy and light manufacturing after the war.

SASH, DOOR, AND BLIND MANUFACTURE AND FINISHED BUILDING PRODUCTS

Wisconsin's sash, door, and blind mills produced a valuable trade commodity during the latter half of the nineteenth century. By 1850, the state already had 13 firms in operation. Employing a total of 67 workers, these concerns produced $47,130 worth of goods during the preceding year (Seventh Census of the U.S. 1850:101). Exhibiting continued growth in the next decade, production rose to $250,000 by 1860, and 232 workers were employed to produce sashes, blinds, and finished lumber across the state in 55 separate mills. Production, however, was still mostly for local consumption, with one or two firms often serving a relatively large regional area. Typically employing two to three workers, the annual value of production in these firms seldom reached over $3,000 for any one firm. Racine, Rock, and Milwaukee Counties were exceptions. There, local market demands supported more extensive and numerous concerns. In Milwaukee alone, 11 firms were producing a total of $101,550 worth of finished building components annually by the beginning of the Civil War (Eighth Census of the U.S. 1860:640-655).

Leading Producers of Sashes, Doors, and Blinds--1860

County	No. of firms	No. of Employees	Value of Product
Dodge	1	7	$ 4,900
Fond du Lac	3	11	8,900
Kenosha	2	6	5,000
Milwaukee	11	79	101,550
Outagamie	2	7	5,800
Pierce	1	7	5,000
Racine	4	21	24,685
Rock	6	31	45,950
Winnebago	4	12	9,236

SOURCE:

Eighth Census of the U.S. 1860:640-655.

Wisconsin's lumber industry experienced a tremendous boom in the post-war years (1865-1890), which spread to all associated enterprises including the manufacture of finished lumber and building components. The rapid development of many new communities at this time, in Wisconsin and elsewhere, stimulated demands for the products of sash, blind, door, and molding factories. In many of these new communities, after a sizable sawmill was established and adequate lumber supplies became available, a local sash and planing mill operation was developed. In areas where economic and geographical factors were superior, the mills often grew into large regional and export operations. But the introduction and spread of railroads proved to be the key factor to future development and expansion of the industry.

As with most industries, the important factors governing success of the building products industry were the availability of both adequate supplies of raw material at an economical price and an efficient means of transporting the finished goods to market. The introduction of railroads to Wisconsin's northern timber regions after the 1860s allowed for the first time the economical manufacture of finished lumber goods on a large scale in many different areas of the state. Although most of the rough timber cut in the state had been rafted to milling sites outside the region for final finishing, the railroads enabled once isolated mills in timber regions to manufacture and ship finished goods without risking damage from water transport. Moreover, the southern mills could now rely on a ready source of rough lumber independent of the seasonal waterway system.

By 1870, 81 companies were manufacturing building products in Wisconsin. Employment jumped to 1,381, a six-fold increase from 1860. The seven-fold rise in production value to $1,852,380 was even more dramatic. Fond du Lac at the southern end of Lake Winnegbago was the king of the industry by a large margin. According to the 1870 census, Fond du Lac County supported nine separate sash, door, and blind firms and employed over 446 workers. No other county in the state employed so many in the industry. Production from the centrally situated country, located strategically between prime timber land and the major southeast Wisconsin markets, reached over $700,000 in 1870 (Ninth Census of the U.S. 1870:742-745). The most extensive production occurred in the growing lake front city of Fond du Lac. In 1868, the Fond du Lac factory of C.J.L. Meyer ranked as the largest in the world and was producing 25,000,000 lights of window sash, 80,000 doors, and 62,000 pairs of blinds annually (Merk 1916:147). Racine and Milwaukee, with access to northern timber by both rail and water and with sizable marketing networks, were also notable centers of sash, door, blind, and millwork manufacture in the mid-to-late 19th century.

By 1880, the total value of production in the state had risen to $2,975,687, and Winnebago County had replaced Fond du Lac County as the undisputed leader in the industry. Led by Oshkosh, the "sawdust city," Winnebago County's rapidly growing planing mills and sash and door factories had gone from a production level of just over $48,000 in 1870 to over $835,000 by 1880. Located at the mouth of the Wolf River lumbering district and linked to three different rail lines by 1882, the growing industrial community of Oshkosh and its environs supported between eight and a dozen different finishing mills during most of the 1880s. Oshkosh also contained mills that manufactured such items as furniture, cabinetwork, matches, caskets, and trucks. Among the largest of the city's late nineteenth century sash and door concerns were those of the Morgan and Radford Brothers and the Paine Lumber Company. The Paine Company was the largest such concern in the world by the early 1900s; it employed nearly of 2,000 workers at its peak (Howard 1981:30-35). Behind Winnebago County, Milwaukee and Fond du Lac Counties were the most substantial producers of finished building products.
The total number of firms operating in Wisconsin through the rest of the nineteenth century remained relatively constant, with 83 concerns in operation in 1880, 88 firms in 1890, and 97 in 1900. The growth in the value of production from Wisconsin mills continued well into the early decades of the twentieth century, reaching upwards of $8,000,000 by 1900. Nationwide, the state ranked third in the value of production of sash, door, and blind mills in 1900 (Twelfth Census of the U.S. 1900:431-440).

By the beginning of World War I, however, the state's entire lumber industry had begun to stagnate. The movement of large scale lumbering operations farther and farther west meant that raw materials were no longer easily attainable by Wisconsin mills. Except for a few concerns, the extensive era of sash, door, and blind milling was about to close in the state. By 1920, the building products industry was not even listed among the state's top 20 industries.

Except for small, local concerns that were sometimes simply located adjacent to saw milling plants, sash, door, and blind operations usually required rather large facilities.

Large receiving areas were needed to handle incoming supplies of raw lumber; open or semi-protected seasoning yards were used to treat and season the wood properly prior to its use. While the actual production processes might be contained within a single building, they were more commonly housed in separate structures. These structures were usually one to three stories in height and of simple, utilitarian brick or wood construction. Individual buildings at a plant might include planing mills, sash fabrication shops, door and blind production areas, glazier shops, finishing areas, power plants, and shipping/packing rooms. While the raw lumber might arrive by water or rail, it was vitally important that adequate rail facilities were available to transport finished goods to market. Almost all firms required extensive railroad siding areas for loading and unloading products. In addition, many plants included main office buildings and sales offices. In the more isolated lumbering regions of northern Wisconsin, the ownership and operation of finishing mills (planing mills, sash and door mills, etc.) was often assumed by the large logging and saw milling concerns that dominated the region rather, than by independent firms. In some cases, entire operations from log to finished sash occurred within one complex.

COOPERAGE

While the making of wooden barrels and containers, was never considered a major industry, it was nevertheless extremely important to a number of Wisconsin communities. Many nineteenth century industrial concerns depended on barrel, bucket, box, and tub makers to provide the storage and shipping containers in which Wisconsin goods traveled east and west, north and south, by ship and rail, to market. For hundreds of years, meatpackers, flour millers, brewers, fishpackers, and others had depended on the cooper's product. Both the rural settler and urban businessman also depended on the local cooper's work. For many rural coopers, the making and repairing of wooden containers was a part-time occupation to acquire extra income during slow winters. But as the demands of communities grew due to expansion and the introduction of small industries, many woodworkers' sideline businesses turned into full-time occupations.

By 1860, Wisconsin had 125 cooperage firms and employed a total of 487 workers to produce approximately $370,700 worth of goods. The largest concentrations by far were in the shipping ports of Milwaukee (47 firms, 161 workers, and $149,000 worth of goods) and Outagamie County (one firm, 50 workers, and $50,000 worth of goods) (Eighth Census of the U.S. 1860:640-655). The most extensive operation in Outagamie County was the Dunn and Brewster barrel factory in Appleton. Built in 1858 at a cost of $40,000, the plant consisted of eight to 10 buildings scattered over several acres along the Fox River. During its first year of operation, the firm produced $30,000 worth of goods. By 1864, production had risen to over $75,000, making it one of the state's largest woodworking operations (Goodspeed 1911:166).

The availability of various hard and soft woods in the state enabled the coopering trade to flourish during the last decades of the 19th century. Cooperage shops took various forms, from the one to three person rural shops that used hand tools to manufacture custom goods for local, to large operations that used water and steam powered machinery to mass produce products for commercial and industrial use. Many industrial concerns, particularly breweries and meat packing houses, actually maintained their own private coopering departments. With its diverse range of commerce and industry, Milwaukee was Wisconsin's largest center of coopering operations through the 1890s. By 1880, 40 separate firms employed over 528 skilled and unskilled workers in the city, and production had risen to over $680,000. Statewide, production had topped the $1.5 million mark with 198 firms, making cooperage the fifteenth largest grossing industry in terms of value in the state. During the 1880s, other areas of strong production in Wisconsin were the dynamic lower Fox River Valley areas of Winnebago, Outagamie, and Brown counties and the Lake Michigan county of Sheboygan (Tenth Census of the U.S. 1880:371-378).

By the late 1890s, however, the market for cooperage items was being rapidly eroded by the demand for various other products, as well as by changes in bulk transportation methods. For instance, sacks and bags were becoming increasingly popular for flour, while meat was packed in tins or shipped fresh in new refrigerated rail cars. Breweries began using metal kegs, and lime and cement were beginning to be shipped in bulk. Similarly, easily assembled paper boxes and cartons rapidly proved their economical value. Gradually, the expensive and often labor intensive manufacture of barrels became less and less a vital part of the state's industrial picture. By 1920, only seven establishments employing 130 workers were in operation in Milwaukee, and by mid-century, they too disappeared (Merritt 1980:26-27).

MISCELLANEOUS WOOD PRODUCTS

Along with cooperages, a number of other allied woodworking interests were centered in the lower Fox Valley and along the shore of Lake Michigan. Menasha, Two Rivers, and Peshtigo were the principle centers of woodenware manufacture, producing various articles for domestic and commercial use such as boxes, measures, bowls, dishes, barrel covers, broom racks, cheese cases, hubs, spokes, pails, churns, and cutlery. Menasha, in particular supported the "largest tub, pail, and churn factory west of the Ohio" in 1870 (Merk 1916:146-147). The community also boasted one of the most extensive hub and spoke factories in the upper Midwest. Sheboygan, better known for its manufacture of chairs, became a major center for woodenware operations in 1884 with the movement of the Swift, Dillingham, and Slade Company from Glenbeulah, Wisconsin to Sheboygan. In Two Rivers, the Two Rivers Manufacturing Company and the Mann Brothers firm operated substantial woodenware concerns throughout the latter part of the nineteenth century. Appleton also claimed substantial operations for the manufacture of specialized wooden products.

In addition, small, local concerns, scattered throughout the state, produced goods for more regional clientele. Producing such items as tobacco boxes, cigar crates, cases for bottled beer, and cheese containers, Wisconsin manufacturers made the most of the region's rich native timber resources. The manufacture of wooden caskets and coffins was another area of specialized production that was somewhat successful in Wisconsin. These items were made by such longstanding and regionally recognized firms as the Berlin Coffin Manufacturing Company (eventually known as the Milwaukee Casket Company 1880-present), the Buckstaff-Edwards Company of Oshkosh, and the Tobias Nehrbass Casket Company of Hartford. Wisconsin's major manufacturers of wooden toys included the Garton Toy Company of Sheboygan, the Instructive Toy Company of Milwaukee, and the Appleton Toy and Furniture Company (also known as Union Toy and Furniture), Appleton (Wisconsin Business Directories, 1879-1910). Little information is available at this time on the true extent of these subsidiary wood product industries.

IDENTIFICATION

Resource Types. Furniture factories, planing mills, assembly shops, finishing shops, upholstery shops, packing and shipping shops, power houses, factory sales offices and showrooms, administrative offices, storehouses, railroad loading and receiving docks, cabinet shops, chair factories, machine shops, rattan, fiber, and wicker workshops. Sash, door, and blind factories, lumberyards, kilns, planing and milling shops, fabrication shops, glazier shops, paint shops. Cooperages, metal shops, stave shops, steam buildings, blacksmith/tool repair shops, woodenware factories, hub and spoke factories, tub and pail factories.

Locational Patterns of Resource Types. The location of resources associated with the various wood product industries relied on two major factors: access to raw lumber and access to market. Thus, sites adjacent to major logging waterways by which timber could be floated directly to the factories were of prime value (including Lake Michigan ports). Water frontage also offered an efficient means of transporting finished products to market, particularly on the Great Lakes. A majority of the goods, however, relied on the railroads for transportation to market, and thus the most prosperous concerns required direct rail access. The urban areas of the eastern part of the state also provided ready markets in themselves.

Previous Surveys. No comprehensive survey work concerning Wisconsin's wood products industries (other than lumber) has been carried out yet. The intensive surveys of Eau Claire and Superior, and the industrial surveys of Outagamie County and Milwaukee's Menomonee Valley have identified a few scattered structures and sites.

Survey and Research Needs. There appears to be little information and research on Wisconsin's wood products industries. While the lumber industry itself is well researched, the secondary processes of furniture, woodenware, sash, door, blind, and barrel manufacturing are sadly underemphasized. Further research is needed to determine the full range of extant resources in the state, and all future intensive surveys should pay particular attention to these secondary operations in addition to any major lumber concerns.

EVALUATION

National Register Listings and Determinations of Eligibility

Kaiser Lumber Co. Office (c.1905), 1004 Menomonie St., Eau Claire, Eau Claire County (NRHP 1983; MRA).
Booth Cooperage, 1 E. Washington Ave., Bayfield, Bayfield County (NRHP 1976).

Context Considerations. Except for some of the larger operations that supported broad market areas of regional importance, most resources should be evaluated for significance on the local level, based on the importance of the property or firm to the local economy. The likelihood of finding machinery or original equipment associated with wood product industries is unlikely due to the outmoded nature of most of these industrial pursuits. Any buildings or complexes retaining intact machinery should be given special consideration, however. In general, structures associated with wood product industries should be evaluated in relation to the total complex, if intact. Many moderate-scaled plants consisted of only two or three buildings, while the larger plants of the late nineteenth and twentieth centuries often contained numerous primary and secondary buildings and yard areas.

Loft, Genivera Edmunds
1916 The Evolution of the Woodworking Industries in Wisconsin. Unpublished Master's thesis, University of Wisconsin, Madison.

Lusignan, Paul
1983 Superior Intensive Survey Report. City of Superior Community Development Office, Superior, WI.

Madigan, M.J.
1982 Nineteenth Century Furniture: Innovations, Revival, and Reform. Arts and Antiques, New York.
Mostly styles.

McKenna, Maurice, ed.
1912 Fond du Lac County, Wisconsin: Past and Present. S.J. Clarke Publishing Company, Chicago.

Merritt, Ray and Carol Snook
1980 Milwaukee's Menomonee Valley. University of Wisconsin-Milwaukee, Milwaukee.

Merk, Frederick
1916 Economic History of Wisconsin during the Civil War Decade. State Historical Society of Wisconsin, Madison.

Nesbit, Robert
1973 Wisconsin. A history. University of Wisconsin Press, Madison.

Oliver, J.L.
1966 The Development and Structure of the Furniture Industry. n.p.

Taylor, Mary
1983 Intensive Historic/Architectural Survey of the City of Eau Claire, Wisconsin. City of Eau Claire, WI.

Walsh, Margaret
1972 The Manufacturing Frontier: Pioneer Industry in Ante Bellum Wisconsin 1830-1860. State Historical Society of Wisconsin, Madison.

Western Historical Company
1880 The History of Fond du Lac County, Wisconsin. Chicago.

Woodhouse, Anne
1984 "Manufactured Furniture from Wisconsin." Wisconsin Academy Review 30:56-58.
Concise overview of Wisconsin's industry--one of few resources.

Zillier, Carl
1912 History of Sheboygan County, Wisconsin. S.J. Clarke Publishing Company, Chicago.

ADDITIONAL INFORMATION

Company Histories. Various company histories may be available from the Historical Society of Wisconsin's archives or directly from operating firms.

Trade Journals. Various trade journals were published concerning the furniture and woodworking trades which might prove valuable to further research. Titles include:

Furniture Journal 1888-1931; Rockford, IL.
Furniture Manufacturer 1880-1910; Grand Rapids, MI.
Furniture Merchants' Trade Journal 1916-1922; Des Moines, IA.
Furniture Record 1892-1940; Grand Rapids, MI.
American Furniture Manufacturer 1911-1925; Chicago, IL.
Woodworking Industries 1908-1932; Milwaukee.
Furniture Workers' Journal 1883-1940; New York.

MILLING

Temporal Boundaries: 1840 - present (peak production era: 1860 - 1910).

Spatial Boundaries: All of Wisconsin, beginning with the earliest settled area. Major concentrations were developed along the Fox and Rock River corridors and in the market centers of Milwaukee, Superior, and La Crosse.

Related Study Units: Wheat Cultivation, Early Rail Lines.

HISTORICAL BACKGROUND

In the historic narrative of the development of the rich agricultural prairie lands of the Midwest, the flour milling industry holds a place of considerable prominence. Local grist mills, large urban merchant-mills, and extensive grain terminal facilities were to be found scattered across the Midwestern frontier of nineteenth century America, supplying the growing economy with sustenance for its rapid growth and early development.

The milling industry was one of the first industries to gain importance in the territorial period of Wisconsin history. In the pioneer communities of Prairie du Chien and Green Bay, some of the first flour mills were built in the "Old Northwest" (c. 1810). After Wisconsin achieved territorial status, then statehood, the wheat economy of the region continued to grow, spurred on by the great influx of farmers and settlers. During the more than a quarter century that Wisconsin was an important wheat producing state, from about 1845 to about 1875, flour milling ranked as the leader of the state's industrial economy, producing more in terms of dollar value than any other industrial enterprise. The products of the state's flour mills and grist mills in 1860 represented 40 percent of the total dollar amount of the state's manufactures. In 1870 flour accounted for 25 percent of this total and in 1880, about 20 percent (Alexander 1929:38). Every village located on a stream with sufficient power to turn a waterwheel had its local grist mill to supply the flour needs of its area. Due to a combination of environmental and economic factors, Milwaukee and the lower Fox River Valley, in particular, were able to become enormous centers of milling and grain handling.

During the years immediately following the Civil War, Milwaukee ranked among the leading flour producing cities of the world, even surpassing Chicago as the world's greatest primary shipping point for wheat. Second to Milwaukee in flour milling in the state were the communities of Neenah and Menasha, located on the substantial power source provided by the Fox River. By 1870 the number of mills in the two communities had risen to 15, with a daily capacity of 3,875 barrels (Nord 1978:113). Other cities, such as Appleton, De Pere, Racine, Janesville, and La Crosse, favored with unlimited water power and excellent marketing facilities also achieved a certain degree of recognition as economic centers of the grain and flour trade. The advent of new milling processes and the westward movement of wheat cultivation brought about the decline of Wisconsin's milling industry by the turn of the century. Superior, Milwaukee, and La Crosse remained prominent milling and shipping centers longer than most, but by 1910 the once leading industry of the state had fallen well down in the rankings in terms of the annual value of production. The number of mills in operation in 1910 had declined to under 100 from a high of 705 in 1880. This study unit will review the development of the milling industry in the state in all of its varied forms.

EARLY HISTORY

The first Wisconsin flour mills were erected long before the large influx of settlers to the

region. In 1809 Jacob Franks built a sawmill on the Devil River east of De Pere, which was quickly adapted to include flour milling. Across the state, along the Mississippi River, Francois Chenevert erected a flour mill in the small outpost community of Prairie du Chien at about the same time. The crude horse-powered mill was replaced in 1818 by the water-powered mill built by pioneer businessman and trader John Shaw at Fisher's Coolee Creek, four miles north of Prairie du Chien (Apps 1980:36). Although these mills served a demonstrated need in the primitive days of early exploration in the upper Midwest, few other mills were established before large scale farm settlement began in the 1830s and 1840s.

As farmers entered the region in increasing numbers during the period from 1830 to 1850, they turned almost exclusively to soft, winter wheat as a staple crop. The ideal pioneer crop, it was easy to grow, produced high yields on the fertile Wisconsin soil, and with the growing demands of an expanding nation, the farmers were relatively assured of future markets for their surplus production. As a result of the region's early emphasis on wheat farming, flour mills in Wisconsin were of immediate and vital importance. In the days of poor transportation and scattered development, each village needed a flour mill, and by the 1840s and 1850s, small wind or water-powered mills were scattered across the settled portions of the state. While only 29 grist mills were located in the state in 1840, by 1850 the number had reached 117 and 392 workers were employed to produce over $3,536,000 worth of flour and milled grain in Wisconsin. By 1860 the number of mills exceeded 370 (Sixth Census of the United States, 1840: Compendium of the Enumeration of the Inhabitants and Statges of the United States, 356; Seventh Census of the United States, 1850: Abstract of the Statistics of Manufactures, 51; Eighth Census of the United States, 1860: Manufactures of the United States, 657.)

The location of a mill was often the key to the development of a commercial village center, the mill acting as an early hub for trade and business, as well as a meeting place for the exchange of news. Many of Wisconsin's early communities developed around the pioneer local mill. The majority of the early mills were relatively crude or simple in design. Mostly of wood construction, they often utilized heavy timber framing to support the excessive weight of the grind stones that were the heart of the milling process. In later years stone and masonry became popular modes of mill construction.

MILL TECHNOLOGY

Most mills were relatively small and normally housed only one or two pairs of millstones. A "run of stone" consisted of a stationary bedstone and a revolving upper, or runner stone, each two to seven feet in diameter, eight or more inches thick, and weighing from 1,500 to 6,000 pounds. The stones were made either from a single, massive block of stone or from several smaller pieces cemented together and bound with an iron hoop. The most highly prized millstones, such as the French buhrstone, were imported from Europe. Others were taken from abandoned eastern millsites, the average life of a good set being over 100 years. Many smaller Wisconsin concerns simply utilized local stones such as quartz and granite. The quality of the flour produced was largely determined by how well the miller dressed (cut grooves into) and balanced the stones, and the speed with which they were driven. The most common practice was to "low grind" the grain by setting the stones close together and running them fast enough to mill the grain in a single grinding. Any impurities or unground material could be sifted out in a simple bolting machine located elsewhere in the mill.

Most Wisconsin mills utilized water wheels to transmit power from flowing water to the millstones. Until the mid-nineteenth century, both horizontal and vertical waterwheels were common in rural mills. The horizontal tub wheel consisted of a series of wooden blades around a central horizontal hub. Often, the whole assembly was placed in a simple wooden tub. Dependent upon a swift running stream of water, the wheel was placed either directly into a streambed or beneath a flow of water directed to it by a flume or

artificial channel. A shaft rose from the center of the wheel to a pair of millstones directly above where the runner stone was mounted onto the shaft end, resulting in a simple, direct drive motive power.

The more popular and efficient waterwheels were those that were vertically mounted. The available quantities of water and head (the distance that the water dropped to the point of impact against the wheel) were the determining factors that dictated which of the three variations of the vertical waterwheel the millwright chose to construct at a particular site: undershot, overshot, or breastwheel. The most efficient type of wheel was the overshot, which turned by the weight of the water that fell into its buckets from a flume at the top of the wheel. With the breastwheel, water was directed into the buckets near the middle of the wheel. The least efficient of the vertical water wheels was the undershot, which was turned entirely by the impact of the water against vanes near the bottom of the wheel. With all of the vertical waterwheels a system of wooden or metal gears was necessary in order to transfer power to the horizontal millstones. The shaft and gearing systems of the vertical wheels (usually housed in the basement of the mills) allowed power to be transmitted to more than just one set of millstones and to any number of other milling devices installed in the mill.

The wooden waterwheel had been the chief source of mill power for over 2,000 years, but in the span of a single generation it was all but discarded in favor of a new power producing mechanism, the turbine. Waterwheels had the disadvantages of being large and cumbersome; they were built of wood which eventually wore out; they were often inoperable in winter; and even the most efficient wheel could only transfer about 60 percent of the water's power to the mill machinery. The turbine, on the other hand, proved to be a much more efficient form of power, with 80 to 90 percent of the total water power brought to the turbine passed on to the mill machinery. Turbines, which were being introduced on a large scale by the mid-nineteenth century, also had a longer lifetime than the waterwheel; they could be mass produced and shipped to mills across the country; and they were much smaller and easier to maintain. By the late nineteenth century, turbines had become the standard of the industry and waterwheels were rapidly becoming a scarce commodity. Among the scattered machine shops and foundries that produced iron turbines was the firm of James Leffel and Company of Springfield, Ohio. Leffel turbines became a common feature of Wisconsin mills as the firm emerged as one of the largest suppliers of turbine machinery in the Midwest in the latter half of the nineteenth century (Apps 1980:26-28).

On the whole, the flour milling industry was hesitant to adopt steam power technology. The proximity to and familiarity with waterpower led most millers and millwrights to convert to water turbines at a time when other industries were adopting steam as a power source. Turbines were cheaper than steam engines and were able to furnish most nineteenth century flour mills with sufficient operating power. As late as 1880, the number of water-powered engines (turbines and waterwheels) in use in Wisconsin's flout and grist mills outnumbered steam engines by a total of 1,372 to 146 (Tenth Census of the United States, 1880: Report on the Manufactures of the United States, 505). With waterpower playing such an important role in mill operations, it is clear that the placement of mills along or over waterways, often in tandem with upstream dams, mill ponds, and sluiceways, was the overriding feature of early mill design. As mills enlarged and began to centralize operations on a large scale in the later nineteenth and early twentieth centuries, the steam engine, which did not have to rely on the unknown vagaries of water supply, became much more widely utilized, especially in urban settings.

In studying the development of the flour milling industry it is important to note the contributions of Oliver Evans, a young Delaware millwright and engineer. In an attempt to relieve the milling industry of much of its hand labor, Evans developed complete systems of improvements that brought totally automatic operations to the mills. Among Evans' most important contributions were devices and systems that transported material

from one place to another. Small buckets attached to endless leather belts that carried continuous, light loads of grain or meal from floor to floor; chutes and movable spouts that enabled material to travel down through the grinding and sifting processes by gravity, and spiral conveyors (worm gears) that moved material horizontally were all designed by Evans and found their way into most Wisconsin mills of any productive scale. Those sites patterned after Evans' automatic mill produced a larger extraction of flour than other mills, with less labor and more efficiency. His 1795 book, The Young Mill-Wright and Millers Guide, served as a manual to many a new mill site construction and operation.

The wind-driven flour mill was a rare site in Wisconsin and was usually found only in areas where no suitable water supply was available, an anomaly in water rich Wisconsin. Only two were in operation in the state in 1876; one was the 1867 mill of Jan Grootemaat in Milwaukee (Rogers 1911:36). Others were built later in Kenosha County (Truesdell, 1871), Taylor County (Plano, 1903), and across the northern portion of the state. The only known extant wind-driven mill is the 1905 Davidson Mill, located in rural Douglas County, east of Superior (NRHP 1979).

By the 1930s, electricity eclipsed all other power sources utilized by the flour milling industry. Although electric power became the motive source in both rural and urban mills, many older structures still retained their former power supplies as back-up sources.

PEAK PRODUCTION

By the 1860s, when Wisconsin was established as a major wheat producing center in the Midwest, the milling industry was changing from its early pioneer character. Improving transportation networks allowed some mills to seek markets beyond their local areas, and large merchant mills were beginning to emerge. Although most early grist mills ground grain for local farmers, taking a percentage or toll of flour as payment, merchant mills paid the farmer for his grain. The miller ground and sold it through newly organized trade channels. The expansion of the roadway system and railroads in the state cut the costs of raw grain transhipment dramatically, and as a result, milling was beginning to become increasingly centralized. Large scale merchant mills in advantageously positioned cities, such as Milwaukee or Neenah, were soon handling great quantities of flour, while in more rural areas small mills continued to custom grind flour and meal for neighboring farmers.

By 1870, Wisconsin had 581 mills in operation with a product of over $20.4 million, a rise in the total value of annual production from $11.5 million in 1860. By 1880 the industry reached its peak, with 705 mills in production across the state. Employment in the mills was recorded at 2,418 workers and total production was valued at $27,640,000. In the period from 1860 to 1880, Wisconsin ranked as the seventh or eighth leading flour and meal producing state in the country, and milling remained the number one economic enterprise in the state in terms of value of product (Nord 1978:112).

As early as 1860, flour milling in Wisconsin had begun to gravitate to several strategic locations, especially Milwaukee and Neenah-Menasha. Of all Wisconsin cities, perhaps Milwaukee had the best resources for flour milling by the middle of the century. Continually expanding railroads connected the city to the vast wheat growing regions of the interior; its lake port connected it to eastern and foreign markets. Business capital and labor were readily available, and its river system provided substantial waterpower locations. In 1860 Milwaukee millers produced about 300,000 barrels of flour for commercial use, and Milwaukee County far outdistanced any other county in the state, both in the amount of production and in the value of investment. The majority of the output was derived from large firms with capital of more than $10,000--a large sum for the 1860s (Nord 1978:112).

After a series of disasterous floods in the mid-1860s, nearly all of Milwaukee's mills

abandoned their Milwaukee River waterpower systems and turned to steam power. At the same time, many rebuilt their mills with the most modern equipment. In substanial mills, such as Empire, Eagle, and Cream City, it was not uncommon to see firms operating as many as 35 separate runs of stone. Flour production quickly soared to new heights, and with the continued expansion of wheat growing and railroad building in the 1860s and 1870s, Milwaukee became the leading flour milling center of the Midwest. In 1870 Milwaukee County, at $3,914,035, was one of only two counties producing more than $1,000,000 worth of flour in Wisconsin. Winnebago County was the second, with a production value of $1,567,655. Further down the scale, the next highest areas were Jefferson and Rock counties, situated along the powerful Rock River (Flower 1881:1170-1175; Ninth Census of the United States, 1870: The Statistics of the Wealth and Industry of the United States, 742-745).

The communities of Neenah and Menasha were the centers of Winnebago County's large flour milling industry, and together they formed the second most productive region of the milling trade in the state from 1860 to 1880. Seven mills, producing nearly $250,000 worth of flour a year, were in operation in Neenah by 1860, and three more were located in Menasha. The total capacity of the mills was about 800 barrels a day. Spurred by the newly arriving railroads and the demands of the post-Civil War period, the milling industry expanded by 1870 to include 11 large mills at Neenah (more than half of all mills in the county) and four in neighboring Menasha, with a total capacity of 3,875 barrels a day. Taking advantage of the Fox River's waterpower, which provided two of the best sites in the state, and good transportation to markets, the two cities were producing about $1.1 million worth of flour annually by the early 1870s.

Among the largest of the area's sizable mills was the 1868 Reliance Mill of the Kimberly brothers in Neenah. One of the last to be built in the area, it is probably the only remaining flour mill structure in the Neenah-Menasha area. Through most of the 1870s and 1880s, Neenah and Menasha continued to produce flour at sizable levels. However, by 1890, like much of Wisconsin, the Fox River Valley fell victim to the westward migration of the wheat growing culture, and new industries moved in to take the place of former water powered milling sites (Nord 1978:113; Smith 1966:64-71).

Other smaller milling centers produced flour in various parts of the state. At Janesville, Watertown, Appleton, La Crosse, and St. Croix County, for example, a fairly large amount of flour was produced throughout the latter half of the century (See map). Inexpensive transportation and the economics of large scale production, however, increasingly worked against the local miller and in favor of the giant firms, especially in Milwaukee. The small mills that continued to produce flour usually turned to specialty products such as rye and buckwheat flour. A revolution in flour processing in the late nineteenth century dramatically altered the milling industry to an even larger extent. In general, by the late 1880s and surely by the 1890s, the era of small scale flour milling in Wisconsin was over.

WHEAT VARIETIES

One of the major contributing factors to the development of technological improvements in the industry was a shift in the type of wheat commonly grown in the United States. Until the 1870s, nearly all of the wheat grown in the United States was an easily ground soft winter variety. During the mid-nineteenth century, new varieties of wheat that grew successfully in the northwestern regions of Minnesota, Nebraska, and the Dakotas were introduced. This new, hard spring wheat was difficult to break using traditional milling techniques. Because the spring wheat defied traditional methods, millers began to experiment with new grinding techniques. They quickly found that moving millstones slowly reduced the heat and pressure that produced a course textured flour from the grain, and that stones set further apart cracked and rolled open the grain instead of pulverizing it into an unsuitable mixture of flour, bran, and germ. This "high grinding"

process created large amounts of what was known as "middlings," which, when sent through a series of successively closer grindings, in what was known a gradual reduction process, produced a higher yield of white flour free from bran or other impurities. An invention called the "middlings" purifier (c.1870) greatly aided the sifting and purification of large quantities of middlings. Placed in combination with the high grinding process, the middlings purifier produced a flour of extreme purity and fine baking quality. The "new process" flour was soon in great demand and gave a tremendous boost to Midwestern grain cultivation (Athan 1979:11-13).

ROLLER MILL TECHNOLOGY

As millers began to install the middlings purifiers and to follow new process methods, an even more significant milling process was being perfected. Millstones were no longer adequate for the needs of the new flour milling industry, because they required frequent dressing and huge amounts of space and power to operate. In addition, despite all of the new innovations, it was still difficult to produce a flour of consistent color and quality using grindstones. For several years, millers and engineers had experimented with rollers made of wood, marble, porcelain, and other materials to mill grain. It was not until the 1870s that steel rollers were developed to replace the burdensome millstones in the grinding mills.

The pioneer work of John Stevens of Neenah, Wisconsin with "roller mill" technology was especially important. Stevens' 1879 development and patent of a set of corrugated steel rollers greatly improved the product of the mills and became a standard of the industry. Like the turbines discussed earlier, the roller mills were smaller and easier to maintain than the cumbersome millstones. They could be mass produced and shipped across the country. They were easily repairable, and most importantly, they were enormously more efficient at their work than the ancient stone grinding process (Apps 1980:67).

In 1878 W.D. Gray, perhaps one of the most prominent milling engineers of the late nineteenth century, while working for the E.P. Allis Co. of Milwaukee, assembled the first commercially successful all-roller mill in the United States for Cadwallader and William Washburn in the city of Minneapolis.

The mill's great success spelled disaster for flour mills operating with mill stones, and foreshadowed the continued rise to prominence of Minneapolis as the new center of flour milling in the region. During the 1880s, the entire milling industry began to shift to the roller system, and the "patent" flour that this system produced became the product of choice across the country (Athan 1979:15-16).

DECLINE OF THE WHEAT INDUSTRY

Many of Wisconsin's older, smaller establishments did not have the financial resources to purchase and install the new machinery. In addition, the advent of new processing and roller milling technology in the 1880s made the spring wheat of the northern plains much more valuable than the winter wheat common to Wisconsin. As a consequence, in the 1880s and 1890s much of the wheat growing economy shifted to the west, toward the vast plain states and the Red River Valley area. Poor wheat crops due to soil exhaustion, pests, and wasteful cultivation practices also helped topple Wisconsin's flour and milling industrial base. By 1890 the number of flour mills in operation in the state had dropped to 497 from 705 (in 1880), and production value had staggered to $24,252,000 (from $27,640,000). Even Milwaukee eventually lost its prominence in flour milling as wheat culture continued to move west, and Minneapolis suddenly became the new center of milling in the United States (Eleventh Census of the United States, 1890: Report on Manufacturing Industries in the United States, 194).

The industry continued to steadily decline in Wisconsin through the turn of the century.

By 1905, only 389 mills were still in operation, a decline of 50 percent in just 25 years. In areas where transportation systems still provided significant links to major markets, modernized mills could still overcome the competition of western mills. In other areas, like Neenah and Menasha, new industries took control of local power sources, often adapting and revising the older mill sites. For the small town miller, the alternative to abandonment was a switch to processing animal feed for the expanding dairy and livestock industries.

Among the last major centers of flour production in the state were the advantageously located shipping communities of Superior, Milwaukee, and La Crosse. La Crosse had featured Wisconsin's largest flour mill, the Listman Mill, from 1889 to 1935. In production until 1921, the mill had an annual operating capacity of 1,320,000 pounds.(Steen 1963:427-428). Milwaukee fought hard to retain its national second place position in the industry at the beginning of the twentieth century. The opening of extensive foreign markets for Midwestern flour and wheat greatly aided the port city's fight, and, as they had earlier, the city's fine railroad and shipping facilities helped maintain the prominence of the port as a flour center until the 1920s. In Superior, the first large scale roller mills were erected in 1885, and the area quickly thrived thanks to its location near the agricultural regions of the West and its access to Great Lakes shipping. In an eighteen month period between 1891 and 1892, six new mills, each of imposing scale, were erected in the city. By 1896, 4,112,855 barrels of flour were leaving the port annually.

Nevertheless, a number of problems after 1900 soon ended Superior's short existance as a premiere flour milling port. The failure of trusts set up to control the operations of the mills and disasterous fires quickly brought a halt to large scale milling in the city, although the Superior/Duluth region remained a major transshipment point for grains. The much altered 1892 Daisy Roller Mill constructed by Milwaukee's E.P. Allis Co. and W.D. Gray is the only remaining mill in operation in the city (Kuhlmann 1929:155-164, Lusignan 1983:60-63, 94-95).

The number of flour mills in the state continued to decrease throughout the early twentieth century. By 1894 the Federal Trade Commission acknowledged that only 96 were in production, and only 3,030,893 barrels of flour were being processed. Wisconsin was ranked around fifteenth nationwide by this time (United States Federal Trade Commission 1920:16). In 1958 only 12 mills remained (Steen 1963:427). Some mills were converted to other purposes, some were dismantled and the machinery used elsewhere, and many were simply abandoned and left to deteriorate. Although production of flour in the state is now handled by only three facilities--in Milwaukee, Superior, and Cochrane (Buffalo County)--former mill sites still dot the Wisconsin countryside in various states of ownership, use, and repair. For instance, the feed mill, sometimes a former flour mill, is now mostly a mixing station where various grains can be mixed with natural molasses and chemical additives, and still serves an occassional dairy or livestock community in various regions.

GRAIN STORAGE ELEVATORS

The growth of the wheat trade and the milling industry in Wisconsin during the nineteenth century gave rise to a particularly unique industrial-commercial structure: the grain storage warehouse and elevator. Although not much is known about their early design and construction, various county and regional histories note the establishment of grain warehouses in early marketing centers like Racine, Kenosha, and Milwaukee as early as the 1840s. The earliest of these grain storage buildings were most likely simple, one-story, wood frame warehouses, often called flathouses, where barrelled and sacked grain could be stored on a temporary basis to await shipment to a distant market for processing into flour. The majority of early flour mills in the state, however, were in production only on a custom basis. Serving local needs only, they did not require large

storage facilities. Small internal storage bins sufficed for their limited trade. But as the milling industry expanded and developed, the state's larger milling centers began to demand more and more wheat in order to satisfy the needs of their markets. These centers were backed by technological innovations, extensive waterpower resources, and capital. Grain storage design and engineering quickly became constant companions to grain processing.

To supply the demands of a growing industry, railroads penetrated farther and farther west into new wheat regions, eventually reaching the rich Red River Valley areas of northwestern Minnesota and the Dakotas. Storage became a serious consideration. At the farm end of the network, it was necessary to combine the production of individual growers, wagon-load by wagon-load, into railcar sized lots. On the receiving and processing end, millers needed to maintain vast supplies ready to feed the voracious appetites of mills which could not afford to be shut down for lack of raw material.

Small, country elevators served the farming communities. Most of these eventually became financially bound into elevator lines, a series of elevators strung along a rail route and controlled by a single line company. In the cities, mill elevators were erected alongside the flour mills to hold the incoming supplies and to replace the increasingly inadequate internal storage facilities that remained common to the small, rural mills.

In later years, many of the railroad lines actually established their own terminal elevators in order to handle the vast amounts of traded wheat and grain. Separate from the mills, these huge elevators were designed to store massive amounts of the farm product prior to its eventual sale, either for local distribution to the mills or to be shipped elsewhere by rail or water.

Inextricably bound together with the growth of railroads, the elevator systems exhibited tremendous growth after the 1860s as vast, growing, networks began funnelling agricultural products into the ever expanding milling areas of the state, particularly into the Milwaukee and Winnebago counties regions. Oliver Evans, an eighteenth century millwright, is credited with designing the elevating devices, endless belts for lifting grain by means of attached buckets or cups, which became the heart of the elevator design (see above). Little more than a grain container or box, the first elevator designs were almost certainly of relatively conventional woodframe construction with wide, low holding bins to control binwall pressure. Not particularly strong, these bins were soon replaced by a new engineering design, the wood cribbed elevator.

The origin of the wood cribbed elevator is obscure, although it seems to have emerged during the 1860s and 1870s and remained typical of elevator construction up to the end of the nineteenth century. In the wood cribbed design, two foot by eight foot or two foot by ten foot sized planks were laid flat, stacked in log cabin fashion, and spiked together with 20d spikes to form strong, pressure resistant bins of solid timberwork. To protect the structures, the exteriors were commonly sheathed in corrugated metal, thus producing what became known as the "iron clad wood elevator." The storage capacity of these wooden structures varied from as little as 100,000 bushels to as much as 1,750,000 bushels. Even smaller country-elevator versions were in existence at railside points in more rural areas. It is these that are most commonly visible today in rural Wisconsin. An example of this form of local, wood-cribbed elevator is visible in the community of North Prairie, east of Eagle in Waukesha County.

Among the largest and oldest extant iron clad wooden elevators known in Wisconsin are the 1887 Globe Elevators of Superior (although a state-wide survey has not been undertaken). Constructed by the J.T. Moulton and Son contracting firm of Chicago for the Sawyer Elevator System Corporation, the three-elevator, waterfront complex, with a total capacity of 4,300,000 bushels, remains the oldest intact transshipment facility in the massive Superior-Duluth harbor (Lusignan 1983:60-63).

Metal clad wood, however, did not solve the fire hazard problem that was a major concern of the industry. Increasingly, towards the end of the nineteenth century, experiments with new materials and new engineering technologies attempted to create the ultimate fire-proof elevator. The first steel bin elevator was reported to have been erected in 1861 at South Brooklyn, New York, but steel production proved prohibitively expensive until the end of the century. At that time nationally significant elevators were erected in the major milling and transhipment centers of Minneapolis and Superior. The entirely steel elevators, represented by the 1900 Great Northern (RR) elevator "S" in Superior, were enormous creations dwarfing the earlier wooden elevators. Anchored to brick or stone foundations, the superstructures rose with a skeletal steel frame of iron or steel that was clad in metal plates surrounding the interior machinery, conveyors, elevators, and storage bins. The elevators, although they might hold as much as 3,250,000 bushels, were extremely costly and, as a result, only a few were ever built in the United States. The elevator "S" in Superior was reported to be the largest in the world when completed in 1900. Smaller, free standing steel bins can still be seen as a part of many modern facilities.

Hollow tile block and brick elevator construction followed similar chronologies, with experimental designs in the late 1870s and 1880s becoming commonplace by the turn of the century. Much less expensive than all-steel construction, tile and brick elevators were much more common and are found in a broad range of sizes and scales.

While steel, tile, and brick designs were receiving national notoriety in the turn of the century milling, construction, and engineering journals, an elevator design that was to doom them all was being tested and experimented. Beginning around 1899 in Minneapolis and developing rapidly in the 1920s and 1930s, reinforced concrete elevator construction became increasingly popular. Economical, quickly erectable, fireproof, strong, and long-lasting, the concrete elevator rapidly became the standard of the industry and remains to this day the mainstay of elevator design.

A vast array of concrete elevator complexes, dating from the 1920s to the 1960s, are in use in Wisconsin today, including the 1928 Great Northern elevators in Superior, the 1965 Continental Grain elevator in Superior, the Ladish Malt Co. elevators in rural Jefferson County, and several others in Milwaukee.

A significant series of changes in grain elevator design also involved the internal technology of the structures. As noted already, the continuous belt elevator bucket system was pioneered by Oliver Evans and first adapted to elevator storage in Buffalo. In the earliest elevators, grain was raised by the elevating bucket conveyor or leg and simply spouted into nearby bins. This basic technique was generally the only technique in use until the 1873 advent of the Chase Plan, which located the bins in two parallel rows extending out from the receiving hopper and elevating conveyor. At the top of this elevating leg, grain was picked up by a horizontal screw conveyor or a wide endless belt and moved out over the tops of the bins to the specific silo into which it was to be deposited. The majority of the work along with any cleaning, weighing, and sorting was carried out in the central "headhouses" or in galleries constructed on top of the storage bins. Grain was removed in very much the same procedure, this time in reverse with a belt beneath the tanks. With the present decline of large scale flour milling in the state, the small rural elevators and those associated with the brewing industry (malt and hops storage) may be among the more common forms still extant and in use.

(The information available on grain elevator technology is relatively limited. The majority of the information contained above was adapted from an article by Robert M. Frame III and the Superior Intensive Survey. Much more in depth research in necessary to fully understand the context of elevator technology in Wisconsin).

ASSOCIATED INDUSTRIES

Like most large scale industries, flour milling gave great impetus to the development of a number of subsidiary or associated manufacturing industries. Among the more prominent enterprises found in Wisconsin were the production of wooden barrels and textile bags for the packaging of flour. The coopering, or barrel making, industry is discussed in the "Wood Products" study unit. The 1890 census noted the use of over 6,050,144 sacks by the flour industry (Eleventh Census of the United States, 1890: Report on Manufacturing Industries in the United States, 704.) One of the largest producers of textile bags and sacks in the state was the Bemis Bag Co. which maintained plants in both Superior and Minneapolis at the turn of the century. The Milwaukee Bag Co. was also a major concern. By the beginning of the twentieth century, the use of paper sacks was also becoming increasingly popular.

Also of significance was the development of firms involved in the manufacture of milling machinery, from millstones and bolting machines to complicated roller mill technology. The E.P. Allis firm of Milwaukee, manufacturers of all forms of machinery, was the acknowledged leader in the industry and by the end of the 19th century had developed a worldwide reputation for its equipment. With fine engineers like W.D. Gray on staff, the Allis Co. was instrumental not only in the manufacture of machinery, but also in its design and innovation, often developing plans for entire milling complexes. Many other smaller local foundries and machine shops were also of equal assistance to regional concerns.

IDENTIFICATION

Resource Types. Grist mills, flour mills, feed mills, merchant-commercial flour mills, storage elevators, warehouses, cooperages, power houses, water power systems, dams (extant or sites) and mill ponds, canals, offices, grain exchanges, millowner and worker residences, shipping facilities (rail and water).

Locational Patterns of Resource Types. The overriding factor determining the location of early flour mills was proximity to water and a water-power source. Almost all major streams or creeks in the agricultural areas of the state at one time or another had a small mill located somewhere upon it. In later years, as steam power and commercial mills became more practical, access to rail facilities or shipping ports became more important factors.

Previous Surveys. Extant milling sites were detailed in the Intensive Survey reports for the communities of Superior, New Richmond, Neenah, Green County, Brown County, the Outagamie County Industrial Survey, and Milwaukee's Menomonee Valley. In addition, a publication by J. Apps and A. Strang, Mills of Wisconsin (Madison 1980), documents a number of smaller extant mills throughout the state. Miriam Rowe conducted a survey of mills in Sheboygan County in 1983-84 for the thematic nomination "Nineteenth Century Grist and Flour Mills of Sheboygan County."

Survey and Research Needs. A thematic survey and research effort should be undertaken to identify and clearly deliniate the importance of local grist mills and larger merchant mills in the state. Little information is now available on the development of grain storage facilities (elevators, warehouses) in the state.

EVALUATION

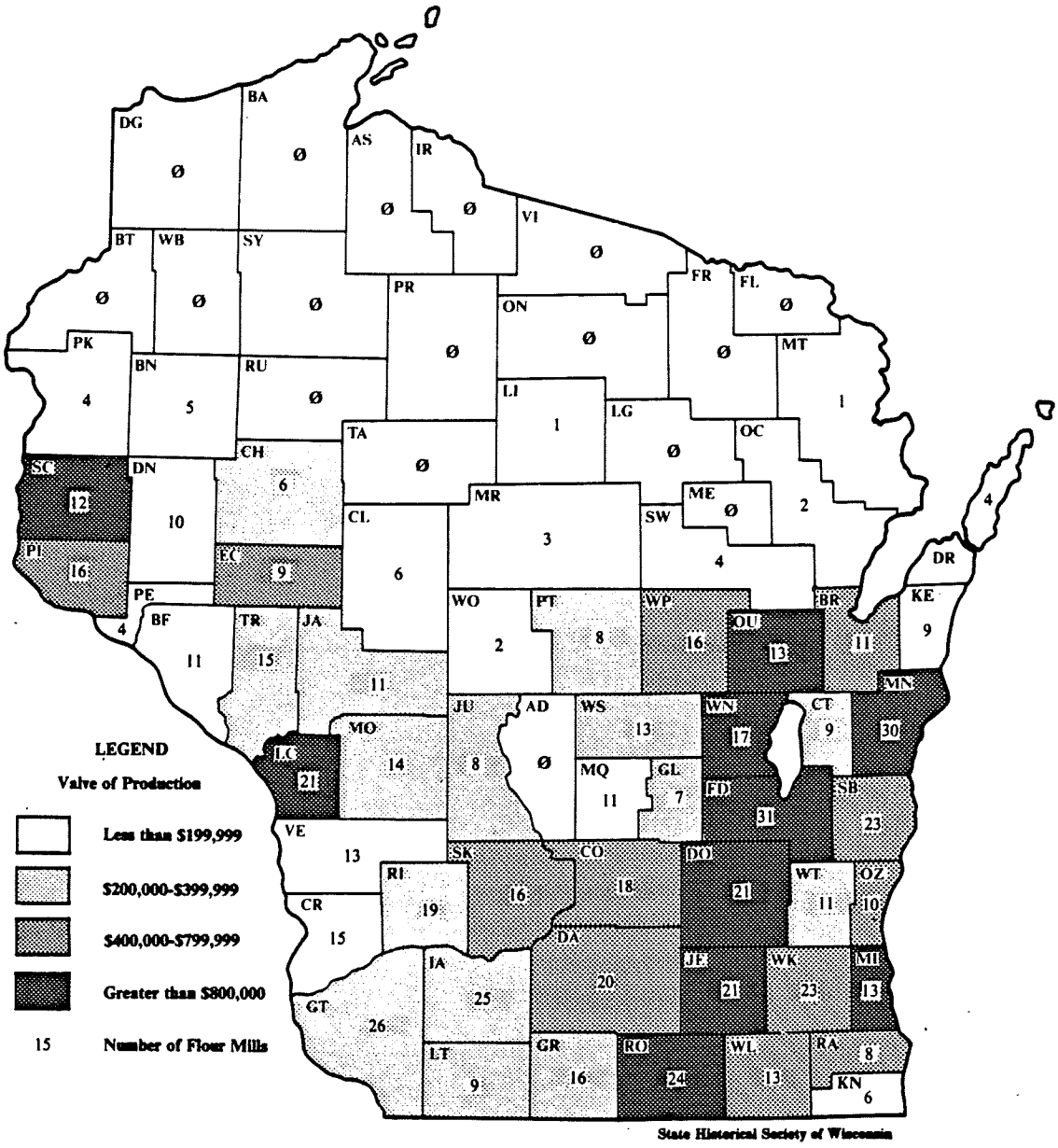
National Register Listings and Determinations of Eligibility

Paoli Mills (1849 and later), Town of Montrose, Dane County (NRHP 1979)
Davidson Windmill (1905), Town of Lakeside, Douglas County (NRHP 1979)
Dells Mill (1867), Town of Bridge Creek, Eau Claire County (NRHP 1974)
Rock Mill (1847), Town of Cooperstown, Manitowoc County (NRHP 1982)
Allis Charles House (1909), 1630 E. Royall Pl., Milwaukee, Milwaukee County (NRHP 1984)
Cedarburg Mill (1855), 215 E. Columbia Ave., Cedarburg, Ozaukee County (NRHP 1974)
Concordia Mill (1853), 252 Green Bay Rd., Town of Cedarburg, Ozaukee County (NRHP 1974)
Grafton Flour Mill (1847; 1884), 1300 14th Ave., Grafton, Ozaukee County (NRHP 1983)
How-Beckman Mill (1858-68), Town of Newark, Rock County (NRHP 1977)
Cooksville Mill and Mill Pond Site (c.1842-1905), Town of Porter, Rock County (NRHP 1980; Cooksville MRA)
Glenbeulah Mill (1857), Town of Greenbush, Sheboygan County (NRHP 1984; 19th Century Grist and Flouring Mills, Sheboygan County)
Franklin Feed Mill (1856), Franklin Rd., Franklin, Sheboygan County (NRHP 1985; 19th Century Grist and Flouring Mills, Sheboygan County)
Gooseville Mill (1879), Town of Sherman, Sheboygan County (NRHP 1984; 19th Century Grist and Flouring Mills, Sheboygan County)
Onion River Flouring Mill (1859), STH 57 and Onion River, Waldo, Sheboygan County (NRHP 1984; 19th Century Grist and Flouring Mills, Sheboygan County)
Gadow's Mill (1843), 1784 Barton Ave., West Bend, Washington County (NRHP 1974)

Crescent Roller Mills (1884), 213 Oborn St., Waupaca, Waupaca County (NRHP 1978)

Context Considerations. Generally, mills or milling sites, due to their vast numbers, are only of local significance and should be evaluated in those terms. The overall integrity of the site should be of major concern and, in particular, each site should be scrutinized to reveal if any original machinery is still extant, whether in the form of original grindstones or later roller mill technology. In many cases, the larger mill site should also be evaluated to reveal if links to possible water power systems are still extant. This includes mill ponds, dams, flumes, spillways, or power canals. Superficial evidence of associated historical archeology sites should be investigated. Many firms that later switched to steam or electric power never removed their original water wheel or turbine systems.

In certain areas, such as Superior, Milwaukee, or La Crosse, where flour milling became a central industry, extant mills may be evaluated on a larger regional or statewide basis. Evaluation would, however, require much more detailed production and market information.



Wisconsin Flour Mills and Value of Production, 1880

Source: *Tenth Census of the United States, 1880: Vol. II, American Industry and Manufactures*, pp. 371-378.

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Temporal Boundaries: 1840-present, peak years of brewery establishment, 1860-1900.

Spatial Boundaries: Statewide with concentrations in Milwaukee and most major communities.

Related Study Units: Ice Harvesting, Later Rail Lines, Early Specialty Crop Cultivation.

HISTORICAL BACKGROUND

The brewing industry in America can be traced back to 1630 when the first brewery was established in New Amsterdam (New York City). Nearly 200 years later, the Midwest's first brewery was built in Indiana. Wisconsin's brewing industry began to develop in the 1840s, with its center in Milwaukee. As the country continued its westward expansion, the brewing industry followed closely upon the heels of German and German-American settlement (Arnold 1933:113).

Among the factors that facilitated the establishment of pioneer brewing concerns in Wisconsin were the availability of fine barley and hops, an abundant water supply, the dependable availability of natural ice, and the ever increasing immigration of a German speaking population to the area. The large German population constituted both an enormous market for the beer and a skilled labor force to man the breweries.

Oddly enough, the first brewery concern established in Wisconsin in 1840 was organized in Milwaukee by three young businesmen, none of whom were of German descent. Richard Owens, William Pallet and John Davis, all Welshmen, established the Milwaukee Brewery (later known as Lake Brewery) on Huron Street in the city and produced both a typical English ale and distilled whiskey at the site. The small brewery remained in business until the early 1880s. Wisconsin's first German brewery was established in Milwaukee in 1841 by Herman Reutelshofer. Reutelshofer's firm, like many in the city, was eventually subsumed by a larger concern, namely the Best Brewing Company (Arnold 1933:113).

The year 1844 marked the beginning of the German brewing concern of Jacob Best. A German brewmaster, Best had come to America with his family and eventually settled in the Milwaukee area where he opened the Empire Brewery on the city's south side. Destined to become one of the largest concerns in the region, with its own malting house, bottling plants, and distribution networks, the Best Brewery remained a family operation under Jacob's son Phillip until 1866, when Phillip's son-in-law, Frederick Pabst, took control of the business. Under Pabst, the brewery grew to national prominence (Kroll 1976:57).

Among the other brewing concerns that were established in the area during the late 1840s and early 1850s were: the Plank Road Brewery of Charles and Lorenz Best (1848), later to become part of the Miller Brewing Company; the brewery of August Krug (1849), later to become the base of operations for the expanding Joseph Schlitz Brewing Company; and the 1851 concern of German-trained brewmaster Valentin Blatz. The output of these early firms was usually limited to only 250-400 barrels per year, all of which was destined for local markets (Walsh 1972:186).

Throughout the 1850s and 1860s, small local breweries sprang up in widely scattered

localities across the settled areas of the state. In particular, those communities, such as Milwaukee, where substantial German populations had settled, quickly developed small concerns. Often established along with pioneer sawmills and gristmills in a community, the small brewing concerns continued to dot Wisconsin countryside through the 1880s. The breweries were often sited along natural riverways which provided needed water, ice, and distribution systems. Housed in simple two and three-story structures of wood-frame or brick construction, the early breweries displayed highly utilitarian building forms, including narrow, gabled roof structures and simple sheds, spacious enough to protect the small six to eight barrel brewing kettles which were set over open flames. Underground cellars or hillside caverns were also common features of early brewery sites. Utilized as cold storage areas for the fermentation process as well as for the storage of the finished product, the "cellars" remained features of brewery design well into the 1890s, when mechanical refrigeration supplanted their usefulness.

For the most part, these early concerns served only local markets within the immediate vicinity of the brewery. Typical examples of such early concerns were the 1852 Potosi Brewery in Grant County (NRHP 1980) and the 1845 brewery of Mattias and Jacob Leinenkugel in Sauk City (Sauk County). In 1855, Jacob Leinenkugel opened a second brewery in Chippewa Falls, which is still in operation (Kroll 1976:11-142). By 1860, Wisconsin had approximately 127 breweries in operation across the state, employing approximately 380 workers. This can be compared to census data from 1850, which lists only 27 firms in operation (Seventh Census of the United States, 1850: Statistics of Manufactures, 19; Eighth Census of the United States, 1860: Manufactures of the United States, 657). (For a partial list of firms in operation outside of Milwaukee prior to 1856, see special note at the end of this study unit).

Milwaukee, however, remained the center of the brewing industry. This was principally due to the large ethnic population of working class Germans in the city, who provided the industry with a ready market for its product and a skilled and knowledgeable labor force. Another factor which helped propel Milwaukee to prominence in the brewing industry was the nature of its local brewers, who sought out and quickly adopted the latest technological and scientific advances in order to keep their firms at the forefront. By 1850, 10 separate breweries had located in the city of Milwaukee, and the community was producing approximately 18,820 barrels of beer a year. The early 1850s witnessed continual increases in production from the breweries, reaching levels of 33,900 barrels/year in 1853 and 47,000 barrels in 1854. By 1855 the number of breweries in the city had risen to more than 20, and production levels topped 50,000 barrels for the first time. Over 250 men were employed by the various firms in the city, which indicates the growth in size of the area's firms when compared to the 1 to 5 man operations of the earlier years and compared to employment in the remainder of the state. In Milwaukee, brewing was becoming a highly profitable business (Walsh 1972:185-187; Nesbit 1973:333; Merritt and Snook 1980:37-40).

Despite economic setbacks brought on by the financial panic of 1857, the brewing industry continued to grow throughout the 1860s. The era from 1860 to 1890 in particular witnessed the most dynamic growth of the industry within the state, in both urban centers and smaller communities. By 1889, brewing had emerged as Wisconsin's third largest industry (behind flour milling and lumber), and the premiere industry of Milwaukee.

Wisconsin Breweries

Year	Total # of Breweries	Total # of Employees (Avg.)	Product Value
1840	3	11	$ 14,000
1850	27	95	$ 153,000
1860	127	382	$ 744,000
1870	176	835	$ 1,790,000

1880	203	1,680	$ 6,312,000
1890	107	3,165	$14,200,000
1900	147	3,904	$19,000,000
1910	136	5,000	$32,000,000

SOURCES:

Sixth Census of the United States, 1840: Compendium of the Enumeration of the Inhabitants and States of the United States, 350.

Seventh Census of the United States, 1850: Statistics of Manufactures, 19.

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The exponential growth seen in the era between 1860 and 1890 can be attributed to a number of major economic, technological and market factors, all of which significantly affected the industry. Unlike the earlier dark, heavy ales produced by English concerns, the German lager beers introduced in the 1850s and 1860s were much lighter beverages and proved to be more palatable to a growing public--a public that was often introduced to the beverage in one of the many beer gardens or halls established by the breweries during the period as unique marketing tools. Germans and non-Germans alike began to demand larger supplies of the lager beer, particularly after the Wisconsin legislature levied a stiff tax upon distilled liquors (e.g., whiskey) in 1850. The measure was matched in 1862 by a second, federal tax imposed in response to demands placed on the federal treasury by the Civil War. Beer, growing in popular acceptance, became a less expensive alternative as an alcoholic beverage, and vast new consumer markets opened up.

The technological advances of the era, however, provided the industry with the results it truly desired--a wider geographical market. Experiments in Europe and America during the 1870s perfected the pasteurization process, and the Milwaukee brewing industry in particular was quick to exploit the technology of bottling and pasteurizing beer products. As a result, they were able to ship their products, which had once been consigned solely to local markets, not only to areas across the state, but also to markets as widespread as Chicago, St. Louis, New Orleans, and Europe. Milwaukee's favorable location on Lake Michigan and at the center of Wisconsin's expanding rail network provided ready access to all of these new markets. Other Wisconsin communities located along rail lines or with access to Mississippi or Great Lakes shipping also realized substantial increases in brewing production. The introduction of "pure yeasts" in the 1880s allowed the larger brewers to provide a consistantly superior product, thus adding immensely to their reputation. The "disasterous" Chicago fire of 1871, which destroyed most of that city's brewery concerns, provided Milwaukee and other Wisconsin breweries with the opportunity to expand their market areas.

As a result, Milwaukee brewers experienced a rise in production between 1860 and 1873 from 36,000 barrels a year to 260,120 barrels. The increase in production, which continued through the 1870s and into the 1880s, led to Milwaukee's ranking as the West's

leading beer export center and Wisconsin as one of the country's major beer producing states.

The enormous expansion in production and market areas in the 1870s and 1880s effected two major impacts on the rural brewing industry. Many of the smaller local concerns were forced to close due to increased competition from larger companies based in larger population centers. Secondly, the statewide distribution of the products of such Milwaukee firms as Pabst and the Miller Brewing Company required the establishment of elaborate distribution networks, with branch offices, warehouses, and depots scattered across the state. Usually no more than simple storage and distribution facilities alongside rail spurs, the brewery depots became common features to a wide range of Wisconsin communities, and remained so through the early twentieth century (Merk 1916:154). The company beer gardens and beer halls also expanded in number. Beginning in the latter part of the 1800s, breweries increasingly financed and supported chains of saloons and taverns in communities throughout the state and nation.

Increased production demands called for continually larger and heavier equipment and machinery. Huge vats, tanks, boilers, and elevators, as well as massive storage areas for raw materials and finished products, required an enormous amount of new construction. Sturdier, more substantial construction was called for, and iron, steel, and brick brewery construction assumed a new scale. In the larger urban areas, plants became almost tiny communities within themselves, a maze of interconnected facilities including brewing houses, malting and bottling plants, offices, storage elevators, "cellars," stables, repair shops, power houses and distribution areas.

Unlike most utilitarian and industrial sites created in response to the industrial boom of the late nineteenth century, large scale breweries were often quite conspicuous buildings. Complexes were commonly embellished with architectural details emulating European precedents. In smaller communities, the scale and ornateness of the brewery facility was usually much less grand. Yet, the sites are still easily identifiable, often because of the prominent three or four story brew house tower or adjacent storage elevators. Smooth, solid floors of concrete and tile became increasingly common by the end of the century, and fresh air and light requirements led to the erection of buildings with numerous tall windows. Brewing was a vertical, gravity fed process rather than a horizontal, linear one, and with increasing equipment size, buildings continued to grow in height. The brew house tower was often the highest point within the manufacturing complex. In large scale designs, the towers were often turretted or ornately detailed and almost always carried a flag and/or the company badge or emblem. Because of their scale and the increasing profitability of brewing, the architecture of brewing sites was no longer simply shelter for machinery, but often became an identifiable symbol for both the firm and the community.

By the turn of the century, consolidation of the brewing industry was in full swing. Increasingly pressured by mounting competition from the larger, more efficient concerns, many of the smaller independent breweries were forced to close or were bought outright by the larger firms. Many of the smaller sites were abandoned or taken over by other manufacturers. Although the number of concerns continued to drop, production levels continued to soar.

The production and distribution of beer from Wisconsin continued to rise through the first two decades of the twentieth century until the Prohibition amendment, adopted in 1919, brought an abrupt end to the state's fifth largest industry. Prohibition forced many firms into bankruptcy or a modification of their plants into much less profitable manufacturing conerns, e.g. candy, soft drinks, cheese, or cereal products. The manufacture of malt syrup, used by bakers and pharmaceutical firms, was also a mainstay of many former brewing firms. Utilizing much the same equipment as brewing, the production of malt syrup required only minor modifications and thus proved popular with many manufacturers. Other former brewing sites, however, completely altered their operations,

opting for the manufacture of such products as heavy machinery or machine parts, which were among the fastest growing industries of the era.

The Great Depression of the 1930s increased the number of troubled brewing concerns. Yet despite the economic hard times and the confining legislation of Prohibition, most of the larger Wisconsin brewers maintained their belief that sometime they would once again resume production. With the repeal of the 18th Amendment in 1933, the industry once again geared up for massive production (Nesbit 1973:462). Despite poor economic conditions, Milwaukee's firms quickly returned to their roles as market leaders, upgrading brewery facilities and reestablishing distribution networks that had remained idle through the 1920s. Pabst Brewing Company remained the number one producer of beer in the United States through the post-World War II era. During this period, automation and new technological innovations in canning, packaging, distribution, and sales revolutionized the industry.

BREWING PROCESS

Brewing employs a gravity fed process. Starting at the top of the brew house tower and working its way to ground level, the brewing process begins with malted barley being boiled in large tubs (120 to 130 degree Fahrenheit) of wood, copper, or stainless steel construction. Converting the dry malt from a starchy material into fermentable sugars and dextrin, these mash tubs (or tuns) required continual mechanical or hand mixing and stirring. Occassionally, portions of the malt mixture were drawn off and boiled separately and later readded to the mix. The end product of the process--the wort--was then strained to remove any remaining solid matter and brought to the brewing kettles where it was mixed with flavoring hops and boiled for a period of 20 minutes to one and a half hours. The brewing kettles, heated by open flames, coal fires, or steam, were the largest vessels in the brewhouse. In smaller concerns, the brewing kettles and the mash tubs were the same unit, limiting the production levels of the firm.

After boiling, the hops were strained off by a device known as the hop jack, and the wort was passed into cooling vats to prepare it for fermentation. The proper fermentation of lager beer was carried out at temperatures of 45 to 60 degrees Fahrenheit, thus requiring the use of "cold cellars" or caves, natural ice, or mechanical refrigeration. (Ale was processed at higher temperatures of 50 to 70 degrees Fahrenheit). Subsequently, various yeasts which induced the fermentation process over a period of six to 10 days were added to the cooled wort mixture.

After that period, the beer was drawn off from the bottom-settling yeasts and put into storage tanks or casks where it was kept at a temperature just above the freezing point to allow for a secondary fermentation process. The beer would remain in this stage from 10 days to several weeks before finally being transferred to the packaging plant for bottling or placement into kegs, barrels, or cans. The pasteurization process, widely accepted by the late 1880s, was also carried out at this stage, prior to shipment to various markets. The heating or pasteurizing of beer to a temperature just below boiling killed harmful bacteria and microorganisms, preventing further fermentation or spoilage and thus encouraging expansion of beer bottling for shipment. Pasteurization enhanced both the quality and stability of beer.

MALTING

An intrinsic part of the brewing process is the malting of barley grain. In malting, the initial step of grain preparation prior to brewing, the barley is soaked in hot water and allowed to germinate, then it is dried or kilned. The resultant malt is thus able to more readily undergo the chemical changes necessary within the brewing process.

Early malting was often done by local brewers who utilized locally grown crops to provide

themselves with a steady supply of raw material. Through the mid-nineteenth century, many firms retained their own malting houses adjacent to their sites. But as the brewing industry in Wisconsin began to expand at a "tremendous" rate in the 1860s and 1870s, malting became increasingly the domain of independent malting companies. The largest number of these firms was located in Milwaukee's Menomonee Valley, where fine, locally grown barley and imported eastern grains could both be economically utilized. By 1885, Milwaukee maltsters were providing over 2,380,000 bushels of malt to city breweries and an additional 1,000,000 bushels were being shipped out of the city. By the mid-1890s, Milwaukee's eight major malting firms were processing over five million bushels of malt annually.

Employing approximately 300 workers, Milwaukee quickly became one of the country's leading malt producing areas. (The heaviest concentration of activity was at the eastern end of the Menomonee Valley at South Water, Florida and Bruce Streets.) Among the largest concerns were the Milwaukee-Western Malting Company and the American Malting Company (Merritt & Snook 1980:36-37). Consisting of large brick and concrete industrial buildings, often with adjacent grain storage elevators and packaging areas, the malting plants continued in production through the Prohibition and Depression era, and Milwaukee today remains a major center of malt production.

MALTING PROCESS

The malting of barley grain, performed by both breweries and independent malters, began with the steeping of the grain in large vats of water. After one or two days, the wet barley was spread over the stone or cement floor of the malthouse where it was allowed to germinate. Frequent stirring and turning over of the germinating barley by hand was necessary. Between 1870 and 1880, more efficient mechanical methods for inducing germination were developed, and the floor-malting process was abandoned. Finally, the green (germinating) malt was taken to a kiln house for smoke or air drying. Housed in stove-like towers or buildings, most kiln drying operations in the early nineteenth century were done in smoke-drying kilns. By the 1880s and 1890s, hot air drying kilns were introduced to pump the malt from one perforated steelwire floor to the next. These kilns had perhaps as many as four levels, and thereby aerated the malt and readied it for bagging and shipment to the brewing site (Downard 1980:114-115; Cochran 1948:13-18).

ASSOCIATED INDUSTRIES

An industry the size and extent of the brewing industry necessarily generated a number of subsidiary industries closely aligned to its specific needs. In addition to the malting industry, there were the coopering, bottling, and ice harvesting industries and the manufacturing of specialized brewing and saloon equipment. Ice harvesting, which was vital to the industry prior to the introduction of reliable mechanical refrigeration at the turn of the century, has been described in a separate study unit. Coopering is discussed in the Wood Products study unit. It is important to mention, however, that most early beer was stored and shipped in casks and kegs of wooden construction. By 1890, Milwaukee alone had approximately 40 firms employing 600 workers in the manufacturing of barrels for beer, flour, and meat products (Merk 1916:154).

The bottling of beer advanced slowly until the pasteurization process, introduced in the 1870s, extended the storage life of bottled beer beyond a scant two to three days. The majority of the early brewers did not do their own bottling. Most firms contracted with outside concerns to carry out the work at adjacent plants. (By 1878 each of the large Milwaukee brewers had associated itself with an independent bottling company: Philip Best Brewing Company with the Stam and Meyer Bottling Company (1876); Joseph Schlitz with Voechting, Shape and Company (1877); and Valentin Blatz with the bottling firm of Torchiani and Kremer.) This unusual situation continued until the 1880s, when the rapidly expanding breweries began erecting and operating their own bottling facilities.

Tax laws, however, still required the bottling process to occur outside of the main brewery building. Connecting pipelines and bridges, still visible at many sites, were commonly utilized to link the two operations. With the popular rise in bottled beer consumption in this century, the bottling and packaging plants became vital aspects of the brewery's industrial complex.

WISCONSIN'S OLDEST BREWERIES OUTSIDE MILWAUKEE (PARTIAL LIST)

Black River Falls Brewery of Ulrich Oderbolz, 1856-1920, Black River Falls.
Fox Lake Brewery of Frank Liebenstein, 1856-1937, Fox Lake.
Bellevue Brewery of Hochgreve and Rahr, 1856-1865, Green Bay.
Jacob Breunig Brewery, 1855-1910, Jefferson.
City Brewery of John Gund and Gottlieb Heileman, 1854-present, Lacrosse.
Adam Sprecher Brewery, forerunner of the Fauerbach Brewery, 1848-1966, Madison.
Eagle Brewery of William Rahr, 1849-1920, Manitowoc.
Gutsch Brewing Company of Leopold and Francis Gutsch, known after the Great Depression as the Kingsbury Brewery, 1847-1974, Sheboygan.
Konrad Schreier Brewery and Malthouse, 1854-1920-present (malt), Sheboygan.
G. Weber Brewing Company, 1850-1961, Theresa.
Ed Mueller Brewing Company, 1848-1920, Two Rivers.
(Kroll 1976:14-104).

IDENTIFICATION

Resource Types. Brewing: brew houses, offices, ice houses, cooperages, bottling plants, storage cellars and/or caverns, stables, garages, repair shops, washing houses (for kegs), refrigeration plants, grain storage facilities, packaging plants, powerhouses, storehouses and shipping areas. Malting: malthouses, kilns, storage elevators, packaging and distribution facilities. Associated properties: worker housing, brewmaster residences, brewery beer gardens, saloons, storage depots, brewery owned taverns.

Locational Patterns of Resource Types. Milwaukee and most larger urban communities (e.g., La Crosse, Oshkosh, Eau Claire, Racine) as well as those communities able to provide ample water and natural ice supplies and access to local grain (hops, barley, malt, yeast) supplies. Larger firms were dependent upon access to major railroad lines.

Previous Surveys. No thematic surveys of extant brewing sites have been conducted by the Historic Preservation Division. The Milwaukee Menomonee Valley Survey and the Outagamie County Industrial Survey, however, contain comprehensive studies of industrial buildings in particular breweries, as do a series of published brewery directories such as Wayne Kroll's Badger Breweries (1976).

Survey and Research Needs. The study of Milwaukee's expansive brewing industry appears well documented, but the growth and development of small local breweries, particularly in communities with a strong German heritage, appears less carefully examined. A study of corporate records relating to the extent and development of brewery owned taverns as a distinct resource type could provide useful documentation.

EVALUATION

National Register Listings and Determinations of Eligibility

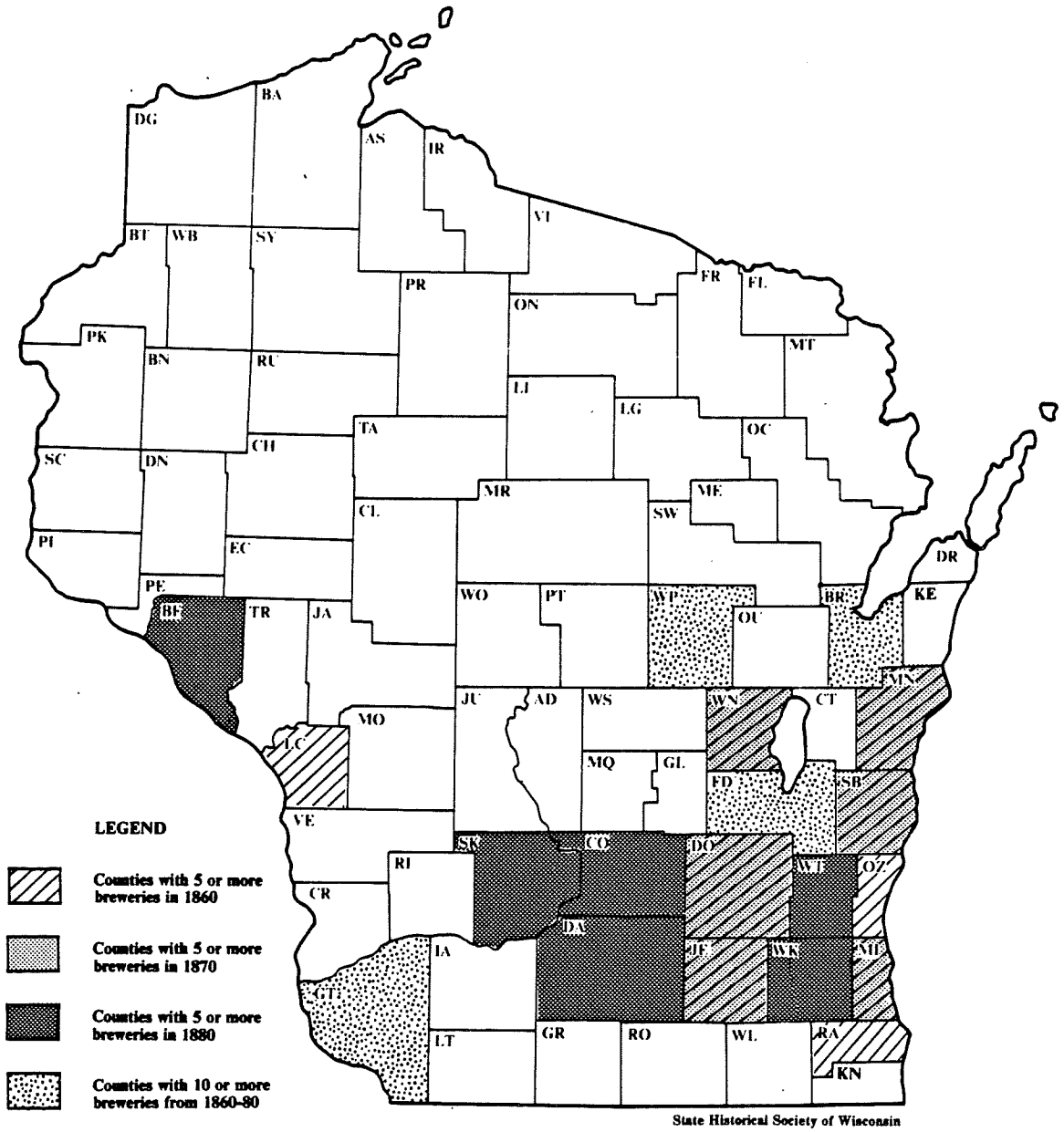
John Johnson Saloon (1882), 216 Fifth Ave., Eau Claire, Eau Claire County (NRHP 1983, MRA)
Potosi Brewery (1852), Main Street, Potosi, Grant County (NRHP 1980)
Joseph Huber Brewery Company (1891), Monroe Commercial District, 1208 14th Ave., Monroe, Green County (NRHP 1982)
Schlitz Building (1888), Monroe Commercial District, 114 17th Ave., Monroe, Green County (NRHP 1982)
Mineral Springs Brewery (1850), Shake Rag Street, Mineral Point, Iowa County (NRHP 1971, Mineral Point Historic District)
Valentin Blatz Brewing Company Office (1890, 1945), 1120 North Broadway, Milwaukee, Milwaukee County (NRHP 1985)
Blatz Brewing Complex (1891-1936), Milwaukee, 1101-1147 North Broadway, Milwaukee,
Milwaukee County (NRHP 1986)
Pabst Brewery Saloon [Zion Rock Missionary Baptist Church] (1896), 1338-1340 West Juneau Ave., Milwaukee, Milwaukee County (NRHP 1985, West Side MRA)
Frederick Pabst House (1890-1892), 2000 West Wisconsin Ave., Milwaukee, Milwaukee County (NRHP 1975)
Frederick Pabst, Jr. House (1891), 3221 West Highland Blvd., Milwaukee, Milwaukee County (NRHP 1984, Highland Blvd. Historic District, West Side MRA)
Joseph Schlitz Brewing Company District (1890-1938), Milwaukee, Milwaukee County (DOE 1984, Brewers Hill MRA)
Joseph Schlitz Brewing Company Saloon (1897) 2414 South St. Clair Street,

Milwaukee, Milwaukee County (NRHP 1977)
Reedsburg Brewery (1904), 401 North Walnut Street, Reedsburg, Sauk County (NRHP 1984, Reedsburg MRA)
Melchoir Hotel and Brewery Ruins (c.1860), First Street, Trempealeau, Trempealeau County (NRHP 1984, Trempeauleau MRA)
Chief Oshkosh Brewery (1879,1911), 1610 Doty Street, Oshkosh, Winnebago County (DOE 1982)
Pabst Warehouse (1890), 139 Division Street, Oshkosh, Winnebago County (DOE 1984)

Context Considerations. The majority of extant brewery facilities have been considerably modernized and altered in an attempt to stay abreast of contemporary industrial practices. Original machinery, where still in place, may be of substantial interest and can enhance a nomination.

In evaluating the breweries, some differentiations should be made between those that exhibited local distribution patterns and those that exhibited regional or national distribution patterns. The former usually consists of small, rather compact brewery sites, while the latter consists of very large complexes, often incorporating bottling, storage, and transhipment facilities, cooperage plants, and stock and mill houses within the compound. When evaluating these larger complexes, careful attention should be paid to the integrity of the entire site. An evaluation of smaller breweries should not attempt a comparison with the larger brewing operations. Instead, these smaller concerns might be evaluated in regard to their overall relationship to each other or to the communities in which they are located, including such areas as community development, ethnic heritage, and general industrial development.

The large brewing firms are usually easily recognized by their dominant brewing house tower which was the focus of plant activity and the most significant aspect of the complex. These larger complexes were normally architect-designed and often incorporated elements of Medieval European architecture, eg. crenelated towers, blind arches, and stepped gables. These complexes should be evaluated for both their architectural and historical significance. Smaller breweries tended to be much more utilitarian in form and should be evaluated principally for their historic role in a community's development.



Brewery Concentrations, 1860-1880

Source: *Eigth Census of the United States, 1860: Vol. III, Manufactures*, pp. 640-655; *Ninth Census of the United States, 1870: Vol. III, Wealth and Industry*, pp. 742-745; *Tenth Census of the United States, 1880: Vol. II, Manufactures*, 371-378.

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MEAT PRODUCTS

Temporal Boundaries: 1850-present, peak development 1860-1950.

Spatial Boundaries: Milwaukee and scattered urban communities..

Related Study Units: Ice Harvesting, Wood Products, Twentieth Century Labor Organizations and Legislation.

HISTORICAL BACKGROUND

The meat packing industry, perhaps more than any other industry in the early period of Wisconsin's development, was dominated by a single community. By 1860, the city of Milwaukee was responsible for over three-quarters of the state's processed meat products. And at this point, Milwaukee was just beginning to expand its markets. Realizing incredible growth during the period before and after the Civil War, the industry brought Milwaukee national prominence as a center for pork processing.

The slaughtering and packing of pork and beef products developed originally as a decentralized operation, with slaughter houses and small meat markets existing in most communities and on many farms. Operated out of frame barns and simple storefront sites, small scale operations served local markets within communities through the mid- and late nineteenth century and continued to do so, particularly in rural communities, well into the early decades of the twentieth century.

The simple butchering of animals for human consumption rarely developed beyond the immediate environs of local communities during the 1830s and 1840s, not even in the growing community of Milwaukee. The southeastern city of Racine was perhaps one of the earliest Wisconsin communities to take advantage of outside markets. Firms such as Charles Herrick, Killip and Clough, and Norton and Mosher, established in the city in the 1840s, were by 1849 exporting to eastern markets a total of 4,125 barrels of beef and 2,385 barrels of salt pork annually (Walsh 1972:164). Taking advantage of elevated meat prices in New York and Boston and their favorable coastal location, Racine's local packing firms established a profitable trade, albeit of only minor proportions. The financial uneasiness of the 1850s, however, terminated Racine's export trade. By 1860, the city's six firms and 18 employees were once again supplying only a local market (Walsh 1972:164-165). By mid-century, the development and expansion of the railroads allowed the meat processing industry to centralize around transportation service hubs, such as Chicago and Milwaukee, that had direct access to both livestock raising areas and eastern markets.

During the early 1800s (1820-1840), the city of Cincinnati, with its advantageous location on the Ohio River, became the center of the early meat packing industry in the west and acquired the name "Porkopolis." By the 1860s, however, with the expansion of the western frontiers to the rich prairie and grazing lands of the Midwest, Milwaukee and Chicago became more advantageous locations for the development of the beef and pork packing industry. Adjacent to abundant supplies of ice and wood (for barrels), linked to eastern markets by rail and by Great Lakes shipping, and central to the livestock raising areas of Wisconsin, Iowa, and Minnesota, Milwaukee became a center of pork processing and packing at this time.The salt used in the preservation of meats was the only major item vital to the industry that had to be imported to the area (Merritt 1980:45). (In 1876, Milwaukee packers alone purchased 135,000 barrels of salt).

Milwaukee's meat production industry began its rise to prominence in the 1850s.

Expanding from a localized market and supplied by a growing number of regional farmers, Milwaukee firms began to slaughter, cure, and pack pork and beef for increasingly wider sale. Under the leadership of such early firms as Plankinton and Layton and Thomas and Edward Roddis, salted pork and beef products found growing markets in the northern lumber camps of upper Michigan and northern Wisconsin and in the large urban areas of the East. Both Plankinton and Layton and Edward and Thomas Roddis firm established plants in Milwaukee's outlying Menomonee River Valley in the early 1850s, initially obtaining their meat, often in dressed form, from local farmers. This custom of pre-dressing meats soon declined, however, as more and more cattle and hogs were shipped by rail. By 1880, nearly all cattle and hogs arrived at the plants on the hoof. Packing was still a seasonal process during this era, limited to the period when ice was readily available from local riverways and lakes to help preserve the meats (see Ice Harvesting Study Unit).

The following section offers a glimpse at some of the major names and firms that shaped Milwaukee's pork packing industry in the latter half of the nineteenth century. John Plankinton arrived in Milwaukee from Pittsburgh in 1844 and immediatey began business in the city with a small butcher shop. As was the case with a number of firms, the small enterprise quickly grew into a major processing concern. Plankinton joined with Frederick Layton in 1850 to establish a sizable slaughtering and packing house that became one of the largest concerns west of Cincinnati by 1860. Layton left the company in 1861 to form his own firm, while Plankinton was joined by Philip Armour. The Plankinton and Armour firm, Milwaukee's largest and most profitable, reaped extensive profits during the Civil War era. Armour moved to Chicago to start his own firm in 1865. The Plankinton firm, F. Layton and Company, and the firm of McGeoch and Van Kirk (who had purchased the former Roddis Brothers plant) dominated the Menomonee Valley's packing industry throughout the 1870s and 1880s. In 1884, Patrick and John Cudahy joined the established Plankinton firm only to leave in 1893 to organize their own plant at Cudahy, Wisconsin, eight miles south of Milwaukee. The Plankinton firm was continued after the elder Plankinton's death in 1888 by his son William. The entire operation was purchased in 1905 by Chicago's meat packing king, C. Swift, and was used by the firm until 1962.

Of those firms operating in Milwaukee prior to 1860 and serving the growing local and export markets, the Plankinton, Layton, and Roddis firms accounted for 70 to 80 percent of the total meat packed in the city. Output from the plants reached values upwards of $504,000 by 1860. On a statewide level, the 1860 federal census reported a total of 14 major packing firms located within the state (listed under provisions, pork, beef, etc.). A review of the county by county breakdowns reveals a single firm located in Jefferson County which employed ten laborers, five firms located in Racine County with a total of 18 employees, and eight concerns operating within Milwaukee County. The total employment of the Milwaukee concerns, however, reached 60 men. For comparison, Chicago supported five individual meat packing operations during the same period. Employing a total workforce of 146 laborers, the output of Chicago's plants reached a combined value of $1,626,142. Wisconsin's total production barely reached over $602,000 by this time (Eighth Census of the United States, 1860:640-655). Although Chicago, with its better rail access and market connections, was the pork processing center of the Midwest at this point, Milwaukee's national reputation as a major center was continually increasing. Moreover, the preceeding figures do not include the great number of small, localized butchering houses which remained a part of Wisconsin's strongly rural landscape throughout the nineteenth century.

The outbreak of the Civil War stimulated a dramatic intensification of production in Wisconsin's meat packing industry, as firms strove to meet the voracious demands of the war effort. Led by the well-established firms of Plankinton and Armour, Layton and Company, and McGeach and Van Kirk, the processing of hogs into barreled salt pork products increased from 60,130 head in 1860 to 133,370 head in 1866 and reached a high of 313,120 head in 1871. In a single ten year span, this increase elevated Milwaukee to

fourth place among pork packing centers in the United States (Merk 1916:151).

Beef packing within the state also increased dramatically during the Civil War years. In 1860, nearly 8,000 head of cattle were butchered and processed in Milwaukee, and in 1864, nearly 19,000 head were processed. Once the war ended, however, beef packing dwindled to insignificance as cities nearer the centers of cattle raising, such as Kansas City, began to dominate production (Merk 1916:151).

While Wisconsin's beef packing industry suffered as a result of the loss of wartime demand, the processing of hogs continued at a steady pace. It continued to rank as one of the state's major industries for the next several decades.

Initiated by the expansive wartime production levels of the 1860s, developments and innovations within the industry in the post-war years dramatically altered the scope and scale of meat packing in the Midwest and influenced its direction well into the twentieth century. Throughout the 1860s and 1870s, plants expanded in size, and new buildings were erected while wood-frame structures were replaced with imposing three and four-story brick slaughtering and packing houses and a vast array of associated outbuildings. In 1869, a significant development occurred in the Milwaukee industry; the Milwaukee and St. Paul Railway Company established the Union Stockyards. Equipped with every modern device for the receiving, feeding, weighing, and herding of incoming cattle and hogs, the stockyard centralized packing operations, creating an efficient network of interconnecting rail lines and vast areas of open and closed pens. The ten-acre site formed the heart of packing operations in the city until 1929 when they were moved to the Muskego Avenue area to take better advantage of the increasing number of cattle arriving by truck.

As the plants grew in size, the slaughtering, cutting, and packing operations became more mechanized and the work more specialized. Because of a host of new machines and technology, meat packing operated increasingly on a mass production basis. The "disassembly line" initiated by Chicago's Swift and Armour firms was rapidly accepted as a method of meat processing in larger plants. No longer a random process, cattle, hogs, and sheep entered the main house at the upper floors, and their carcasses exited the lower floors. At the same time, marketable products passed from floor to floor or to adjacent work houses by way of overhead trolleys, conveyors, and shutes that moved animals past specially trained laborers, who had their own particular tasks, sometimes at a rate of 20 animals a minute. (See Process)

Typical plant layout responded to industrial growth and appeared on various scales. In the 1880s, the Plankinton and Armour plant contained a three-story brick slaughtering and packing house, 170' x 240' in size. In addition, there was a 32' x 100' boiling house, a huge ice house, a ham house, a curing house, a cooperage, a drying house for transforming wastes into bagged fertilizer, a lard rendering building, and various storage and repair shops. The 14-acre site was situated near both a shipping canal and the railroads; covered tramways connected most buildings. The city's Layton and Company firm of the same period was located on a six-acre site upon which were scattered most of the same types of buildings in both brick and wood frame construction. Other concerns operated plants of a more manageable size, often housing the cutting and packing opertions and the drying, salting, barreling, smoking, curing, and rendering processes in one or two buildings, normally two to three stories in height. The way these concerns operated perhaps best characterized more localized operations, such as Peter Myers' Pork Packing Plant (NRHP 1983) in Janesville (Flower 1881:1681).

Perhaps the single most significant development to affect the meat packing industry during this period was the introduction of the refrigerated rail car. Initiated by resourceful Detroit industrialist, George H. Hammond, in 1869, the shipment of dressed meats in freight cars chilled with ice dramatically bolstered an industry that remained, in

spite of its early expansion, a strongly seasonal and localized enterprise. With the ability to economically process and ship fresh meats year-round, the meatpacking industry coalesced into a major economic enterprise, rapidly expanding its scope to nationwide and even international levels. Chicago's Gustavus F. Swift was the first established packer to fully utilize the technology developed by Hammond, building a nationwide market network for his meat products by 1877. Milwaukee firms quickly followed Swift's lead; fresh dressed meats, as well as salt pork and beef from Milwaukee, began to find markets across the United States and in Europe. With this new expansion in market area, Milwaukee's meatpacking industry rapidly became the leading industry in value of goods produced in the Menomonee Valley area. It remained one of the city's leading industries for the next 30 years.

Statewide statistics, as detailed in the census reports of 1880 and 1890, reflected the packing industry's growth in Wisconsin and Milwaukee. Producing $6.5 million worth of pork, mutton, and beef in 1880, the industry ranked sixth overall in the state in value of goods produced. Of the 13 firms noted in the census, seven were located in Milwaukee County. These seven accounted for approximately 93 percent of the state's total output, and employed over 89.9 percent of the state's packing workforce. La Crosse County, which had three packing houses and 18 employees, ranked next with a production of $155,000 worth of processed goods. Brown, Eau Claire, and Jefferson counties each recorded a single enterprise that supplied regional and local markets.

By 1890, the product value of the state's meat packing houses was more than $8.3 million. At that time, Milwaukee's four firms employed 6,780 workers. The reduction in the number of firms marked a consolidation of a number of smaller concerns under the control of major companies, such as Plankinton and Layton. La Crosse employed 41 laborers in its three concerns by this time, taking full advantage of its access to the railroad and the Mississippi River. Oshkosh also had three concerns, but their total labor force was only nine. In total, 688,000 hogs, 16,000 head of beef, and 15,000 sheep were slaughtered and processed in the state during the 1890 census year.

The industry continued to expand through the turn of the century. The number of firms remained relatively constant, ranging between 10 and 20 major companies statewide. Product values, however, increased dramatically, reaching levels of $13.6 million and $27.2 million in 1900 and 1910 respectively. The sizes of the packing concerns and the number of workers employed continued to rise as well.
An important aspect of labor-management relations began to evolve around the turn of the century with the formation of the Amalgamated Meat Cutters and Butcher Workmen of North America labor union. Although experiencing only limited success with their own efforts, the union was responsible, in part, for the initiation of some of the major restructuring that occured within the industry during the first decades of the twentieth century. During this period, increasing demands for proper sanitary procedures and guidelines on meat quality approval stimulated widesweeping changes in the industry, including the adoption of more efficient machinery. The landmark Pure Food and Drug Act of 1906, initiated under Theodore Roosevelt, proved the ultimate catalyst for many of these alterations. In the 1930s and 1940s, with the formation of the United Packinghouse Workers of America (CIO), the industry acquired its most powerful union-organizing group, and working conditions in the plants began to improve substantially for the first time.

While the industry was instituting these changes, events in Europe were building an incredible demand for packaged meat products. The outbreak of World War I provided the industry with its most significant boom since the introduction of the refrigerated rail car. By the war's end, production from Wisconsin's 21 concerns (11 in Milwaukee) reached the $104 million mark (Alexander 1929:30-49). Moreover, wartime production stimulated an increase in the number of women employed in the state's packing houses.

Due in large part to the diffusion of packing concerns into western states nearer to cattle raising areas, Wisconsin no longer ranked among the nation's top meat packing states by 1920. But the meat packing industry nevertheless moved up into fourth place among the state's manufacturing concerns in terms of value of goods produced. Among the more significant firms drawn to Wisconsin by the wartime boom was that of Bavarian-born Oscar Mayer, who purchased a former farmer's cooperative meat packing plant in Madison in 1919 and moved extensive portions of his Chicago-based firm to Wisconsin.

The industry experienced another boom period following the lean years of the depression with the outbreak of World War II. Bringing with it extensive modernization of plants and machinery, this period marked the last era of extensive meat production in the state. On a broad scale, plants began to decentralize their operations, moving or establishing new sites closer to both livestock production areas and regional markets. Milwaukee, which butchered 12,500 head of cattle and 15,000 hogs daily in 1946, processed only 165,000 cattle and 49,000 hogs in 1978.

SUBSIDIARY INDUSTRIES

Like most large-scale industries, meatpacking brought forth a host of minor, subsidiary manufacturing and processing industries. Coopers and boxmakers were needed to provide shipping containers; tin shops and can manufacturers developed after the popularization of canned meats in 1879; ice harvesting concerns were necessary to provide refrigeration, as were mechanics who repaired the packing houses' specialized refrigerator cars. More important, however, was the processing associated with the scraps or wastes of the butchering operations. The meat packing industry was extremely proud of the fact that almost no parts of slaughtered animals were wasted. Hogs' coarse hair was processed into fine bristles for brushes, blood and offal were processed into fertilizer, and lard was rendered in large kettles and pressurized tanks into neatsfoot oil, illuminating oil, soap, candles, or glue.

These operations were often carried out directly by larger packing concerns in order to ensure full use of the firms' capital investments in livestock. In other cases, separate, private concerns, often on a cottage-industry scale, were established to process the packing industry's by-products. In 1890, nine of the state's 17 firms operating as large-scale soap and candle manufacturers were located in Milwaukee, as was over 73 percent of the industry's small labor force of 179 (Eleventh Census of the United States:1890). Among these sizable rendering and processing firms was the 1867 concern of Burdette Johnson and George Beard of Buffalo (Buffalo County), whose Menomonee factory eventually became the basis for the gigantic Palmolive Soap Company (c.1915-1934 in Milwaukee) (Merritt 1980:50-51).

The manufacturing of sausage was another enterprise often not carried out directly by the packing industry. Prior to the introduction of suitable machinery (c. 1870), sausage manufacturing was a highly labor intensive process that did not appeal to many packing firms. Numerous small concerns appeared to manufacture lesser quality cuts of meats into sausage, knockwurst, or bratwurst, such as the 1888 Jones Dairy Farm (NRHP 1978) of Fort Atkinson, still in operation. The city of Sheboygan was especially noted among Wisconsin communities for its bratwurst production. Sheboygan probably owed its reputation to its heavily German popuation; in many Wisconsin communities with large German populations, bratwurst emerged as a specialty product.

PROCESS

As mentioned above, the processing of cattle and swine in packing plants evolved into a more mechanized and ordered industry as the twentieth century approached. The disassembly line remained, however, the basic ordering principle in the process. Cattle were taken from the vast open pen areas of the stockyards to upper floors of the main

slaughtering/packing houses by way of elevated ramps. Once at the top of the houses, the animals were attached to conveyors or overhead trolley lines and summarily slaughtered. Progressing by way of the conveyor line from station to station, each manned by an operator with a specified task, the bodies were drained of blood, passed through a scalding bath, processed through scraping machines, and cut and dressed. The carcasses then proceeded to a cooling room to await further butchering. Offal and other byproducts went to other parts of the building or to adjacent sites by way of shutes, drains, and conveyors. Once sufficiently cooled, the initially dressed meats were cut into appropriate sections and forwarded to the curing rooms for laying out in dry salt or brine baths or to the smokehouse or packing areas to await shipment to market by rail, ship, or wagon.

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FRUIT AND VEGETABLE PRODUCTS

Crops: Peas, Corn, Snapbeans, Beets, Cabbage/Kraut, Cucumbers, Fruits and Berries

Temporal Boundaries: 1887 to present.

Spatial Boundaries: Broadly scattered throughout the state with strong concentrations in the central counties of Columbia, Dodge, Fond du Lac, and Green Lake and the Lake Michigan counties of Ozaukee, Sheboygan, Door, and Manitowoc.

Related Study Units: Twentieth Century Labor Organization and Legislation, Fruit and Vegetable Cultivation, Specialty Agricultural Production.

HISTORICAL BACKGROUND

The processing of fruit and vegetables in Wisconsin, particularly canning, provided the state with an extensive, small-scale industry linked directly to its rich agricultural development. Fruit and vegetable processing began in the last quarter of the nineteenth century; by the early decades of the twentieth century, Wisconsin had become one of the country's leading states in fruit and vegetable processing. The canning of vegetables was the most prominent processing industry.

The art of canning fruit and vegetables emerged in France during the reign of Napoleon. Seeking to provide his constantly moving army with sufficient provisions on their extended campaigns, Napoleon initiated a competition to develop an efficient and scientific means of preserving food. Thus, the science of canning owed its early origins to the work of an obscure French confectioner, Nicolas Appert, whose "Monograph Upon the Art of Preserving Animal and Vegetable Substances," published in 1809, outlined the process involved in preservng food by the application of heat and storage in sealed, wide-mouthed glass or earthenware containers. Subsequent to Appert's pioneer work, hosts of other inventors and scientists began to focus their attention on the field of preserving and canning. Among them were the Englishman Peter Durand, who in 1810 patented an improved storage container: a tin-coated metal cannister or can. By the 1840s, the tin can had achieved widespread acceptance in the industry.

About 1819, a young English apprentice, William Underwood, brought the canning process to America, establishing this country's first commercial canning concern in Boston. From there, operations were eventually established along the eastern seaboard, particularly in New York State and in the Maryland and Delaware areas around Baltimore. Until the Civil War, no commercial canning operations were located west of the Atlantic coast, except for small concerns at Cincinnati and Indianapolis. Like those in the East, these operations were not much more than family canning concerns operated out of small shops or barns, with all processing and packaging done by hand.

With the settlement of Wisconsin farmlands in the nineteenth century, small garden plots of vegetables appeared uniformly across the state, increasing proportionately with the spread of settlement. By 1880, Door, Kewaunee, Sheboygan, Manitowoc, and other lakeside counties had developed an early and relatively substantial cash crop of peas and beans for fresh-market sale. By the late nineteenth century, industrialists began to consider the possibility of canning the products for resale in local and distant markets. Nationally significant concentrations of large-scale production did not appear until the turn of the century, however, when commercial production surged in the central counties of Columbia, Dodge, Fond du Lac, Green Lake, and Waushara, where the light soil and cool climate proved highly conducive to raising canning crops.

The earliest Wisconsin cannery was established in 1887, when Philadelphia seedman Andrew Landreth, impressed by the quality of commercial peas grown in the lakeshore counties, purchased land in Manitowoc and built a factory to process the peas he grew. Although not early by Midwestern standards (other states had canneries 10 to 15 years earlier), the Landreth plant and a branch operation at Sheboygan that started in 1890 set an important precedent in the state. The second pioneer canning concern in Wisconsin was that of William Larsen of Green Bay. Originally engaged in the wholesale produce business, Larsen organized his canning operation in the Fort Howard area in 1890 (Stare 1949:460-474).

In the early development period of the canning industry in Wisconsin and for a number of years to follow, pea canners had to plant and harvest their own crops from land either owned by the firms or leased from area farmers because of a lack of interest among canners in raising peas. As the industry grew and farmers became convinced of the economics of raising vegetable crops for sale to canneries, many of the vast company-owned farms were replaced by private suppliers. Early in the industry's development, the University of Wisconsin College of Agriculture assumed an active part in the development and encouragement of the canning industry in the state, offering scientific and economic expertise on a broad range of agricultural topics (Stare 1949:462).

The availability of laborers was an important consideration of early plant operation. Out of necessity, canning plants had to locate in areas where a dependable, annual supply of seasonal laborers existed. Early operations, such as Larsen's and Landreth's, regularly hired more than 1,000 men, women, and children during the picking season to harvest the crop and to prepare it for canning in the factory (e.g. shelling peas, husking corn). All operations were done by hand (Stare 1949:475). In later years, mechanical devices, such as the pea viner, dramatically decreased the industry's dependence on seasonal labor.

The early concerns of Landreth and Larsen struggled through their first years of production with crude machinery, a dependence on hand labor, and an overall lack of experience, but they ultimately became successful and professional promoters of the canning industry. Private investors soon began to press for the establishment of vegetable canneries across the state. By 1900, approximately 15 canning plants had been established in the state. About one-half of these were located in the fertile area bounded by Lake Winnebago, Lake Michigan, and Green Bay. From that early core, the industry spread outward; first to the south and southwest where factories were scattered along a corridor stretching from the southern tip of Lake Winnebago to the point where the Wisconsin River turns westward. In later years, the industry spread into the northwestern areas of the state, avoiding the sandy central area and the dense woodlands of the extreme north (Krause 1948:19).

Early canneries in Wisconsin packed a variety of vegetables and fruits, including tomatoes, corn, peas, cucumbers, sauerkraut, beans, pumpkins, apples, and peaches. Tomato and corn packing dominated early production. But as the industry developed, four products proved the most economical for cultivation and processing: peas, corn, beets, and snapbeans. By the early 1900s, these four crops accounted for 80 to 90 percent of the total vegetables packed in the state annually (Krause 1948:13).

Among the earliest and most profitable canning concerns to establish plants in the state prior to 1900 were: the Randolph Canning Co. at Randolph, Wisconsin (1894); the Reynolds Preserving Co., Sturgeon Bay (1896); The Sauk City Canning Co., Sauk City (1894); the W. Seyk Co. of Kewaunee (1896); the Fond du Lac Canning Co. (1898); the Manitowoc Pea Packing Co. (1897); the Platteville Canning Co. (1899); and the J.P. Gedney Pickle and Canning Co. of Prairie du Chien (1896). The majority of these firms were housed in plants consisting of one or two buildings. Of simple, frame construction, the narrow one to two story factories commonly featured gabled roofs with

ventilators and front or side receiving/loading areas. Building dimensions ranged from the 36' X 60' Fond du Lac plant to the large 200' X 50' factory of the Algoma Packing Co. in Kewaunee County. As firms expanded, new buildings were added to hold new machinery or to warehouse stock. In addition, a number of firms acquired former flour mills and breweries for canning activities (Stare 1949:313-612).

The earliest factories housed little machinery; instead, large areas of floor space were occupied by the vast numbers of employees needed to perform the manual tasks of preparing and packing the products. By the end of the century, however, the pea-viner and other inventions had become common features in many factories, some matching the daily efforts of 100 laborers in a single hour. (For more information, see "The Canning Process" subsection below). With each new machine, plants expanded production, often adding new buildings, placing more land under cultivation, and realizing greater profits. Scientific research on crop growth and preservation technology greatly aided the industry as it progressed into the early twentieth century.

The number of canning plants in Wisconsin more than tripled during the first decade of the 1900s. By 1910, over 49 plants across the state were processing peas, beans, sweet corn, and other vegetables. Varying greatly in capacity and quality, the plants were a mix of privately owned corporations, family businesses, and cooperatively managed farmers' associations. Located as near as possible to the fields of production, the canneries of the early 1900s were most numerous in Manitowoc, Calumet, Sheboygan, Fond du Lac, Dodge, Columbia, Washington, Ozaukee, Jefferson, Dane, and Brown counties. Approximately one-fifth of the total processing acreage was still retained by the canning firms. With a large number of small, scattered operations, a high rate of turn-over in ownership characterized the early industry. Individual plants often passed through a number of different owners (Macklin 1921:4). In 1905, the state's first industry-wide business associaton, the Wisconsin Canners Association, was established (Stare 1949:262).

Wisconsin Canning Operations: 1900-1945

Year	Number of Plants
1900	15
1910	49
1920	126
1930	169
1940	146
1945	156

SOURCE:

Krause 1948:20

In the second decade of the twentieth century (1910-1920), Wisconsin's canning industury experienced its most rapid growth. A total of 126 firms were in operation by 1920. Development in the northwestern portion of the state was especially strong during the decade, aided in large part by the extension of dependable rail service. Farmers and canners found the area's cooler climate especially conducive to snap bean production. Two periods in particular evidenced the greatest number of newly established firms: 1911-1913 and 1919-1920. The latter, with an estimated constructon of 23 new plants, was the peak year for plant expansion in the state (Krause 1948:20).

The decade also was a period for change in plant construction methods. Profitable

firms were turning to brick construction to replace the older, wood-frame facilities. With the Prohibition that resulted from the enactment of the Volstead Act in 1918, the adaptive reuse of brewing facilities for canning purposes became even more common. Unfortunately, production statistics for the early years are not readily available.

In the 1920s and early 1930s, the number of plants established in the state continued to increase although the pace slowed considerably by 1925. The year 1931 marked the high point in the total number of plants canning seasonal vegetables in Wisconsin, with a total of 170 plants in operation. The Depression years eventually took a toll on the industry, causing numerous facilities to close or suspend operations during the 1930s. New construction and the updating of plant machinery were delayed until the outbreak of the Second World War brought a new vitality to the industry. An increase in the number of firms taken over by large outside canning corporations, such as Stokely and Libby (neither of which were based in Wisconsin), characterized the 1930-1940 decade. The practice became even more prevalent later in the century (Krause 1948:20-33).

With the enormous demand for packaged foods stimulated by the Second World War, Wisconsin reached a new peak in production in 1945. Harvested acreage for that year totaled around 259,000 acres, with approximately 150,000 acres set aside for peas, 97,000 for corn, and 11,000 for beans (Stare 1952:36). The output from Wisconsin plants totaled more than 21 million cases (504 million cans) in 1945, easily ranking the state as the leading producer of canned seasonal vegetables in the nation. Maryland-Delaware, California, and Washington-Oregon were ranked next below Wisconsin (Krause 1948:29).

The fuller utilization of existing plants and facilities, together with advanced machinery, played a large part in providing Wisconsin with its greater than 16 percent share of the market. The number of plants licensed to operate in 1945 was less than 90 percent of the number in operation in 1931, yet production had grown four to five times greater. The retooling of plants with a host of modern, efficient machines appears to have marked the period directly before and after the war. The canning industry's first serious competition became apparent during the decade, as developments in quick-freezing and dehydration promised to offer future challenges to the industry.

A 1944 College of Agriculture Bulletin summarizing the statewide industry noted that Wisconsin contained a total of 153 canning plants. Owned by 118 companies, the plants were most heavily concentrated in the eastern and east-central areas of the state. Dodge County (as it had for a number of years) led all other counties with 13 separate processing plants. It was followed by Columbia, Fond du Lac, and Sheboygan counties with nine firms each, Brown County with six, and Calumet, Outagamie, Ozaukee and Washington counties, each with five plants (U.W..College of Agriculture Bulletin 1944:NP).

Wisconsin continued to lead the nation in canned vegetable production well into the mid-century, consistently ranking first in the packing of peas and other products, such as carrots, beets, sweet corn, and sauerkraut. Overall production from the state's 120 plants in 1958, which employed over 40,000 laborers during peak season, amounted to one-eighth of the nation's total output.

CANNED PRODUCTS

The leading seasonal vegetables packed in Wisconsin included peas, corn, snapbeans, beets, cabbage (for kraut production), and cucumbers (for pickles). Smaller volumes of carrots, onions, lettuce, and spinach were also packed for sale. Although green

peas were the first and easily the most dominant vegetable grown commercially for processing in Wisconsin, most canning concerns processed more than one type of vegetable. A number of concerns processed as many as three or four types, although almost all included peas. In the following paragraphs, specific vegetables and fruits and their associated production will be examined.

Peas

Although peas were canned by the Landreth Plant in Manitowoc as early as 1887, the years between 1907 and 1920 constitute the period in which pea-canning in Wisconsin became firmly established. The new machinery that replaced the early crude equipment and hand processes helped assure the industry's establishment. By 1910, over 1,200 pea viners operated in the United States. Ten years later, the number of viners had doubled; Wisconsin manufactured and distributed most of them. A small machinery manufacturer in Kewaunee produced a number of the machines for local use (Stare 1952:37). Sometime later, the introduction of the modern "sanitary" can eliminated the extensive amounts of time and labor once consumed in hand-soldering cans. By about 1919, the Hansen pea and bean filler, which automatically measured peas and brine into cans, was being produced by the Wisconsin Chair Co. in Port Washington (Canning Trade Journal January 1, 1920:46). All three developments proved vital to the growing industry, as did the extensive research programs undertaken by the University of Wisconsin College of Agriculture.

Prior to 1920, Wisconsin produced about one-third of the nation's canned peas. During the 1920s, that figure rose to approximately 52 percent or an average of six to ten million cases a year. After declining sharply in the 1930s, the industry rebounded to about the 40 percent level by 1945. Increasing competition from the Washington-Oregon region and other western areas prohibited a return to the 1920 levels, but production in the state has consistently remained near the top of the national market. Throughout the high production years, the highest concentration of pea-canning concerns were in the east-central counties of Columbia, Dane, Dodge, Fond du Lac, and Green Lake (Krause 1948:54-59).

Corn

The processing and packing of corn products was second in importance to peas among the seasonal vegetables canned in Wisconsin. Heavily concentrated in Fond du Lac, Dodge, and Columbia counties, corn canneries produced an average of 330,000 cases annually during the period from 1905 to 1918. From 1919 to 1936, with the aid of new cooking and packing machinery, the average statewide production level rose to 600,000 cases annually. Reaching over the one million mark consistently through the late 1930s, production rose to over five million cases by the middle of World War II. Experiments with hybrid varieties of corn allowed such high levels of production to continue after the war. Corn was most commonly canned in combination with peas; by the 1950s, no plants in Wisconsin were processing only corn (Krause 1948:67-74).

Snapbeans

Wisconsin's snapbean crop (wax beans, green beans) was widely scattered over a broad area across the northern portion of the state, where competition from other crops was less keen and where the cool climate was more conducive to growth. Canning plants were distributed throughout the areas in which the beans were grown, but there was no sharp concentration of plants, such as that in the corn and pea industries. The majority of these concerns canned beans in combination with other vegetables. From approximately 500,000 cases produced annually in the

mid-1920s, production in the state rose to more than 1,000,000 cases in 1930. The output of canned beans remained between 800,000 and 1,000,000 cases annually through the 1940s, consistently ranking the state behind Maryland, New York, and Michigan in production and maintaining a nine percent share of the national market (Krause 1948:91-105).

Beets

The cultivation of beets in Wisconsin stimulated the advent of two very distinct food processing industries: canned beets and beet sugar refining. Becoming prominent by the late 1920s, beet production in Wisconsin ranged from 500,000 to two million cases annually over the next 30 years. Generally, the industry maintained a 30 to 40 percent share of the national market throughout the period, along with New York state. The third largest segment of Wisconsin's canning industry, beet processing plants, were concentrated to the east of the heaviest pea canning areas in Ozaukee, Washington, Calumet, and Dodge counties (Krause 1948:81-83).

Beet Sugar Refining. The earliest known sugar beet refinery operating in the state was the short lived concern of Bonnesteel and Otto at Fond du Lac. One of the pioneering concerns in the country, the 1869 Fond du Lac plant ran into trouble due to insufficient capital, a lack of suitable sugar beets, and faulty machinery. After a single season in production, the owners were forced to leave Wisconsin for California. In the following years, a limited number of small refineries were established across the state, including the First Sauk County Farmers Association for the Fabrication of Beet Sugar, which operated a plant at Blackhawk, Wisconsin beginning in 1871. Lack of experience and working capital forced all of the concerns to close by the mid-1870s. With the turn of the century, there was a renewed interest in the beet sugar industry, and by 1906, firms operated in Menomonee Falls (1901), Chippewa Falls (1904), Janesville (1904), Madison (1906) and Menominee, Michigan (1903) (Woll 1905:13-16). The Menominee, Michigan plant is continually listed in contemporary accounts due to the fact that over 70 percent of its raw beet supply was provided by Wisconsin farmers.

Processed in large plants requiring access to ready supplies of clean water, sugar beets were converted into three main prouducts: common granulated sugar that left the plants in sacks or barrels; beet molasses, used in alcohol manufacturing; and beet pulp, which when combined with molasses, served as nutritious cattle silage. Beets were unloaded from wagons and rail cars into long, large storage sheds with capacities of up to 12,000 to 20,000 tons. From the storage areas, the beets were sent by way of water flume into the main factory for cleaning and processing. Large brick structures with buttressed walls and numerous windows, the main buildings were commonly two to four stories in height and contained the weighing, cleaning, slicing, and extracting machinery for the plants. The sugar was extracted from the beets by successive treatments with water heated by steam and boiling with various chemical mixtures in a large series of diffusion batteries and carbonation tanks. Once the clear juice was removed and purified, it was sent to large evaporators and centrifuges for crystallization and separation from the molasses. Finally, the refined products were sent to bagging and shipping departments, commonly located in other sections of the plant complex. Because of the huge amounts of power and water required in the extraction process. the major concerns located along the sizable riverways in the state (Woll 1905:13-16).

The growing of sugar beets for refining centered most strongly in the region stretching from Dodge County, up the eastern shore of Lake Winnebago to Green Bay, and then north. A second concentration occurred in the Kenosha-Racine area. The industry reached a production peak in the mid-1920s, with over 21,000 acres planted to supply sugar beets to Wisconsin's six operating refineries. The individual

processing capacities at the sites ranged from 900 to 1,000 tons of sliced beets daily. In 1938, only 3 plants using Wisconsin sugar beets remained, at Janesville, Menominee, Michigan, and Green Bay (1919). By 1948, only 10,000 acres were planted to supply the only surviving facilities, at Green Bay and Menominee, and sugar production continued a downward trend (Beal 1938:3-13; Ebling 1948:50).

Cabbage/Kraut

During the early part of the twentieth century, Wisconsin played a major role as a leading producer of kraut from cabbage. The Hamilton and Sons Canning Company of New London, founded in 1919, was one of the largest early twentieth century producers of sauerkraut in the United States (Stare 1949:432). Perhaps the most highly localized of the food processing concerns, kraut manufacturers and canners seem to have been limited to areas of Racine and Kenosha counties, Outagamie and Brown counties, and Milwaukee County, each of which contained significant numbers of German-American citizens. The number of plants that packed both sauerkraut and sauerkraut juice and featured large brine and fermentation tanks peaked around 1930, after which the industry fell into decline in Wisconsin (Ebling 1948:51). The Hamilton and Sons Company plant, closed in 1974, contained 11 buildings on seven acres of land, of which only a small portion remains (Abrahams 1982:18).

Cucumbers

Many of the plants processing kraut were also involved in the production of pickles from cucumbers. An important cash crop in Wisconsin since the late nineteenth century, cucumbers and associated pickling concerns appear to have been concentrated most strongly in the light soil regions of the central and northeastern counties, particularly Waushara, Portage, Waupaca, and Oconto counties. The city of Green Bay, with companies like the Green Bay Food Company (1917), was a strong center of production. Predating the canning era, the Ripon Packing Company of Ripon, Wisconsin was manufacturing pickles as early as 1873, making it one of the oldest manufacturers in the Midwest. The pickling process involved cleaning the cucumbers and then soaking them in a salt/brine mixture. Once dryed, the "salted stock" was packed into containers along with various spices and special ingredients; boiling vinegar was added to complete the pickling and preserving process. Each step usually occurred in large vats and tanks in the main plant. Along with the central processing plants, the industry also supported a network of low, gabled roof salting stations located adjacent to the rail lines that traversed the producing areas of the state. The stations were located where area farmers could unload the raw vegetable for shipment to the processing facility. By 1948, 152 separate stations were located in Wisconsin (Stare 1949:429-543).

Fruits and Berries

Finally, the cultivation of extensive areas of fruits and berries in the hospitable climates of the Door and Bayfield peninsulas, as well as in other areas of the state, gave impetus to a limited fruit canning industry in Wisconsin. While most of the fruit grown in the state was shipped for fresh market sale, firms such as the Bayfield Canning Company (1921, Bayfield), M. W. Miller & Co. (c. 1940, Sturgeon Bay), Wittke Canning Company (1899, Oconto), Fruit Growers Canning Company (1918, Sturgeon Bay), and the Sparta Canning Company (1925, Sparta) processed and canned a numerous cherries, blueberries, strawberries, raspberries, and apples for shipment. Often using only surpluses from fresh stock, early fruit canning was commonly only one aspect of a concern's extensive line of products (Stare 1949:313-612). Considerable local tradition holds that Berlin (Green Lake County) was the birthplace of the Wisconsin cranberry industry in the late nineteenth century.

THE CANNING PROCESS

The canning of fruits and vegetables entailed a series of successive steps and processes, which during the earlier years of production in Wisconsin, were generally performed by hand. The introduction of modern and efficient machinery provided the industry with the tools it required to emerge in Wisconsin as a leading producer of canned products in the early twentieth century. The factory operations involved in the processing of canned food included washing, peeling, and grading the products, filling the cans, cooking and cooling the product, and packaging and warehousing the final goods.

Before placing the raw food into sealed containers, it had to be carefully prepared for processing, which might have involved cleaning, blanching, soaking, husking, straining, or any other number of techniques, depending on the type of vegetable or fruit. Before 1890 to 1900, the majority of this work was done by tedious hand labor, but by the turn of the century, devices such as corn cutters, automatic fillers, and pea podders and viners were becoming increasingly popular. The introduction of the pea viner was instrumental in Wisconsin's rise to prominence as the nation's top pea canning region by the eary 1910s. Rather than marching armies of seasonal laborers into the fields at harvestime, harvesting machines could be moved into the fields to haul the peas to nearby factories that were equipped with combined podder and viner machinery. Pitched into the modified threshing machines like hay, the crop was automatically shelled, sorted, sized, and cleaned, and the pods and vines were set aside for use as valuable silage. The podder and viner was a major technological contribution, and within a few years, it supplanted the hand work of thousands of Wisconsin workers.

Upon completion of preparatory steps, the fruits or vegetables were placed in various containers and sealed shut. The earliest containers and cans required hand soldering to seal small caps over the filler holes in the top of the cans. Increasingly sophisticated machines were introduced in the late 1800s and early 1900s to mechanize the soldering of lids, often performing the operation on a number of cans simultaneously. The development and manufacture of the sanitary, or open-top, can between 1905-1908, however, had the most dramatic impact on the canning industry. Soldering, which was often time consuming and sometimes hazardous, was no longer necessary, since rapidly operating rollers and crimpers cleanly and efficiently sealed the new containers at an amazing rate, guaranteeing a perfect closure with a double seam at both top and bottom. Introduced in the late 1800s, the sanitary can replaced the older, soldered types almost completely by 1920. Large manufacturers, such as the National Can Company of Green Bay and the Continental and American Can Companies of Milwaukee, supplied the industry with the necessary cans.

The heart of the canning process centered around the preservation of the food by subjecting the canned goods to prescribed, elevated temperatures for set periods of time, after which they were slowly cooled. Heating the contents of the can destroyed any spoilage organisms that may have been present, and the sealed cans prevented reinfection through exposure to air. The earliest system employed for cooking was a water bath process in which the food, packed in containers, was immersed in water and boiled for a prescribed time. The extremely slow process was eventually replaced by processing in closed, steam-pressure retorts (ovens), or pressure cookers, which reduced the "cooking" time by preparing the canned goods under constant pressure. The large iron and steel steam kettles were the centerpiece of most plants. By the mid-twentieth century, continuous, or tunnel cookers, working on an assembly line concept, were transforming the process once again. In the post-war years, the canning industry emerged as an almost fully automated, mass production process.

The final stage of canning was the labeling and storage of the product in large warehouses to await shipment by rail or truck. As plant production grew, so did the amount of space necessary to warehouse all of the canned goods. By mid-century, adequate storage space became a primary concern of plant design.

For more detailed information on the development of the canning industry and its machinery see The Story of Wisconsin's Great Canning Industry by Frederick Stare.

IDENTIFICATION

Resource Types. Canning plants, storehouses, office buildings, powerhouses, machine shops, pickling plants, salting stations, sugar beet refineries. Resources closely associated with the industry might include can manufacturing plants and machinery manufacturers, as well as those sites associated with the agricultural aspect of the industry (see Fruit and Vegetable Cultivation study unit).

Locational Patterns of Resource Types. The majority of the sites are situated in the heart of the agricultural areas of the state, with access to raw products much more important than immediate access to markets. Railroad lines provided the most efficient means of access to market prior to the development of public highways and truck transport, an important locational consideration.

Previous Surveys. No major surveys of extant properties associated with the fruit and vegetable processing industries exist at this time. Only the Brown and Outagamie County Industrial Surveys (Abrahams, 1982) offer a brief overview of the specific properties located in those areas. Fred Stare does, however, offer an in-depth historical survey of all canning facilities in existance in the state prior to 1949 in his book, The Story of Wisconsin's Great Canning Industry.

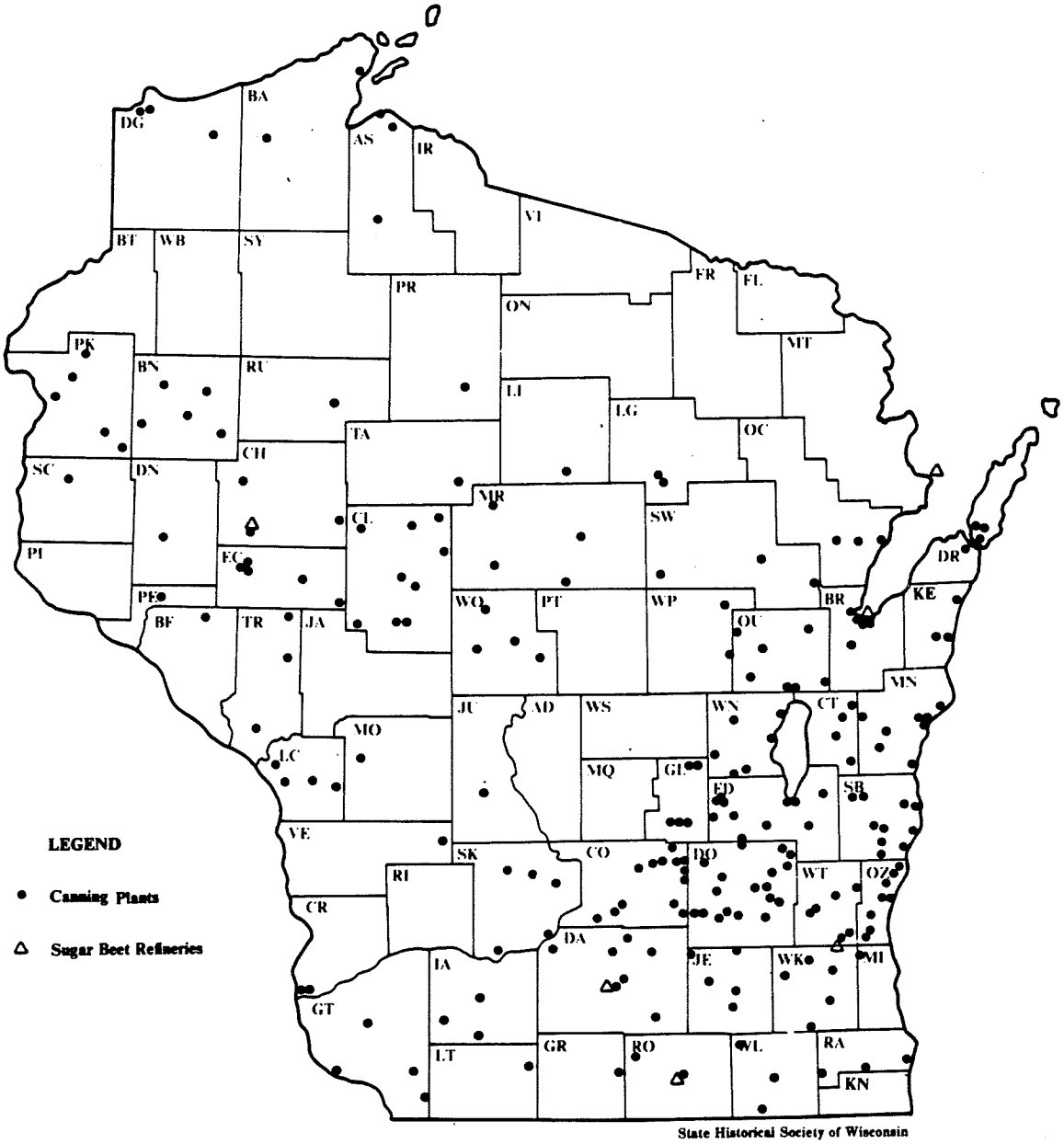
Survey and Research Needs. Study of canning industry-related properties should be included in any further surveys. An in-depth study to identify any of the remaining facilities associated with the limited sugar beet refining industry could prove valuable.

EVALUATION

National Register Listings and Determinations of Eligibility

Gov. James T. Lewis House, 711 W. James St., Columbus, Columbia County (NRHP 1982)

Context Considerations. Generally, canning sites are of local significance because of their contribution to the economic development of a specific area. A small number of sites may be of statewide significance, however, as examples of the earliest or largest plants associated with what became a vital industry in Wisconsin. Retention of buildings and an overall scale relating to the plants' period of significance is an important consideration. With rapid advances in technology, original equipment is not likely to be extant. Because of their limited number and regional significance, sugar beet refineries may be more important on a statewide level than other canneries.



Canning Plants and Sugar Beet Refineries, 1890- 1950

Source: Fred Stare, *The Story of Wisconsin's Great Canning Industry*, (Madison, 1949), p. 313; F. Woll, *The Beet Sugar Industry of Wisconsin*, University of Wisconsin Agricultural Experimental Station Bulletin no. 123 (Madison, 1905).

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TANNING AND LEATHER PROCESSING

Temporal Boundaries. 1842-present (peak growth and production years 1870-1914).

Spatial Boundaries. The largest concentration of major factories was found along the Lake Michigan shoreline, particularly in the vicinity of Milwaukee. Other sites centered around the state's inland waterway systems.

Related Study Units. Logging and Lumber Milling, Meat Products, Early Labor Movements.

HISTORICAL BACKGROUND

The tanning of leather consists essentially of treating animal skins with natural or synthetic chemical agents to preserve and toughen them. The three most essential materials necessary for the operation of a productive tanning concern are: the hides or skins (mainly bovine), water, and a tanning agent, all of which were readily available in nineteenth century Wisconsin as the tanning industry began its move westward. A relatively simple operation, tanning was carried out as an industry as early as the 1620s in New England. Amazingly, the industry progressed from that point well into the late nineteenth century without major technological change. In Wisconsin, the earliest tanning manufacturer was in operation by 1842 and from the mid-1860s until the 1920s tanning remained an important growth industry in the state, ranking consistently among the first five in value of product. At its peak around the turn of the century, Wisconsin's tanning industry was producing about 15 percent of the United States' raw leather, ranking only behind Pennsylvania in total production.

Wisconsin proved ideal territory for the development of the tanning industry as industrialists moved westward in search of new resources and markets in the early nineteenth century. The chief tanning agents being used throughout the industry in the early 1800s were derived from the barks of various trees and shrubs including oak, hemlock, chestnut, and sumac. Wisconsin's rich reserves of hemlock timber, which grew exceedingly well in the soils of the eastern half of northern Wisconsin, provided what seemed like a limitless supply of raw material for the expanding industry. Tanning barks, particularly hemlock, were relatively scarce in other Midwestern states, thus adding to Wisconsin's favor. As well as being abundant, Wisconsin's forest lands were readily accessible. Those of northeastern Wisconsin were easily reached by way of Lake Michigan and Green Bay and the numerous rivers that drained into them. To the west, the Mississippi and Wisconsin Rivers provided ready supply routes to the more inland forests. Until the introduction of synthetic tanning agents in the late nineteenth century, Wisconsin's hemlock and oak forests provided the solid foundation for the state's amazing growth in leather production. In 1891 alone 57,921 cords of tan bark were cut and shipped to the city of Milwaukee and large amounts were also shipped out of the area to distant tanneries (Schefft 1938:95). A number of the state's larger tanning concerns actually maintained and logged their own private woodlots in order to maintain constant supplies.

Leather tanneries required siting along streams or lakes to enable the factories to take advantage of the enormous amounts of water needed for the processing of hides. The waterways also provided effective means of disposing of industry effluent. (Along with paper plants, tanneries had perhaps the most detrimental effect on local environments in terms of water and odor pollution.) The waterfront locations of most sites provided some concerns with a source of economical power with which to run the new machinery that was increasingly introduced in the latter part of the century. The early ethnic character

of the state had a large part to play in the establishment and success of the tanning industry as well. In the 1840s and 1850s, a great influx of Germans settled in the territory. Many were skilled craftsmen in a host of Old World occupations, including the tanning of leather. Propelled by a knowledgeable and skilled labor force, the industry was able to realize rapid growth in the pre-Civil War era and lay the foundation for later expansion. Of the 13 tanneries operating in Milwaukee by 1860, ten were owned by German-Americans and a majority of the laborers were also of German descent (Schefft 1938:16).

For the most part, the early tanning industry had been a village industry, with individuals processing local hides on a custom basis. "A tannery or two seems to have been uniformly a part of the economic outfit of the inland town. The working dress of the people was largely composed of leather garments... (shoes, aprons, leggings), with materials coming from animals slaughtered on the farms and the local craftsmen utilizing native resources" (Schefft 1938:4). Leather harness work, important to both farmers and tradesmen, was also a major use of processed leather. In the mid-1800s, numerous small inland tanneries were dispersed throughout the hemlock producing areas of the state. Serving local markets with hides obtained from area farmers and butchers, the small shops remained a fixture of a number of Wisconsin communities through the 1870s. However, mounting competition from urban factories during the last quarter of the nineteenth century displaced most of the local shops. Unlike the larger permanent factories, upon the exhaustion of local wood supplies, many of these smaller concerns simply moved on to new locations closer to raw supplies as well.

From its inception, the Wisconsin tanning industry was concentrated in a few lake port cities such as Kenosha, Racine, Fond du Lac, Manitowoc/Two Rivers, and Milwaukee. These areas provided the best economic and environmental conditions for the establishment and growth of the industry in the state. With access to abundant supplies of nearby tan bark, excellent facilities for collecting hides and pelts from the interior, and wide convenient consumer markets, these areas quickly thrived as leather processing centers. Perhaps the earliest firm of any size to become established in Wisconsin was started in Milwaukee by Daniel Phelps in 1842. Phelps' concern was located in a frame structure on the west side of the young community. Another of the earliest large concerns to operate in the state was that of George and William Allen from Cazenovia, New York. First settling in Milwaukee, the pair eventually moved to the forest areas around Two Rivers in Manitowoc County. There, in 1848 along with Cyrus Whitcomb, the men established what became known as the Wisconsin Leather Co., manufacturers of harness and light leather. By 1851 the firm maintained a sizable 270' by 50' factory building that contained a total of 134 tanning vats on the ground floor and extensive drying and storage rooms on the second (a typical layout). At the time, the plant was considered one of the largest in the upper Midwest. By the end of the Civil War the Allens' firm had grown to include extensive plants and distribution facilities in Milwaukee (as well as in Two Rivers) and ranked among the country's leading manufacturers, until the depletion of local bark supplies forced the closure of the Two Rivers plant in the late nineteenth century (Schefft 1938:9,23).

By far the most significant growth in the tanning industry in the state took place when Guido Pfister and Fred Vogel of Wurtemburg, Germany, began operations in the city of Milwaukee. Coming to Milwaukee via Buffalo in the late 1840s, Pfister originally set up a small leather goods store in the city, while Vogel began operation of a small tannery. By 1853 the two enterprising businessmen had merged their operations, creating an operation that emerged as the state's leading manufacturer of leather and business of worldwide reknown. Today, the firm remains a mainstay of Milwaukee's now depleted tanning industry. In 1853, the Pfister & Vogel plant consisted of a 130' by 60', three-story factory, a separate powerhouse fueled by waste bark, and a leach house to process the tan bark. The brick and wood factory contained 63 vats on the first floor for the processing of leather, hide and bark storage areas, and a bark grinding machine on the second floor,

and extensive drying rooms on the third. The 25 person operation could produce about 50 hides a day at peak production. In 1862 Pfister and Vogel began operation of a second tannery at Two Creeks in the northern reaches of Manitowoc county. By the 1870s, the firm operated five separate facilities across the state (Schefft 1938:25; Jensen 1955:1-16).

The city of Kenosha boasted its first tanning concern in 1856 when N.R. Allen (no relation to Geo. and Wm. Allen) began a tannery operation on the city's waterfront. The Allen tannery (originally Grant, Allen & Co.) survived an 1866 fire to become one of the city's leading nineteenth century industrial concerns, along with the Bain Wagon Works. Production value by 1875 had already reached over $70,000 for the tannery, and N.R. Allen and Sons remained a fixture in the city until after World War I. A number of smaller concerns were lured to Kenosha by the strategic Lake Michigan location and access to markets (Schefft 1938:27). Racine enjoyed an even more productive tanning history. By 1855 the community's two tanneries were producing more than $62,500 worth of leather annually, ranking them among the city's top industries. The first tannery was established in the city by F.J. Burnham, who chose a prominent site along the Root River. During the Civil War, Burnham's firm was the third largest in the state, and by the war's end the city supported 11 other independent concerns. The total production value arising from Racine's tanning factories by 1870 was over $200,000, which placed the county behind only Milwaukee County in terms of value of leather production in Wisconsin. Manitowoc County, with plants in Manitowoc, Two Rivers and Two Creeks, was third with $123,000 worth of leather produced annually (Schefft 1938:27-29).

While Sheboygan, Brown, Kewaunee and Winnebago counties all contained a number of sizable firms prior to the Civil War, one of the largest concerns north of Milwaukee was located inland at Fond du Lac on Lake Winnebago. The F.J. Rueping tannery was established on the Fond du Lac River in 1854 and was among the pioneering industrial concerns of the city. Because of extensive railroad connections and a central location in relation to supplies of raw materials and markets, the Rueping factory played a key role in Wisconsin tanning, particularly in the latter half of the nineteenth century when the industry developed new technologies and processes.

Although the pre-war years were marked by the industry's establishment and gradual growth in the state, the Civil War decade of the 1860s was marked by incredible production demands that dictated a massive expansion of the industry. Wisconsin firms, large and small, were called upon to meet the army's requirements for shoes, harness work, and equipment (pouches, packs, bags), and the tanning industry quickly became a highly profitable trade for enterprising businessmen. From 45 firms in 1860, the number of operating tanneries in the state rose to 85 by the end of the decade, and production values jumped from $439,985 in 1860 to over $2,000,000 in 1870 (Schefft 1938:44). The city of Milwaukee had become the unchallenged leader in the state, far surpassing any other Midwestern community in the number of firms and production. In 1860, Milwaukee had nine tanneries, of which only two were substantial operations. By the close of the war, 15 were in operation and by 1872 the number had risen to 30. In total, Milwaukee's tanneries employed over 600 people by 1872 to produce approximately $2,560,000 worth of tanned leather. The figures for the actual leather output from the city were even more impressive: in 1860 the city had produced a total of 45,000 hides, 18,000 calf and kid skins, and a small quantity of sheepskins. By 1872 the output had risen to 158,523 hides, 125,000 sheep pelts, and a proportional number of calf skins. In addition, deer and goat skins were processed depending on local supply and demand. For the most part the city's processed hides were destined for manufacture into harness, sole and upper leather, while sheep pelts became linings and bindings. The manufacture of boots and shoes, in-state and out, utilized a considerable portion of the Wisconsin product. Milwaukee, in particular, had several large boot and shoe factories by the end of the 1860s, most notably the 1843 concern of Bradely and Metcalf (Merk 1916:148-149). (See section on shoe manufacturing at the end of this study unit for more information.)

Transportation, perhaps more than any other single factor, was the key to Milwaukee's preeminence as a tanning center in Wisconsin. Bark from nearby forests could be shipped to the city by boat, wagon, or rail; hides from inland points or from Chicago were economically attainable by way of extensive inland railroad systems; and the city's established trade networks opened up markets for Wisconsin goods throughout the United States. Another important factor which added greatly to the city's leadership role in the industry was the concentration of skilled German tradesmen and laborers in Milwaukee. Milwaukee meat packers were not as important a source of hides in later years as one might assume, for they processed mostly hogs while the tanneries worked principally with beef and calf hides. By the 1860s, industrialized Milwaukee, with its aggressive businessmen, skilled labor force, and extensive trade and transport systems, was recognized as the largest tanning center "west of the Alleghenies" (Merk 1916:149). On a local level, the manufacture of leather ranked behind only iron and clothing in terms of value of product produced in the city. Among the large firms in operation in the city, besides the dominant Pfister & Vogel and Wisconsin Leather Co. concerns, were: the Herman Zourlaut Leather Co. (later taken over by Pfister & Vogel), Trostel & Gallun (NRHP 1984), R. Suhm and Son/Kinnickinnic Tannery, Henry Booth, William Elkert & Son, and G.B. Vollhardt (Schefft 1938:40).

Despite the economic crisis that began in 1873, the growth of the tanning industry in the state continued relatively unabated through the 1870s and 1880s. The era, in particular, saw increasingly broadened markets for Wisconsin goods. Firms such and Pfister & Vogel in Milwaukee, F. Rueping in Fond du Lac, and others throughout the state were establishing fine reputations in the eastern and southern portions of the United States, as well as in areas closer to home such as Chicago, St. Louis, Cincinnatti, and Louisville. New England, where the shoe industry had grown extensively in recent decades, played an especially dramatic role in the marketing of Wisconsin leather. The northeastern factories provided a market for over 90 percent of Milwaukee's sole leather products alone during the 1870s (Nesbit 1973:277-278).

Increasing demands, however, meant increasing pressures for many of the smaller tanning concerns not able to produce at high levels. The new machinery required to keep pace with consumer demands was often not within the financial range of many small local concerns, and, as the transportation systems in the state improved, many of these firms began to lose their regional markets to the larger urban factories that could deliver a consistent product in sufficient volumes to please a growingly sophisticated consumer audience. The period from the mid-1870s through the 1890s was marked by consolidation and centralization of the industry. Many of the state's smaller tanneries merged with the larger establishments, becoming subsidiary plants, or simply closing down operations. Between 1870 and 1880, the number of firms in the state had declined from 85 to 73, and by 1890 the number had fallen to 38. The decline in no way signified a reduction of production levels, however, as Wisconsin's product value during the same period topped $4.3 million in 1880 and more than doubled to over $11.1 million by 1890 (Schefft 1938:40-46).

Milwaukee witnessed the greatest change as the number of firms dropped from 27 to 15 by 1890. Tanning ranked second among the city's major industries by 1890, however, and Milwaukee was aggressively challenging Philadelphia for supremacy in the production of leather in the United States. In the 1890s the Pfister & Vogel firm was decidedly the largest tanning concern in the state, operating three tanneries, employing over 600 people, and producing as much as $2 million worth of leather stock annually. Among the state's other significant producers were: the H. Zouraut Leather Co., A.F. Gallon & Son, and the Albert Trostel Tanning Co., all in Milwaukee and each employing at least 150 workers to produce more than of $500,000 worth of product annually; the La Crosse firm of Davis, Medary & Platz (1880-1910); and the C.T. Roenitz Leather Co., Sheboygan. By the start of the last decade of the nineteenth century Wisconsin was the fourth largest leather

producing state in the country, behind Pennsylvania, Massachusetts and New York (Schefft 1928:96, 44-60).

The turn of the century (1890-1910) was noted by industrialists and businessmen alike as an era of technological changes that greatly altered the tanning industry. New machines for all facets of production were constantly being placed on the market to increase the production capacities of plants, and often necessitating site expansion. Tanning "extracts" were introduced that no longer required the delivery of large quantities of tanning bark to the plants. As a result of newly developed processes, much of the work could be performed at the forest sites and only the resulting extracts (often only ten percent of the weight of bark) needed to be shipped. The development of extracts and extracting processes freed tanning sites from the necessity of being located in close proximity to local wood sources, and dramatically reduced the costs of a major segment of the industry.

The availability of various chemical extract formulas meant a greater diversity of products was possible. In 1884, the chrome process was first introduced to United States tanneries. Utilizing mineral salts such as chromium, iron and aluminum as tanning agents instead of vegetal tannin, the process allowed the manufacture of fine kid and upper shoe leather at moderate prices, in a portion of the time normally required. Wisconsin firms were relatively slow to accept the new process, and it was not until the late 1890s that the F. Rueping firm of Fond du Lac became one of the first in the state to utilize it. The Rueping firm quickly confirmed the value of the process and was among its most successful utilizers in the Midwest.

Electricity played an extremely important role in the industry. Prior to the advent of the electric light, the tanning industry was predominantly a daylight operation. The greasy, oily nature of the manufacturing process made open-flame lighting with gas or oil extremely dangerous and most firms operated only in the daylight hours. The introduction of electricity meant that tanneries could use the full 24-hour day. Throughout the industry, scientific plant operations were being practiced and the role of the scientist and chemist was quickly outstripping that of the skilled craftsman.

The turn of the century era brought forth two new forms of tannery management in the industry: the packing house tannery and the trust. As early as 1890 domestic supplies of hides were proving insufficient to meet the needs of the growing leather industry. Imported hides became a prominent feature, favoring east coast firms especially, and many Midwestern firms began to form strong, almost monopolistic ties with area meat-packing plants. By 1919 four packing companies were supplying 54 percent of the country's shoe leather. In an effort to fight rising competition by combining and pooling resources, tanning trusts, such as the U.S. Leather Co. (1893), were formed. Milwaukee remained predominantly independent from trust manipulation, but other Wisconsin concerns were affected, particularly those in the western part of the state. The operation of the tanning trusts remained relatively intact until the end of World War I.

By 1910 the industry was entering upon its final boom period. The total number of tanneries in the state was 32, of which 11 were located in the city limits of Milwaukee. Utilizing approximately 2 million hides annually to produce over $27.4 million worth of leather, Milwaukee had finally achieved the status as the world's largest leather manufacturing center. The Pfister & Vogel firm alone operated five separate tanneries, including a Menominee Valley operation consisting of 38 buildings spread over a 15 acre site. Employing a total of 2,400 workers to process over 30,000 hides a day, the firm also maintained selling branches in a number of eastern cities and in Europe (Pfister & Vogel 1948:np). Over 13.6 percent of the leather produced in the United States was coming from Wisconsin, and the state remained behind only Pennsylvania in total production (Pennsylvania produced 23.8 percent and Massachusetts was third with 12.2 percent.) (Schefft 1938:96). However, the rumblings of future problems were nearing.

In the 1910s, foreign tariffs on leather and leather goods were lifted, introducing increasing competition for United States companies from European and South American producers. The demands of World War I brought the industry back to life briefly, but by the war's end, certain economic and technical factors initiated the steady decline of the industry in the United States and Wisconsin. Increasing foreign and domestic competition, the nature of the hide market, and the leather market itself, which was quickly being eroded by alternative materials, led to steady declines in United States production. The Great Depression of the 1930s was the final shock that ended the operation of many concerns and left only the strongest firms in production. Milwaukee remains prominent in leather production, with nineteenth century firms like Pfister & Vogel, A.F. Gallunm, and Albert Trostel still in operation, but the industry now plays only a minor role in local economics. The F. Rueping Leather Co. of Fond du Lac retains a moderately sized operation as well.

TANNING PROCESS

The process of manufacturing tanned leather from animal hides involved relatively few steps. The raw hides and pelts were first cleaned and soaked to remove dirt and excess oils. Tanning agents were then applied which displaced the water from the interstices between the protein fibers that make up the bulk of the animal hide. Well coated, the fibers were combined and cemented together by the tannin (tanning agent), to produce strong but resilient leather. Finally, the leather might be oiled or finished according to the desires of the buyer.

In its simplest form, the tanning was done in large vats or pits commonly located on the ground floor of the main tannery building. The pelts and hides were placed in the vats in alternating layers with ground tan bark. Water was then poured to cover the hides and the whole mixture was left to sit for six to 12 months with only occasional stirring and mixing. Some factories might contain as many as 100 separate vats, each filled with a prescribed amount of tanning agent and hides according to the desired end product. Once the tanning process was completed, the hides were taken from the vats and allowed to dry using simple air drying methods such as hanging the hides on hooks or on horizontal racks, or by mechanical means such as tunnel and cabinet kilns or vacuum drying. In many early firms the drying was done in large open rooms on the top floors of the factories where adequate ventilation was possible.

The tanning material used in the manufacture of leather was available in concentrated extract form by the latter part of the nineteenth century, which aided in shortening the time the hides were required to sit in the vats. To form the extract, the tanning bark (hemlock and oak in Wisconsin) was ground up by machine, leached with water and/or chemicals, and eventually concentrated into solid or powdered form until ready for use. Advancing chemical technology introduced chrome tannage in the late 1880s and early 1890s. The use of mineral salts of different kinds instead of vegetable tannins shortened the tanning process from weeks and months to days in many cases, and produced an end product of greater uniformity with a wider range of performance characteristics. The chromium process is still among the principle methods in use today for light leathers. The use of other synthetic tanning agents was widely popular after the 1900s.

Many of the hides brought to the tanneries and stored in cooled cellars or storehouses required additional treatment besides a simple washing in order to remove excess oils, preserving salts, hair, or other impurities. Often special enzyme and lye baths were used, in addition to specialized dehairing, scraping, and splitting machines. At the other end of the process, additional treatments to the finished leather might also be required. Depending on its intended use, the leather may have been dyed by hand or machine; oils were often added to keep the material soft and pliable; various fats were applied for waterproofing; and special patterns and textures could be embossed. Additional finishing touches included mechanical or chemical treatments with pigments, resins, lacquers, and

waxes.

One of the most distasteful aspects of the industrial process associated with the tanning industry was the disposal of factory effluent, most commonly into nearby streams. For most early concerns the adjacent waterways were not only sources of processing water but also economical means of eliminating wastes which included hair, tannin, oxides, enzymes, trimmings, and other materials. The location of tanning concerns was often well known in a community, thanks to their bad odors and chemical pollution. The areas were not the most likely to be greeted by nearby residential or commercial development.

SHOE MANUFACTURING

The shoe and boot manufacturing industry was by far one of the largest users of Wisconsin leather, both in-state and out, utilizing the fine sole and upper leathers produced across the state. In a state where farming maintained such a strong economic hold, the horse and oxen were of prime importance and each required elaborate harnesswork and saddles, also produced of Wisconsin leather. Many other items manufactured in the state, such as gloves, belts, trunks, straps, and bearings, also utilized considerable amounts of leather.

The manufacture of shoes had come to Wisconsin early, at the hands of itinerant craftsman cobblers. Practically all of the early manufacturing of shoes (c. 1830-1850) was done by hand, the leather of the local tannery being made into shoes by journeymen shoe workers who traveled from village to village in yearly cycles, often working in the customer's home. As settlements grew and production demands increased, the master cobblers (many of them German) began to establish small shops where shoes could be made to order. Housed in small frame buildings or on the upper floors of other commercial buildings, the shops marked the first definitive effort to put shoe production on a semi-factory basis. Most of the work remained in the hands of skilled hand-craftsmen, four to eight of whom might be employed by a single shop. By 1850, 76 shoemaking establishments were in operation in the state. Employing 376 men and 13 women, the industry was producing $289,998 worth of boots and shoes a year (Seventh Census of the United States, 1850,15).

The growth of these specialized shops gradually led to the establishment of "central shops" or factories where the skilled all-around craftsmen were no longer essential and workers specialized in only one phase of the shoe manufacturing process. The central shops made it easier to introduce new machine processes, a trend that was to gain enormous impetus during the next several decades. By 1860 the manufacturing of shoes in Wisconsin was being carried out by 1,034 workers in 286 small shops scattered across the state. The total value of production was nearing the $920,000 mark with Dane, Fond du Lac, Jefferson, Racine, and Milwaukee counties leading the state in production (each producing over $40,000 worth of goods). Milwaukee, as the center of the leather tanning industry, supported 50 firms, 321 workers, and had a production value of $369,932 (Eighth Census of the United States, 1860,640-655). The Bradley and Metcalf Shoe Co. was among the earliest and largest boot and shoe firms in Milwaukee. Organized in 1843, the shop successfully expanded; by the start of the Civil War, it employed 70 workers and produced 65 percent of the footwear manufactured in Milwaukee (Merritt 1980:74).

In the 1860s and 1870s, the shoe industry experienced a dramatic upturn. As population and urban demands increased, larger factories began to appear. The Civil War conflict provided a strong impetus for expansion as generous government contracts were awarded to Wisconsin concerns. The expanding railroads enlarged the markets for Midwest producers, stimulating the region's leather industry to produce plentiful supplies of local sole and upper leather for the shoe industry.

The demands created were impossible to supply under the old systems of hand-production

technology. The adaptation of the sewing machine to shoemaking in the early 1860s and the introduction of McKay's pegging machine in 1862 (for attaching the uppers to the sole of the shoe) helped revolutionize production and left only a small portion of the process in the hands of skilled labor. Over the next several years numerous other mechanical devices continually redirected shoe production efforts. By 1870, total production in the state was valued at $1,181,677, and 927 workers were involved in manufacturing shoes on a factory basis. The actual number of firms had declined to 78, as many of the smaller shops were forced to shut down or merge with other firms. Dane, Fond du Lac, Milwaukee and Racine counties remained led in the value of production in the state (Ninth Census of the United States, 1870,742-745). (See map.)

The city of Milwaukee in 1870 provided working space for 11 firms that employed 392 workers and produced over $560,000 worth of goods. Among Milwaukee's major shoemaking concerns in the 1870s and 1880s were the firms of Bradley and Metcalf (1843-1934), the Beals and Torrey Shoe Co. (later Beals-Pratt 1867-1920), the A.W. Rich Shoe Co. (later Rich Vogel Shoe Co. 1867-1930), and F. Mayer Boot and Shoe Co. The industry had its problems, however, including the formation of the Knights of St. Crispin, a pioneer national union organized among the shoemakers in Milwaukee in 1867. The union spread across the United States and included 11 local lodges in eastern Wisconsin. In its early days, the union proved to be a strong labor organization, but it ultimately failed in strike attempts. The 1873 panic led to the disbanding of the organizaton (Merritt 1980:74-75). (See Early Labor Movements study unit.)

By 1880 the statewide shoe and boot industry was manufacturing leather goods with a value of $1,736,713. The growth of the industry continued strongly for the next half-century, reaching production values of $2.9 million in 1890, $4.8 million in 1900, $13.6 million in 1910. By the end of World War I, production value was more than $16.6 million. Ranked among the top ten producing states in the Union, Wisconsin maintained a shoe industry that was characterized by increasing mechanization and the displacement of highly skilled wage earners by less skilled employees. Specialization had also become a feature of many concerns, as efforts were directed toward the production of a particular type, shape, or style of shoe or boot. Increasing centralization was also evident. Of the $13.6 million worth of goods produced by Wisconsin firms in 1909, $7 million was from Milwaukee factories, about four million pairs of shoes. The size of many factory complexes had expanded to impressive scales, utilizing brick and masonry construction. The Great Depression signaled the end of large-scale production in the state, however. Today's industry is scattered among various eastern Wisconsin communities and is mainly restricted to specialized leather footwear. Unlike many mechanized industries, as the industry grew into factory production, local cobblers and shoe repairers still found work in many communities across the state, often in assocation with retail establishments that sold factory-made goods.

The saddle and harness-making industry, trunk manufacturing and other leather processing enterprises followed much the same pattern as the shoe industry, emerging from small local craftsman shops into large factory concerns. Increased consumer demands and new technological developments moved all of the concerns into industrialized forms of varying importance. Racine became a major producer of trunks and valises that incorporated leatherwork, and in 1880 344 saddle and harness concerns were in operation producing over one million dollars worth of goods in the state.

IDENTIFICATION

Resource Types. Tanneries, vat houses, leaching houses, storehouses, drying sheds, chemical processing stations, finishing areas, loading and receiving docks (rail and ship), powerhouses, machine shops, laboratories, offices, tanning bark lumber camps, factory built housing, owner and employee housing, distribution and branch offices, union halls. Related processing facilities: boot and shoe factories, glove and clothing factories, saddle and harness shops, trunk manufacturers, retail leather shops. Typical industrial buildings of utilitarian design, the multi-storied, brick and frame structures that comprised tannery sites, might rise as high as five or six stories and were commonly long, rectangular forms with low roofs. Multiple window openings allowed for abundant natural lighting and ventilation. Larger plants consisted of interconnected complexes of structures.

Locational Patterns of Resource Types. Tanning concerns required large amounts of water for processing and refuse disposal and were thus located adjacent to major waterways (rivers, streams, canals, lakes). Economical access to both markets and resource supplies also required access to major railroad lines. Due to their environmental impacts many were sited in rather secluded areas or in heavily industrialized sectors of a community.

Previous Surveys. The Milwaukee Menominee Valley report and the Kenosha intensive survey were the only reports to identify extant sites in the state. The Wisconsin State Gazetteer and Business Directory lists the name and location of all Wisconsin tanneries for various years in the nineteenth and early twentieth centuries.

Survey and Research Needs. Extensive information is available from local and county histories on Milwaukee's tanning industry as well as some of the other large Lake Michigan centers, but research is required to compile the information into a more usable form. In addition, information concerning the inland tanning industry and its importance to the entire Wisconsin picture is seriously lacking.

EVALUATION

National Register Listings and Determinations of Eligibility

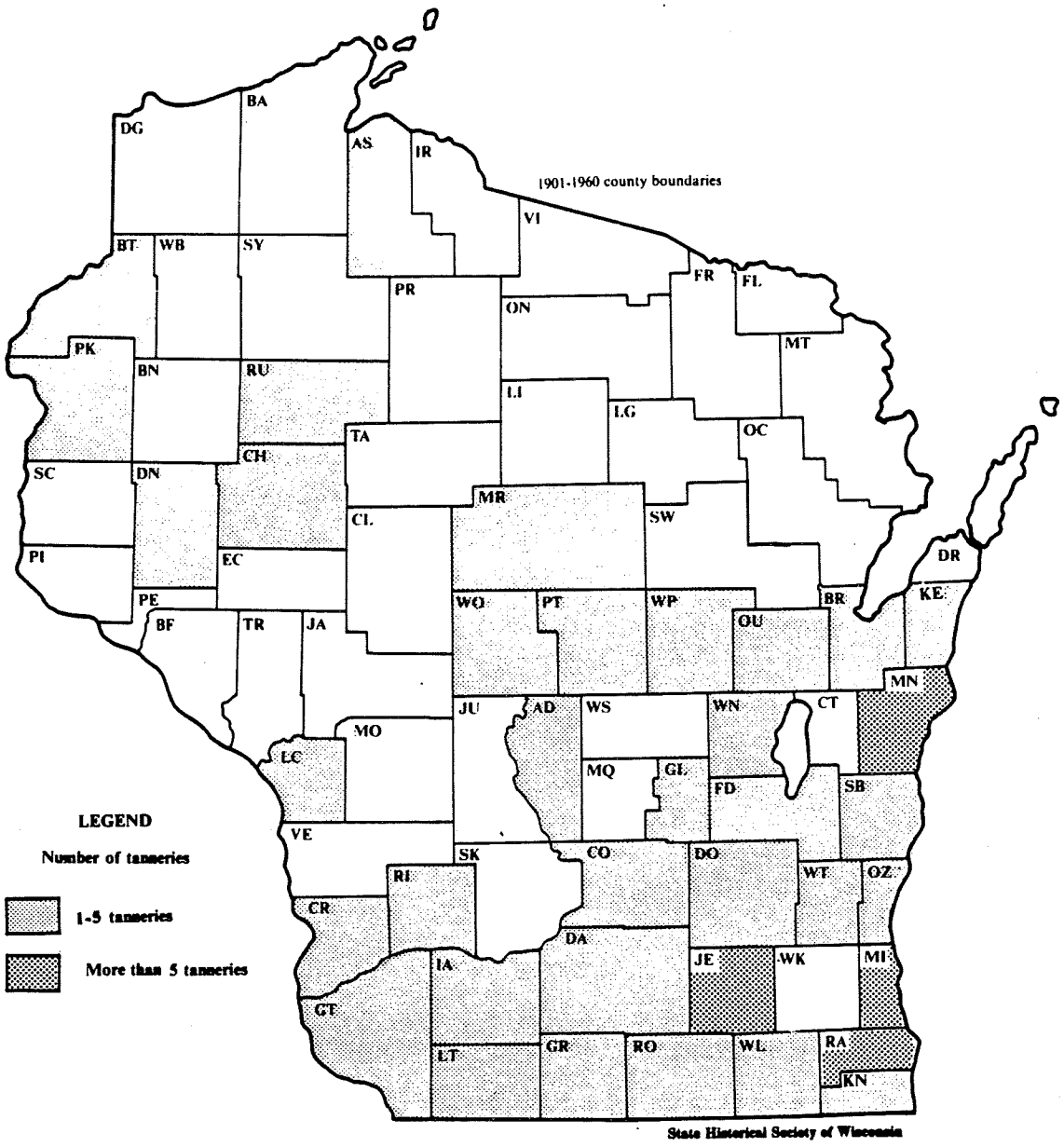
Beals and Torrey Shoe Co. Building (1904), 100 N. Milwaukee St., Watertown, Jefferson County (NRHP 1984)

Gallun Tannery Historic District, 1781 and 1818 N. Water St., Milwaukee, Milwaukee County (NRHP 1984, Brewers Hill MRA)

F. Mayer Boot and Shoe Co. (1892,1899), 116 E. Walnut St., Milwaukee, Milwaukee County (NRHP1984)

Pfister and Vogel Leather Co. Buildings (1870-1900), Oregon St., Milwaukee, Milwaukee County (NRHP 1978, Walker's Point Historic District)

Context Considerations. Structures associated with the tanning and leather industry should be evaluated in relation to the firm's total system. Many moderate-scaled plants consisted of only two or three buildings, while the larger plants of the late nineteenth and early twentieth centuries often contained numerous primary and secondary buildings and shops. In general, most sites should be evaluated for significance on a local level. In some instances, however, with firms such as Pfister & Vogel or F. Rueping, state or even national significance may play a role in final evaluation.



Location of Tanneries, 1872-1910

Source: Charles Schefft, *The Tanning Industry in Wisconsin* (M.A. thesis, University of Wisconsin, 1938).

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Leather Works Journal
1917- Kansas City, Missouri.
1926

Wisconsin State Gazetter and Business Directory
1876- Milwaukee
1922

CARRIAGE AND WAGON WORKS

Temporal Boundaries. 1840-1920.

Spatial Boundaries. Widely scattered throughout the state, following the lines of settlement. By the mid- to late-1800s a number of large, dominant firms located in the southeastern portion of the state (eg. Racine, Kenosha, Janesville).

Related Study Units. Agricultural study units, Agricultural Machinery and Implement Manufacture.

HISTORICAL BACKGROUND

The early manufacture of carriages and wagons in Wisconsin played an important role in the early stages of industrial development in the state and greatly aided the continued settlement of the region's pioneering agricultural areas. Growing out of independent blacksmith and wheelwright concerns, carriage and wagon manufacturers marked one of the first small scale industries, along with flour milling, to develop within the expanding agricultural regions of the state. Abundant supplies of natural hardwoods and the continual growth of agricultural development in the Upper Midwest ensured that wagon production remained a vital enterprise through the nineteenth century. The early years provided the industry with the strong base from which it grew into a major nineteenth century Wisconsin activity, with important links throughout the western frontier.

Although it can be considered a basically simple manufacturing process, the carriage and wagonmaking industry evolved into diverse concerns from the blacksmith who performed work on wagons to the wagon manufacturer who hired smiths to work in his shop. Blacksmiths were among the first craftsmen to ply their trade in the newly opened areas of settlement in pioneer Wisconsin. Blacksmith shops quickly joined the flour mills and saw mills in establishing businesses in the small crossroads communities that dotted the countryside. Able to manufacture and repair a wide range of farm tools, machines, and wagons, the smith promptly began to provide an indispensible service in the local community. The blacksmith/wagonmaker who could repair the wheel of a wagon, fashion new hardware, or build a complete vehicle remained the mainstay of the wagon industry well beyond the turn of the century.

As larger communities began to develop in the state during the 1850s and 1860s, specialized firms and artisans began to establish themselves in the area. Concerns involved strictly with the manufacture of wagons and carriages became common in communities of any size. Production from these specialized shops, which might include as laborers wheelwrights, carpenters, painters, blacksmiths, and leather workers, quickly outstripped that of the more rural blacksmith/wagonmaker and became the major manifestations of the carriage and wagon industry in the state. The parallel efforts of the blacksmith/wagon repairer and the larger wagon manufacturer continued well into the early twentieth century. The local smiths remained as small one-to-two man operations, while the manufacturers grew into sizeable industrial concerns. The largest of Wisconsin's concerns, the Bain Wagon Works of Kenosha, employed 450 men by 1915 (Lyman 1916:305-345). (Census data concerning the industry is difficult to interpret over a span of years due to the fact that in some years counts included smiths and wheelwrights as "wagonmakers" while in other years separate counts were made).

As an industry, carriage and wagon manufacturing in the state was still in its infancy in 1840. Federal census figures for that year reported only eight independent firms engaged exclusively in the manufacture of carriages and wagons. The value of production from

these firms totaled only $2,600. Of the eight concerns, five were situated in Racine County at the heart of the state's early agricultural and population center. Grant County to the west supported two concerns and the Brown County/Green Bay area the other (Sixth Census of the United States 1840,352).

Serving the rapidly growing farm population of Wisconsin, the wagon industry grew continually during the next several decades as more and more settlers arrived to try their hand at cultivating the region's rich prairie lands and to establish new communities. New concerns were established across the state directly following the lines of new settlement. Although the manufacture of wagons, carts, and sleds for agricultural/farm use remained the mainstay of the industry, manufacturers also served the growing urban centers of the state. By the 1850s and 1860s, census data began to distinguish between carriage and coach manufacturing and the production of wagons and carts. Simple wagons and drays were fine for the farmers and tradesmen, but growing city populations demanded more "dignified" and comfortable conveyances.

By 1850, 74 firms were listed as simple wagonmaking and wheelwrighting concerns in the state, employing a total workforce of 291 and producing $205,000 worth of goods. The number of coach and carriage making concerns totaled 10 shops. With a workforce of over 85, these firms produced $64,350 worth of carriages for a predominantly urban consumer market. County by county listings of carriage and coach firms, as detailed in the census, further reveal the strong tendancy of firms to locate only in counties with major urban centers, notably Milwaukee, Racine, Kenosha, and Fond du Lac (Seventh Census of the United States, 1850:36,121).

The figures above clearly relate the differentiation between wagon and carriage manufacturers that marked the mid-nineteenth century. The production of carriages and coaches, which utilized more than twice as many craftsmen per firm, was much more labor intensive than wagon manufacturing, largely because of the amount of finish work involved in the completed product. While wagons were simple units sturdily built, carriages often required the efforts of custom painters, skilled upholsterers, and even trained brass or silver smiths, in addition to the normal contingent of blacksmiths and carpenters. The relative value of the products manufactured by the carriage concerns, of course, reflects this increased complexity of production.

Although this division between wagon and carriage manufacturers remained a distinctive feature of the industry during its earliest growth phases, by the late 1800s, with the increasing centralization of the industry in larger factories, many concerns developed broad ranges of vehicle types from simple carts to elaborate coaches. Whether manufacturing carriages, wagons, or sleds, the antebellum production processes remained predominantly in the hands of skilled craftsmen who designed, fabricated, and assembled the complete vehicle under one roof using little or no mechanical devices or mass produced components.

By 1860, the number of carriage manufacturing concerns in operation in the state rose to 17, and the associated workforce grew to 118. Wagon and cart manufacturers in the state totaled 179 and employed a total of 610. The value of production of the two branches of the industry reached $125,000 and $481,000 respectively, and the state was well on its way to becoming one of the major manufacturers of horse-drawn vehicles in the Midwest (Eighth Census of the United States, 1860,640-655).

Among those firms that established themselves in the 1850s was the small manufacturing and repair shop of Edward Bain in Kenosha. The Bain Wagon Works, started in 1852, ultimately led the state in the manufacture of wagons and carriages. Continually a leading industrial concern in the community, by 1900 the firm supported one of the largest wagonmaking plants in the entire United States, producing over 18,000 wagons annually (Lyman 1916:305).

The decade from 1860 to 1870 marked the industry's most remarkable and dramatic boom period, as the post-Civil War era placed enormous demands on the development and production of agricultural lands in the Upper Midwest. With the expansion of agricultural production, in addition to an increased industrial capacity, the demand for wagons, carts, and coaches expanded dramatically. By 1870, 485 firms were attempting to meet those demands across the state. Employment in the shops and factories had risen to 2,184, but more importantly, production rose above the two million dollar mark to $2,596,534 (Carriage and wagon statistics are combined in the 1870 census) (Ninth Census of the United States, 1870,742-745).

Carriage and wagon production in the state lagged behind only flour milling and lumber in terms of the value of the products it produced. On a nationwide level, Wisconsin was behind only Pennsylvania, Ohio, New York, Missouri, Michigan, Indiana, and Illinois in both the number of firms and the value of wagon and carriage products. By far the most productive areas of the state were Kenosha and Racine counties where an abundant supply of hardwoods, access to local and distant markets by rail and water, and an early start in the industry provided local companies with a decisive advantage in the marketplace. Production value from Kenosha County's eight firms had surpassed the $353,000 mark by 1870, second only to Racine County's production which was valued at $505,050 (13 firms). Together, the two areas produced 33 percent of the state's total wagon and carriage manufacturing output (Ninth Census of the United States, 1870:742-745).

While communities like Kenosha and Racine retained the production of such dominant firms as the Bain Wagon Works, Mitchell and Lewis Wagons (1866), and the Fish Brothers (1862), the manufacture of wagons and carriages in more rural areas remained the province of small scale concerns employing four to six craftsmen. Housed in simple frame or masonry structures commonly one-and-a-half to two stories in height, the shops often contained adjacent blacksmithing areas, and in some cases, simple "showrooms" in which various products could be displayed. The 87 ft by 24 ft Ritger Wagonmaking shop in Hartford, Washington County (1867, NRHP) is probably typical of the many simple shops located in the outlying communities of Wisconsin. In addition to Kenosha and Racine, those regions that maintained the most sizable production levels during the war and postwar era included the counties of Fond du Lac, Green, Rock, Walworth, and Milwaukee, where production was centered more on vehicles for industrial and personal use than on those for farm use.

By 1880, the boom period of wagon manufacture expansion was over. During the financial depressions of the postwar years, particularly 1873, many of the concerns that had emerged during the prosperous 1860s failed. Throughout the 1870s and increasingly during the 1880s, the industry experienced a period of consolidation, in which increased rail access and improved methods of manufacture placed larger concerns in the southeastern portions of the state at a dramatic advantage over scattered smaller sites. Many of the small, often isolated firms were forced to close, and the production levels at the major plants rose sharply to take over their markets. By 1880, Racine and Kenosha accounted for over 50 percent of the state's output of wagons and carriages (Tenth Census of the United States, 1880:371-378).

The total production of the 156 firms recorded in the 1880 census was valued at $4,350,454, a figure that pushed Wisconsin into fifth place behind Pennsylvania, Ohio, New York, and Illinois in the value of wagons and carriages produced in the United States. Wisconsin products were finding markets well beyond the state borders, as firms began shipping wagons in large numbers to the western farmlands of Iowa, Minnesota, and the Dakotas. Among the areas of the state that still retained substantial manufacturing sites besides Racine and Kenosha were Fond du Lac and Winnebago counties, where 19 firms recorded in the 1880 census produced $677,000 worth of goods.

Much of the production was undoubtably the result of the emergence of local paper and lumber industries, as well as agricultural production and urban development (Tenth Census of the United States, 1880:371-378).

New manufacturing processes and procedures that were implemented in the late decades of the 1800s had a dramatic impact on the statewide industry. The increasing mass production of vehicles from a broad line of stock components, rather than from the individualized custom work of the earlier era, became a major feature of the evolving industry. The concept allowed the larger concerns to gain wider and wider areas of the market by lowering costs and improving production. Interchangeable parts and stock patterns allowed overhead costs and time to be cut dramatically. The dependence upon skilled laborers was also increasingly lessened in many areas of production. For example, where possible, stamped metal parts acquired from nearby Lake Michigan foundries and metal shops were employed to alleviate much of the tedious work once performed by smiths. While perhaps not quite as advanced as the assemblyline process, the mass production of parts and wagons, made possible only by the formation of large concerns, was an important aspect of Wisconsin's continued role as a manufacturing center for wagons and carriages.

Changes in production methods resulted in required changes in other aspects of the industry. In many cases, plants expanded tremendously in the latter part of the nineteenth century as factories replaced small shops. Larger manufacturers began to include machine shops, assembly plants, pattern shops, parts storage areas, paint shops, and a host of other minor departments housed in frame or, more often, brick buildings. Most facilities remained only one to three stories in height, due to the energy and expense required to raise or lower the heavy wagons from one floor to another. Direct access to rail facilities for the receipt of incoming raw materials and shipment of finished products also became essential, as many of the customers were no longer driving their purchases home. As distributorships began to influence the marketing of products, the company showroom became important and distribution warehouses became a necessary adjunct to the industry.

Among the many firms to build and/or establish sizable concerns during the late nineteenth century were the Janesville Carriage Co. of R. Hodge and H. Buckolz, the Wisconsin Carriage Co., also of Janesville, the Jung Carriage Factory in Sheboygan, which had began operating in the 1850s, the 1865 Stoughton Wagon Co. of Targe Mandt, which employed over 500, mostly Norwegian, laborers by 1920, and the ever-present Bain Works in Kenosha that by the early 1900s had grown to include 12 separate buildings on its four block site.

Domination by larger firms continued to mark the industry beyond the turn of the century and into the early 1900s. Production levels continued to rise through 1920, but the relative importance of the industry in the statewide industrial arena began falling off dramatically. In the 1870 census, with production valued at $5,947,500, the industry ranked tenth in the state in value of product; in 1900, with production value at $6,956,340, the industry ranked thirteenth. By 1910, production value had reached $8,899,000, but the ranking dropped to eighteenth, and by 1919, with production value only rising to $9,455,000, the industry was dropped from the list of top 20 industries (Compiled from United States Census Data for the years 1890, 1900, 1910, 1920).

With the turn of the century, a new aspect of vehicular design, the horseless carriage, was introduced. The automobile, which began to appear in the early 1900s in the state, eventually caused the demise of the wagon and carriage industry as reviewed above. In the early years, a number of firms attempted to develop automobile departments within their wagon and carriage factories, marketing both products from their showrooms. By the 1910s, however, the automobile was gaining wide acceptance, as was the gasoline tractor, and the demands for farm wagons and riding carriages rapidly decreased.

Many concerns were retooled for the sole manufacture of automobiles, which in the early days was not dramatically dissimilar from wagon production. With the introduction of farm tractors and other heavy machinery for use on the farm, other concerns combined with closely allied agricultural machinery firms in the production of farm equipment.

IDENTIFICATION

Resource Types. Blacksmith/wagonmaking shops, small wagon and carriage manufacturing shops, assembly plants, paint shops, pattern shops, forges, powerhouses (mostly steam), storage houses, carriage show rooms, distribution warehouses, offices, craftsmen and owner's residences.

Locational Patterns of Resource Types. Early shops were scattered across the settled areas of the state, often located at crossroads "commercial" centers in agricultural areas. Local supplies of natural hardwoods were important to early firms, while later establishments relied more on direct rail access for raw materials and the shipment of goods. Carriage concerns were normally located in or near urban or developed areas because of their markets.

Previous Surveys. Intensive Surveys of Green County, Reedsburg, and Racine have identified extant carriage/wagon shops, but no systematic thematic survey of such properties has been conducted.

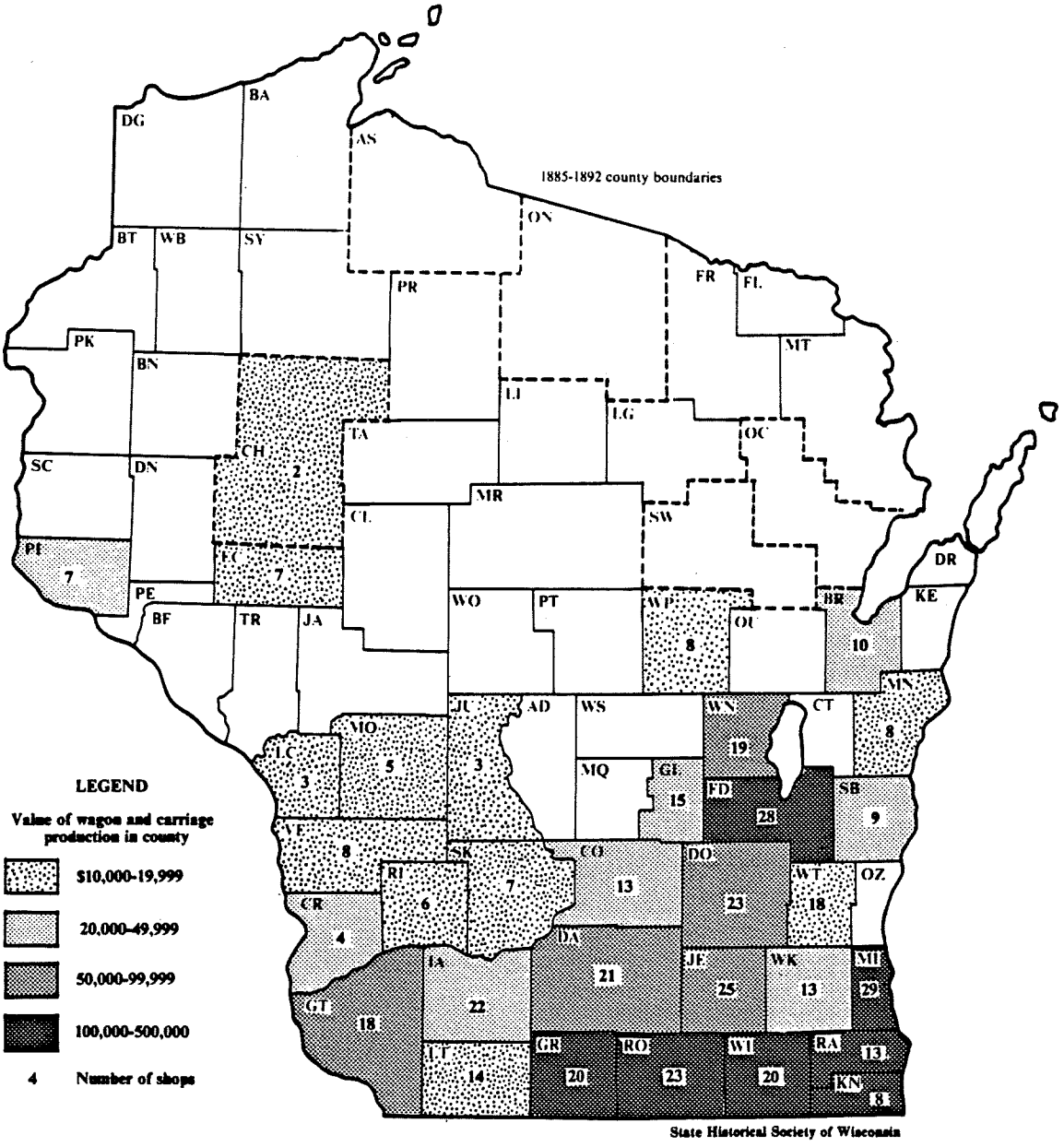
Survey and Research Needs. Studies of wagon and carriage manufacturing sites should be included in any future surveys, particularly in the rural areas of the state where they are more likely to be extant. Actual production statistics for individual shops, in terms of the number of units produced, the types, and the extent of the market areas may be of future research value.

EVALUATION

National Register Listings and Determinations of Eligibility

Ritger Wagonmaking and Blacksmith Shop (1867;1915), Hartford, Washington County (NRHP 1982)
Jung Carriage Factory (c.1885), Sheboygan, Sheboygan County (NRHP 1974)
Hollenstein Wagon and Carriage Factory (1876), NW corner of Bridge and German Sts., Mayville, Dodge County (NRHP 1979)
Wagon and Paint Shop (1912), Water St., Baraboo, Sauk County (NRHP 1969, Ringling Bros. Circus Headquarters)

Context Considerations. Except for some sites in the southeastern urban centers of the state, most resources are probably significant on a local level, based on the importance of the site to the local economy. Being an outmoded industry, the likelihood of finding machinery and/or equipment intact is unlikely, although rural sites may still retain traces of substantial smithing forges.



Number of Carriage and Wagon Shops and Value of Production, 1870

Source: Ninth Census of the United States, 1870: Vol. III, *Industry and Wealth*, pp. 742-745.

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AGRICULTURAL MACHINERY AND IMPLEMENT MANUFACTURE

Temporal Boundaries. 1840-present.

Spatial Boundaries. Southeastern Wisconsin, with major centers in the Racine and La Crosse areas.

Related Study Units. Carriage and Wagon Works, all Agricultural study units.

HISTORICAL BACKGROUND

A study of the development of the agricultural machinery industry in Wisconsin must be viewed in context with the incredibly rapid development of agricultural cultivation in the frontier state. With the expansion of the nation's frontiers in the early 1800s, the center of wheat production moved steadily westward, leaping from New York and Pennsylvania to Ohio and Illinois and eventually reaching into the rich prairie lands of southern Wisconsin and Minnesota. By the 1840s, Wisconsin was becoming an important and vital part of the nation's granary (see Agricultural study units for more information). To match the increasing scale and production levels of Wisconsin agriculture, enterprising businessmen and mechanics quickly established concerns that supplied the region's farmers with required tools and equipment for cultivating their rich farmlands.

Growing out of small blacksmithing and wagon making enterprises, the manufacturing of agricultural implements and machinery developed in the latter half of the nineteenth century as one of the leading industrial activities in the state. The industry first emerged in the early southeastern wheat producing areas of the state. The area, which offered abundant waterpower sources, a ready supply of useable hardwoods, and central access to market, formed the heart of Wisconsin's agricultural manufacturing industry well into the present century.

In the early 1840s, however, Wisconsin farms still obtained implements and machinery from local smiths, wagonmakers, and carpenters, many of whom were simply repairmen for eastern manufactured goods shipped west on the Erie Canal and the Great Lakes. At this point, the rural blacksmith/repairman was a vital link in the agricultural infrastructure of the state. But increasingly, as the 1800s unfolded and the state's agricultural base continued to expand, the demand for new, up-to-date machinery and implements at reasonable prices and on short notice increased dramatically. The 1840 census recorded only eight people or firms employed in manufacturing and repairing agricultural implements in Wisconsin, the majority of whom were also recorded as wagonmakers. Of the eight firms, five were located in Racine County. By 1850, however, 31 shops operated in the state, employing over 177 workers and producing approximately $187,000 worth of goods. Racine continued to be the center of the industry, with seven independent firms established by 1850. Together, these seven shops produced 1,225 fanning mills, 550 ploughs, 125 threshers, and an assortment of other implements (Seventh Census of the United States 1850:46).

Along with Racine, the southeastern counties of Walworth and Rock and those areas along the Rock River valley provided the manufacturing industry with its first foothold in the upper Midwest. In the heart of the earliest wheat producing areas of the state, the firms had access to local and later to regional markets, an abundant supply of the native hardwoods and raw materials required to manufacture the early machinery, and sources of dependable water power. The broad prairies and level farmland of the area proved

particularly well adapted to the use of such new implements and machinery as steel ploughs, mechanical reapers and harvesters, and hosts of other labor-reducing tools.

Among the earliest concerns to emerge in Wisconsin's expanding marketplace during the important growth years of the 1840s and 1850s were those of such men as George Esterly, Richard Ela, Lucius P. Blake, Albert Dickey, Edwin Putham, and Joel Potter. Esterly manufactured one of the first successful harvesting machines in the state from his small shop at Whitewater in 1844. Richard T. Ela who began producing fanning mills at Rochester in Racine County as early as 1838, was producing 100 such mills a year by 1842 along with ploughs, wagons, and other equipment. Ela operated branch shops at Waterloo and Waupun to the north by the mid-1850s. Lucius Blake came to Racine as a carpenter in 1839. In 1844, he and James Eliot began to produce fanning mills, designed to separate the chaff from harvested grain. By the late 1840s, their shops were producing 100 to 300 fanning mills a year. Albert P. Dickey came to Racine in 1845 by way of New York and Chicago, where he had been involved in the production of agricultural implements. By 1850, he was constructing 625 Wisconsin-made fanning mills a year. Edwin Putnam and Joel Potter's 1845 Grant County concern, which continued well into the 1880s, was one of the few western shops able to hold its own under competition from well organized southeastern concerns (Smith 1973:532, Walsh 1972:294).

One man in particular, Jerome I. Case, best conveyed the evolutional patterns so typical of the embryonic industry in its antebellum years. Case, whose name was synonomous with agricultural machinery production in Wisconsin throughout the nineteenth century, began his career in New York state where he worked doing custom threshing for local farmers. Upon hearing of the vast new wheat producing areas opening up in the upper Midwest, he purchased a number of eastern-built threshing machines and moved to Wisconsin. Settling in Rochester, Wisconsin in 1842, Case promptly sold his machines to a receptive farm audience, keeping one unit for himself with which to continue his custom threshing operations. While in Rochester, Case was introduced to local manufacturer Richard Ela, and the two began to work on improvements to the threshing and winnowing machines. But after developing a vastly improved threshing machine, the pair were unable to secure water power rights on the local Fox River. In 1844, Case moved to Racine where he built a three-story brick factory on the Root River. Only 30' x 80', the 7,200 square foot factory was nonetheless one of the largest in the region. By 1850, it was producing 100 of the improved machines annually and was one of the most profitable operations in the state (J.I. Case Co., 1948).

Most of the early shops were simple firms which hired blacksmiths, millwrights, carpenters, and other mechanics to assemble and repair stock components into completed machines. But by the mid-1850s, the more progressive firms, including Case's, were beginning to construct their own foundry and machine shops as well as their own elementary design departments. Important to Wisconsin's role as a major source of nineteenth century agricultural machinery was the fact that the industry's participants were much more than simple manufacturers; they were also inventors, designers, and master salesmen. Aggressive firms found that their reputations quickly expanded beyond the local market areas to farmlands in Indiana, Illinois, and Iowa as well as to areas across Wisconsin which became important markets for Wisconsin goods.

Having established a relatively solid base during the 1850s, the industry experienced its most substantial growth in the decades during and immediately after the Civil War. Although the Panic of 1857 brought severe setbacks to many firms, the Civil War conflict stimulated a dramatic increase in the demand for wheat production. In response to the elevated demand, more and more Wisconsin and Midwestern farmland was put under cultivation, causing an increased demand for farm machinery and implements. The war also robbed the area of much of its itinerant farm labor. In order to make up for the lack of a plentiful labor force, farmers began to depend on and demand the most modern and efficient agricultural machinery.

The agricultural machinery industry responded by expanding. By the mid-1860s, a total of 81 shops and factories employed an average of 6,700 people a year. Individual firms grew in size during the period as well. While firms such as the Case Threshing Machine Company employed as many as 70 workers, the average firm grew from a two to three person operation into one employing seven to ten workers. Those numbers grew even larger by the end of the decade when a total of 1,387 employees worked in 82 different firms across the state (Ninth Census of the U.S., 1870:742-745).

With the expansion of cultivated farmland, the location of firms across the entire southern portion of the state broadened even further. Wherever farming was heavily concentrated and sufficient woodlands were available, small firms emerged. But a strongly developed base, access to an improving railroad network, and the experienced promotional skills of the earliest firms allowed the center of the industry to remain in the southeastern corner of the state. The city of La Crosse posed a dramatic exception to the rule. Aided by its prominent location on the Mississippi and adjacent to the newly opened farm areas of northwest Wisconsin and Minnesota, the community of La Crosse supported 50 laborers employed in the manufacturing of various agricultural implements and machines (Ninth Census of the U.S. 1870:742-745).

In the southeastern portion of the state, the communities of Beloit, Janesville, Madison, and Whitewater were all considerable centers for the manufacturing of farm equipment, especially reapers and mowers. Beloit and Whitewater were also significant centers of plough manufacturing. Madison eventually became the major producer of sorghum mills in the state as well. The production levels attained by several concerns during the Civil War period reflected the extent of the wartime boom that affected the industry. The Madison firm of E.W. Skinner and Company produced only one sorghum mill in 1861. By 1863, the firm's production had risen to 100 machines annually, and in 1865, 500 mills left the firm's shops. The pioneer firm of George Easterly, mentioned earlier, was producing 5,000 mechanical seeding machines from their Whitewater plant by 1868. Further to the north from a site on the Rock River in the village of Horicon, Daniel and George Van Brunt's firm was producing almost 3,200 similar machines. In 1860, on the other hand, the firm produced only 60 machines. Racine, as it had from the beginning, led the state in the production of threshing machines. The continually expanding J.I. Case Company was creating 1,300 units annually by 1870, and total annual production for the firm was valued at close to $1,000,000 by the war's end (Merk 1916:145-146).

With the end of the war and the beginning of the latter decades of the nineteenth century, the agricultural machinery industry in Wisconsin continued to expand rapidly. The Homestead Act of 1862, the westward expansion of railroads after the war, and the rapid influx of returning soldiers and European immigrants to the Midwest opened more hundreds of thousands of acres to wheat and other grain production. The new rail lines also helped make these newly opened agricultural frontiers in Minnesota, Iowa, and the Dakotas accessible to Wisconsin's manufacturing centers. New inventions and machinery, such as John Appleby's revolutionary automatic twine-binder (1878, Beloit), were continually appearing on the market. Steam powered machinery and steam engines, which had replaced waterpower in most factories by 1870, were used increasingly on larger farms at this time, due in no small measure to the efforts of Jerome Case's Racine firm.

The federal census of 1880 reported that 108 independent firms existed in Wisconsin for the manufacture of agricultural implements and machines. The firms employed a total workforce of 2,067 laborers. This period marked the high point for the number of firms involved in manufacturing farm machinery in Wisconsin. Through the next few decades and into the twentieth century, the absolute number of firms in production decreased dramatically, shrinking to 51 firms by 1890 and to 34 by 1920. Production levels, however, continued to rise as did the total number of workers employed (Compiled from

Census Reports of the U.S. for 1880, 1890, 1900, 1920).

These statistics reflect the fact that the 1880s marked a significant turning point in the development of Wisconsin's agricultural machinery industry. The wood-based industry of the 1860s and 1870s was evolving increasingly into one of metal components and highly sophisticated machinery. The portable steam power units and steam "tractors" introduced in the 1870s were becoming commonplace, while large scale casting and foundry departments became integral parts of diverse multi-faceted enterprises. The advancing technology of the later nineteenth century led to the replacement of small shops by larger factories and industrial plants. Repair work and small machinery construction still occurred in scattered mills and shops across the state. But increasingly, both the necessity for large capital outlays to produce machines in quantities sufficient to satisfy growing markets at a price farmers could afford and the need for adequate rail transportation to deliver these goods to market resulted in a stronger concentration than ever of manufacturing complexes in the southeastern corner of the state. The Milwaukee area in particular, which had not played a major role in the development of the industry in its early years, became increasingly involved as the once "light industry" emerged from the late nineteenth century as a major heavy industry.

As specialized management personnel and research and development departments replaced the formerly omnipotent company owner, many larger firms attained a new degree of sophistication. The marketing aspects of the industry, often overlooked, were actually a key factor in the growth of Wisconsin's firms. Company agents, itinerant salesmen, local distributors, credit sales, and extensive advertising programs all played crucial roles in creating a network through which Wisconsin firms were able to supply farmlands as far away as California and Mexico by the turn of the century. The ability of Wisconsin manufacturers to exploit favorable market situations to their best advantage bolstered the industry from the 1850s through the twentieth century. Although the industry ranked only eleventh in the state in 1890, Wisconsin manufacturers of farm machinery were producing over five million dollars worth of equipment a year, placing the state behind only New York, Ohio, and Illinois in total value of agricultural machinery products manufactured (Fitzpatrick 1931:324).

The industry continued to consolidate through the early decades of the twentieth century, as larger concerns, such as J. I. Case, Milwaukee Harvester, and Allis-Chalmers, bought out or forced the closure of many smaller operations. Tractors, combines, and other large equipment became more important facets of the overall farm machinery industry as well, and the manufacturing of agricultural products once more became closely allied to the carriage and wagon industry from which it had started. (See Carriage and Wagon Works study unit). World War I (during which Wisconsin was ranked second in agricultural machinery production) and World War II resulted in huge booms in the industry. In addition, during this era, many older plants were retooled as mass, assembly-line operations became the standard of production.

MACHINERY FOR MIDWESTERN FARMING

Until the nineteenth century, the cultivation of agricultural lands was a relatively unchanged process, relying on much the same techniques and technology as it had for centuries. The majority of farm labor in America, as late as 1830, was still performed by hand or with the aid of an occasional tool, oxen, or other draft animal. After tilling his fields with an oxen and plow, the farmer sowed the seed, individually or using the simple broadcast method. The continual cultivation and weeding of the crops by manual labor proceeded throughout the growing season. When the crops were ready for harvest, the farmer, perhaps aided by his hired hands, took to the fields with sickle and scythe to bring in the crop and ready it for market.

The mounting industrial revolution began affecting the American farmstead by the

mid-1800s and, as demands for production continued to increase, the American farmer began to seek new time and labor-saving devices. A generation earlier, the cotton gin had made possible the extensive cotton culture. By mid-century, the invention of mechanical implements for the farm--the reaper, the mower, the steel plow, the seed drill, and the threshing machine--made farming possible on an extensive scale, particularly in the prairie regions of the Midwest where old farming practices often proved impractical. Some of the major innovations in agricultural machinery brought to the Midwest during the nineteenth century are discussed in this section. The information was summarized from two main sources: John Oliver's History of American Technology (NY: Ronald Press, 1956) and Frederick Merk's Economic History of Wisconsin during the Civil War Decade (Madison: State Historical Society of Wisconsin, 1916).

Plows

Wooden and cast iron plows, the product of local carpenters and blacksmiths, had served farmers well since Greek and Roman times. The soil of the western prairie, however, lacked the stone and grit that normally scoured the plow's mold board, allowing it to freely lift and turn the soil. Through the efforts of Illinois mechanic, John Deere, the all-steel plow was developed and rapidly proved a huge success in the Midwestern states. By 1858, the John Deere factory was producing 13,000 steel plows annually for the prairie trade. A number of Wisconsin concerns soon followed the lead, manufacturing their own steel and iron plows, particularly in Brodhead, Port Washington, and Sheboygan Falls. As the century progressed, the factory production of plows displaced the local blacksmith from the manufacture of plows, turning his operation increasingly toward repair work. During the post-Civil War era, the design and manufacture of plows continued to improve. The introduction of the gang plow with its attached seat in the late 1860s allowed the operator to sit astride the plow while it turned a series of regular furrows at once. Later inventions included the disc plow as well as power driven units and machines.

Planters and Grain Drills

The farmer with a sack of grain about his neck scattering seeds and grain was a slow, laborious, and often wasteful method of planting a field. Seed drills mounted on wheels, equipped with force feeding devices and fluted hoes that opened furrows for the seed, were introduced to farmers as early as the 1840s and allowed a single man with a two horse team to sow eight to ten acres a day. The general use of grain drills and seeders, for corn as well as wheat and barley, would not come until the last quarter of the nineteenth century. Wisconsin was dominated in the manufacture of such products by the firms of George Easterly (Whitewater), Van Brunt and Company (Horicon), and Rowell and Company (Beaver Dam).

Reapers

Perhaps the most significant development in agricultural technology during the era was the invention of the reaper. From earliest times, the harvesting of grain was performed by hand using a sickle or cradle. Cyrus Hall McCormick combined in a single machine a rapid means of cutting and harvesting grain while not damaging or loosening the ripened seed from its protective stalk. McCormick's reaper, patentened in 1831 and propelled by animal power, dramatically reduced the time needed to harvest a farmer's crop, allowing both an expansion of cultivated lands and a freedom from the necessity of hiring large seasonal labor forces. Sales of the reaper were slow during the first few years of production, while McCormick remained in the hilly countryside of Virginia. After he moved to Chicago in 1844, sales increased rapidly. Farmers on the broad open prairies soon realized that they could expand their acreage many times with the aid of the McCormick harvester. Within 5 years, McCormick sold close to 5,000 reapers from his Chicago factory; he was followed by a host of other concerns, including some from Wisconsin. The industrial communities of Beloit, Janesville, Madison, Whitewater, and La

Crosse established extensive trade in mechanical reapers. Hay mowers and corn harvesters were also developed during the period, as were a host of cultivating tools, such as spring harrows, disc cultivators, tooth harrows, and other such items.

When harvesting grain with the early reapers, several extra men were needed to operate the machine, drive the team, and to rake the straw into bundles which were bound into shocks for easy handling. The automatic twine binder brought about the final evolution of the harvesting machine. The device made bands of twine (early machines used wire), and an automatic knotter tied the twine around the bundle of grain and cut it. John Appleby of Beloit, together with Jacob Behel and Marquis L. Gorham, is considered the pioneer of the development of the self-binder which by the late 1870s, was standard equipment on all harvest machinery.

Threshing Machinery

The final step in the grain harvest is the threshing of the harvested crop to remove the seed or whole grain from the chaff or straw. Originally performed by beating the grain on the floor of the barn with a wooden flail and then allowing the chaff to be blown away by the wind (winnowing), the process was obviously far too time consuming and tedious for the large scale farming that eventually appeared on the prairie frontier. European threshing machines were brought to the United States as early as the 1820s, but were found only on the farms of small numbers of wealthy gentlemen farmers. The first practical machine for large scale threshing was developed by Maine inventors Hiram and John Pitt in the late 1830s. The Pitt invention was one of the first machines to combine both the threshing, separating, and winnowing processes.

A host of other machines, both more and less complicated, soon followed the Pitt thresher. Designed to thresh 200 to 250 bushels a day, the machines could easily be transported from farm to farm. The work was commonly done by itinerant threshermen who provided custom threshing to farms through the Civil War era. The fanning mill was a device used in connection with threshers to remove the chaff from the grain. Threshers and fanning mills became exceedingly important products of the Wisconsin manufacturing industry during the second half on the nineteenth century. The Racine firm of J.I. Case took the lead in early threshing machinery production in the Midwest, and its designs and machinery remained the standard of the industry well into the twentieth century.

The last technological development in the history of grain harvesting was the invention of the combine, an extraordinary and imposing machine that combined the harvester and the thresher. The combine, drawn by a steam tractor or "30 mule team," cut, threshed, cleaned, and bagged the grain in one massive operation. First introduced in the 1880s, the machine proved well adapted to the vast, level fields of California and the West coast and to the Dakota wheatlands. By the turn of the century, the combine had been introduced to farming in many areas and helped transform much of agriculture from a small scale to a major industry.

POWER

Oxen and horses were critical to farm operations through much of the nineteenth century. As newer machinery was introduced, the draft animal remained a necessity for the farmer, drawing his plows, cultivators, and harvesters, and supplying power to his fanning mills and threshers. The horse-power, a tread mill device which could be attached by way of belts to a farm machine to supply necessary power, was produced by many Wisconsin manufacturing concerns. Through the 1860s and 1870s, horses remained the main motive power on most farms, but the steam engine began to appear on scattered farms. The J.I. Case Company in Racine developed a "portable" steam engine in 1869. Mounted on wheels, the unit could be drawn by horses from site to site. By 1876, 75 units were being sold each year by the firm, and the number was growing. Efforts to

increase the safety of the machines and lessen the dangers due to fire allowed the machines to play a major role in farm production during the 1880s and 1890s. The self propelled steam traction engine (or tractor) of the late 1800s and early 1900s advanced agricultural development even more. By the first decades of the twentieth century, most farms could boast of tractor driven machinery and its associated benefits.

During the nineteenth century, a multitude of smaller inventions and innovations affected the way Americans cultivated the land. The science of agriculture received its biggest boost during this era, as farming became a productive and scientific business enterprise.

Agricultural Implements and Machinery

Year	# of Firms	# of Employees	Value of Product (In dollars)	Avg. # Employees/ Shop
1850	31	177	187,335	5.7
1860	81	666	735,198	8.2
1870	82	1,387	2,393,428	16.9
1880	108	2,067	3,742,069	19.1
1890	51	3,031	5,015,512	59.4
1900	51	5,300	7,886,363	103.9
1910	45	4,095	11,411,000	91
1920	34	7,341	43,623,368	215.9

Wisconsin Agricultural Machinery Production for the Year 1870

Cultivators	571
Fanning Mills	725
Grain Drills	3250
Rakes	100
Harrows	60
Horse Rakes	172
Ploughs	6734
Reapers	1540
Rollers	865
Seperators	500
Threshers	99

Figures for both tables taken from United States Census data, 1850-1920.

IDENTIFICATION

Resource Types.

Early Resources (pre 1870). Small blacksmith, wheelwright, and carpentry shops specializing in agricultural implements; plough works; moderate-sized, machinery factories; foundries; machine and woodworking shops; powerhouses (water and steam engine).

Later Resources (post 1870). Manufacturing complexes; casting and foundry sheds; office buildings; storehouses; powerhouses; assembly areas; distribution centers (rail, water); local distributorships; wholesale and retail jobbing houses; owners' residences; workers' housing.

Locational Patterns of Resource Types. Early sites developed in proximity to water power sources and supplies of natural hardwoods. Most important, though, was ready access to farm areas. Later establishments, concentrated in southeastern Wisconsin, depended less on water power resources and more on rail access, as well as proximity to iron and steel producing areas.

Previous Surveys. While no extensive survey has been completed on agricultural machinery or implement industries, intensive surveys of the southeastern communities of Racine, Beloit, Milwaukee, West Allis, and Janesville, etc. are of value.

Survey and Research Needs. Determining the breadth of individual marketing regions of Wisconsin firms may help in understanding the significance and scope of the industry and the companies studied.

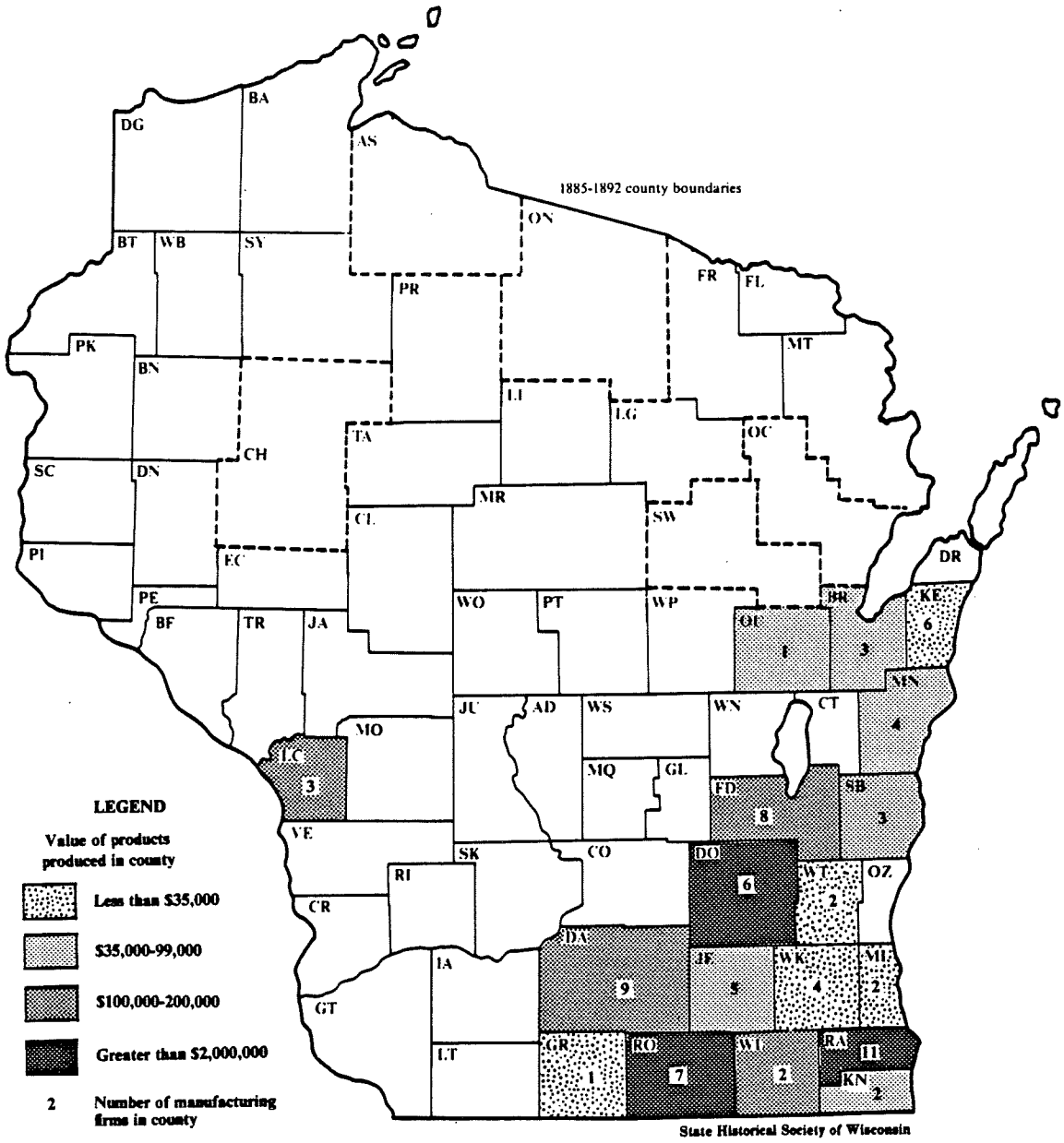
EVALUATION

National Register Listings and Determinations of Eligibility

Charles Parker House (1853), 231 Roosevelt Ave., Beloit, Rock County (NRHP 1983, Bluff St. Historic District).
Daniel C. Van Brunt House (1858), 139 W. Lake St., Horicon, Dodge County (NRHP 1981).

Context Considerations. In early buildings, it is possible that some simple machinery, such as smithing forges or powerhouses and transmitting equipment, may be extant. In later mills, retooling during the late nineteenth century and again in the early twentieth century may have removed much original machinery, but exterior configurations should be relatively unchanged.

AGRICULTURAL MACHINERY AND IMPLEMENT MANUFACTURING



Agricultural Machinery and Implement Production, 1880

Source: *Tenth Census of the United States, 1880: Vol VI, Report on Manufacturers*, pp. 371-378.

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STONEWARE AND EARTHENWARE PRODUCTS

Temporal Boundaries: 1836-1915 (peak production 1855-1885).

Spatial Boundaries: Closely follows lines of early settlement. Early stoneware factory production occurred most strongly in Milwaukee and the southeastern counties of Wisconsin.

Related Study Units: Brick manufacturing (stone).

HISTORICAL BACKGROUND

Although approximately 70 establishments and 200 operatives produced claywares for home and dairy use between 1844 and 1925, research materials concerning the Wisconsin pottery industry are extremely limited. Perhaps the best recent work concerning the early potter's trade in the state is the thesis written in 1972 by Mark H. Knipping and cited in the bibliography. A large part of the following text draws on Knipping's thesis (Knipping 1972:11). Stoneware and earthenware manufacture has enjoyed a long tradition in the United States. Beginning with the first wave of English and European settlers, the production of household and commercial pottery accompanied the great westward migration, and by the early 1800s, shops and factories began to open up in the Ohio Valley and the "Old Northwest." The methods and materials used by these early manufacturers remained almost unchanged well into the early part of the twentieth century.

The first earthenware manufacturer on record in the Wisconsin territory was a pioneer potter named McCann who established himself near Dubuque, around 1836. The southwestern region of the state supported a number of early producers who served the young lead mining communities of the area. Many left no record of their work, however, and simply set up temporary shops wherever the market for their products was good and where clay, fuel, and water were readily available. According to various records, more than 225 potters worked in Wisconsin between 1836 and 1915. The industry achieved its greatest success between 1855 and 1885, during the years that Wisconsin's frontier expanded (Knipping 1984:24). Federal census data is deceptive, however, because it rarely enumerated the rural, small scale potters. Instead, it recognized only larger factory operations.

The production of clayware pottery fell into two broad categories: the manufacture of a relatively soft-bodied red earthenware and the manufacture of more modern and durable stoneware and porcelain. Between the twelfth century in Europe and the nineteenth century in Wisconsin, the methods of producing earthenware changed little. The local potter dug ordinary coarse brick clay from local deposits, cleaned the material of sticks or pebbles, and ground it in a simple pugmill to gain a consistent working material. The pugmill, a simple mixing tub, might have been hand operated or driven by a horse or oxen. After vigorously kneading and mixing the plastic clay with sufficient clean water, the potter threw his pots and clayware on a foot-powered kickwheel. Once formed, the products were dried and glazed, often with lead oxide (toxic), and readied for firing in wood-fueled kilns.

These kilns were built in a variety of forms, largely in accordance with local traditions and conditions. The most common form was the simple stack kiln. Constructed of brick in the form of a circular, often bottle-shaped chimney, the kiln had openings at the bottom for loading and firing and an open top. Metal bonds were often used to stabilize the brickwork, especially after repeated firings. Kilns could be located within the pottery shop

itself, in a separate kiln shed, or left freestanding a short distance from the shop. Fired for up to 30 continuous hours at a time at temperatures ideally ranging from 1,700 to 1,900 degrees Fahrenheit, the kilns were constant fire hazards. To obtain these temperatures, abundant hardwood--usually maple, hickory, or oak--was obtained from local woodlots. After being fired and allowed to cool down, the kiln was unloaded and the earthenware was ready for distribution.

Potteries were soon established in those areas of the state with easy access to both raw materials and markets. And because earthenware was relatively simple to produce, farmers and tradesmen often turned to its manufacture as an ancillary business during the slower winter seasons.

Earthenware did have its disadvantages. As a soft-bodied clayware, it chipped easily and did not stand up well to hard daily use. In addition, the lead glaze commonly applied to the items could be leached out or scaled off, producing dangerous poison. But for many outlying communities, the local earthenware pottery remained the only source of household table and cooking ware.

Stoneware, on the other hand, was a "high technology" improvement in pottery production developed during the fifteenth century in Germany. While stoneware was still commonly thrown by hand, the setting was often that of an urban factory with large numbers of both skilled and unskilled workers hired to specialize in individual aspects of the production process. The simple kickwheel was often replaced by water powered or steam driven wheels; large sheds and lofts were constructed for drying unfired greenware.

The stoneware kilns, fired with wood, charcoal, or gas, were normally much larger than the earthenware kilns and were fired at much higher temperatures (approximately 2,300 degrees Fahrenheit). The use of continuously fired tunnel kilns was common in some of the large establishments by the late nineteenth century. The higher firing temperatures applied to stoneware permitted the use of non-toxic salt glazes on the clay products and partially melted and fused the clay/sand bodies to produce a highly durable, vitrified vessel impervious to liquids and quite superior to any earthenware product. Since these operations commonly utilized extensive permanent facilities, substantial amounts of suitable clay had to be available nearyby or transported at high cost to the production site.

Unlike earthenware clays, stoneware clays had to possess certain granular and mineral characteristics in order to bond properly at high temperatures. While Wisconsin possessed an abundant supply of earthenware clays, it lacked sufficient quantities of stoneware clay deposits. As a result, few stoneware manufacturing concerns were established in the state; and those stoneware facilities that were established were forced to import stoneware clays from other states, including Ohio, Illinois, and New Jersey. During the late 1890s, sizeable deposits of a white kaolin clay, suitable for stoneware production, were discovered in St. Croix and Dunn counties, in northwestern Wisconsin. By that time, however, stoneware manufacturing was on the decline in the state, and most of this clay was shipped to other regions of the country. One of the largest Wisconsin suppliers of raw stoneware clay was the Superior China Clay Works of Hersey, established in 1893 in southeastern St. Croix County (Buckley 1901:240-241).

As a result of having to import the raw clays, those late nineteenth century stoneware manufacturers that were established within the state were forced to locate in urban areas where local market demands could support the importation costs and where sufficient labor was readily available. As roads and railways spread across the state, stoneware products gradually began competing for sale with locally produced earthenware. In direct competition, earthenware products could not hold their own. Moreover, as stoneware became more readily available in an area, small potteries were forced to relocate or close. Of the 14 major stone and earthenware manufacturers listed in the 1880 census, 10 were located in Milwaukee County and employed 70 workers to produce $68,600 worth of

clayware products (Tenth Census of the United States, 1880: Report on the Manufactures of the United States:371-378). Other Wisconsin communities with sizable stoneware concerns included Sheboygan, Portage, and Menasha (Knipping 1972:28).

Wisconsin manufacturers eventually discovered that importing finished products was more economical than local production, which utilized imported raw materials. Consequently, by the turn of the century, stoneware and earthenware manufacturing was rapidly disappearing from the local industrial scene, even with the discover of extensive clay deposits in Dunn and St. Croix counties.

If the operation of Conrad Langenberg, outlined in Knipping's article "A Nineteenth Century Wisconsin Potter," is representative of a typical one man pottery operation, circa 1870, then annual production might have ranged somewhere around $600. Translated into actual table, cooking, and dairy ware products, that would have equalled about 8,000 to 10,000 individual items (Knipping 1984:26). Not all items were sold directly from the pottery. Many manufacturers maintained sales agreements with local merchants who might purchase items outright or agree to carry locally made wares on a commission basis. Larger suppliers might even establish distribution/sales networks of their own.

Among the early immigrants to the newly opened Wisconsin frontier was a group of English potters attempting to escape economic unrest in their homeland. Settling in Columbia and Marquette counties between approximately 1848 and 1850, many members of the Potters Joint-Stock Emigration Society quickly turned to farming, but census data also reveals that the appearance of new potteries emerged in the area as well: one in Columbia County and two in both Green Lake and Waushara counties (Eighth Census of the United States, 1860: Manufactures of the United States in 1860, 640-655; Foreman 1938:375-396).

IDENTIFICATION

Resource Types. Pottery shops, pottery sheds, wood sheds, clay pits, kilns and kiln houses, pottery factories, warehouses, jobbing wholesale houses.

Locational Patterns of Resource Types. Small concerns were scattered across the rural countryside. Clay, wood fuel, and water supplies had to be nearby, but the shops did not have to be built directly on a waterway. Commonly, they were located adjacent to farm residences (many farmers turned to pottery manufacturing as an ancillary business). The larger pottery "factories" were principally located along the eastern transportation corridors of the state to allow easy access to imported stoneware clays.

Previous Surveys. No thematic surveys of extant stoneware and earthenware manufacturers have been undertaken (2/86).

Survey and Research Needs. To date, little research has been conducted on this topic in Wisconsin. Rural reconnaissance and intensive surveyors should be alerted to the possibility of extant resources, particularly in the early settlement areas in the southern and eastern portion of the state. Further research is needed to identify the location and existence of stoneware operations in the state.

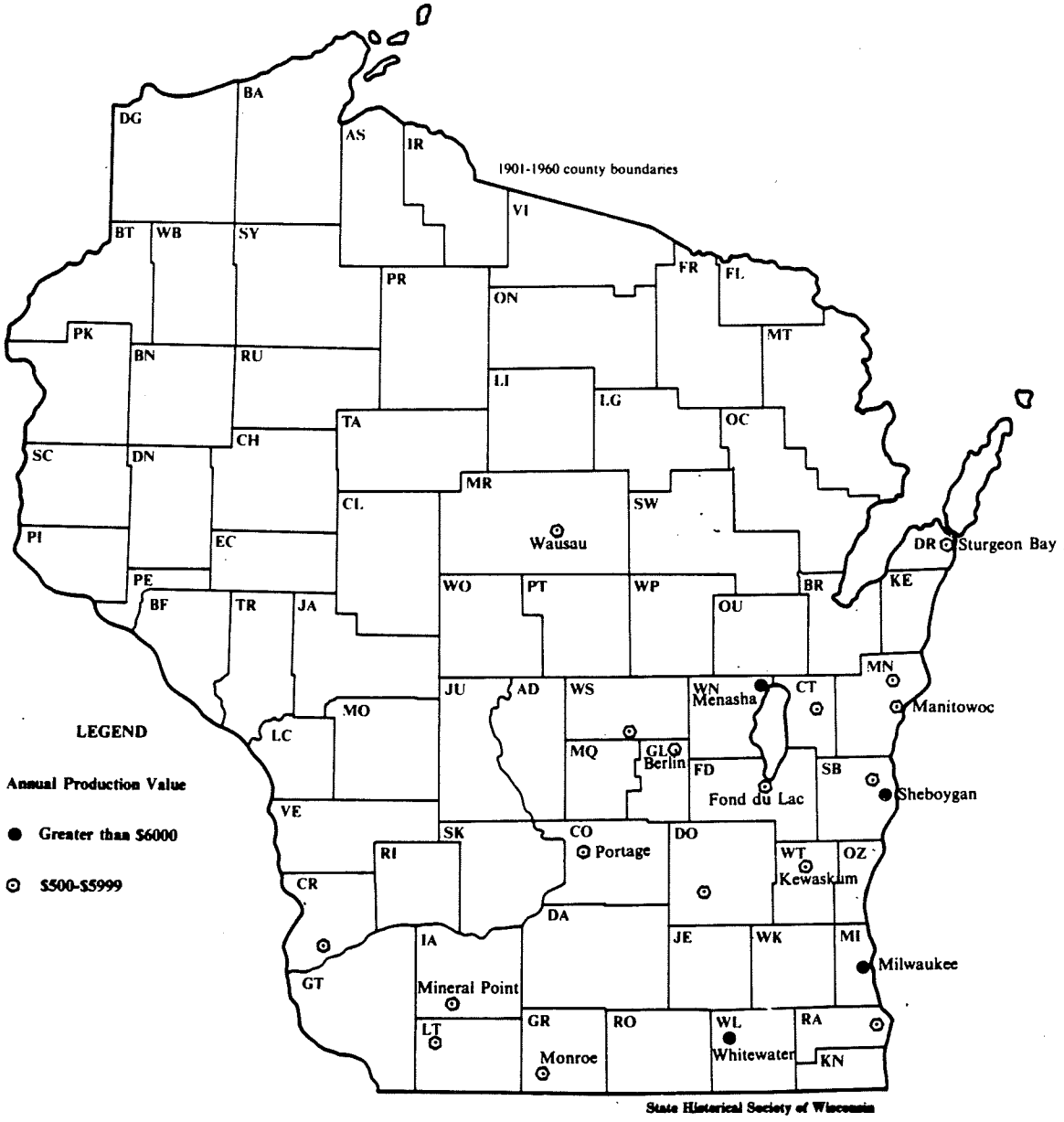
EVALUATION

National Register Listings and Determinations of Eligibility

None (2/86).

Context Considerations. The forming area in the pottery or the firing kiln, central to the operation of a pottery, should be intact for the property to retain sufficient integrity. The forming area can be an interior space or an exterior space. Because the potters wheel, although critical to the forming area, was portable, it may be absent from the forming area. All other buildings and/or sheds are secondary in nature and should be evaluated as such.

It is quite likely in many of the smaller locations that only the kiln will remain extant. Other features of the property are likely to be in ruins or hidden by overgrowth or layers of soil. Generally, for early home industry type sites many of the resources may be of an archeological nature.



Major Pottery Locations, 1850-1880

Source: Mark H. Knipping, *The Wisconsin Pottery Industry* (M.A. thesis, University of Wisconsin, 1972, pp. 47-47, 80-96).

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SHIPBUILDING

Temporal Boundaries: 1836 to present (peak wooden shipbuilding era: 1840-1880; peak iron and steel shipbuilding era: 1890-1920, 1941-1945).

Spatial Boundaries: Wisconsin's largest Great Lakes shipbuilding centers were Manitowoc and Two Rivers, Milwaukee, Sturgeon Bay, and Superior; other minor facilities were scattered along the Lake Michigan shore. Inland boat building concerns centered around the riverfront cities of Oshkosh and LaCrosse.

Related Study Units: Great Lakes Navigation, Mississippi River Navigation, Inland Waterways.

HISTORICAL BACKGROUND

Great Lakes shipping made invaluable contributions to the development of nineteenth century Wisconsin. It brought people, goods, and products to the frontier region, and within a few short years, it provided export capabilities for the area's rich resources of lumber, grain, and other products. The fleets of ships--schooners, clippers, barges, tugs, ore boats, steamers, bulk carriers, and passenger liners--that plied the waters of Lake Michigan and Lake Superior were at the heart of the Great Lakes transportation network. The development of a sizable shipbuilding industry within the state was obviously an important aspect of Wisconsin's early commercial growth, particularly before the emergence of extensive rail travel.

The first crafts to work the waters of the great inland seaway system were wooden sailing vessels. Until the 1880s, these wind driven fleets carried the burden of most of the Great Lakes trade. In Wisconsin, fishing boats, lighters, and scows that transfered goods and lumber from shore to sailing schooners were the first types of ships built in commercial shipyards. Gradually, increasingly larger vessels were designed and built, and shortly thereafter full schooners and barkentines were commonly constructed. Wisconsin's eastern shoreline offered two of the most important assets to successful shipbuilding operations in the era of the great wooden ships: a series of protective lakefront harbors for the location of yards and abundant local timber resources, particularly native hardwoods like oak. Coupled with the growing demand for seaworthy commercial trade vessels, these factors assured Wisconsin's assent as a major shipbuilding center during the mid- and late nineteenth century.

The communities of Milwaukee and Manitowoc were the homes of the first pioneer shipbuilding yards in Wisconsin; both areas began to operate in the mid-1830s. The first large vessel from Milwaukee's shipyards was launched in 1837. It was the schooner "Solomon Juneau" constructed by local shipbuilder George Barber. Over the next several decades, the shipbuilding industry continued to grow and develop in the port city due to the efforts of such moderately sized firms as D. Merrill and Company, George Barber (situated on the Menomonee River), Captain James Monroe Jones, and Wolf and Davidson. By 1850, the total number of employees in the various shipbuilding concerns totalled approximately 145. By the 1860s, the Milwaukee firm of Wolf and Davidson was the leading builder in the city, and its 13 acre site at the foot of Washington Street was among the largest on the western Great Lakes (Gregory 1931:323-332).

Manitowoc, further to the north and blessed with a fine natural harbor and abundant local timber resources, also developed into a major shipbuilding center by the middle of the nineteenth century. Staffed with skilled craftsmen from New England and several Scandinavian countries (particularly Norway), local concerns like Hanson and Scove,

J. Butler, P. Larson, William Bates, and Rand and Burger made the Manitowoc-Two Rivers area into one of the major centers of wooden shipbuilding both in the state and throughout the entire Great Lakes system. Between 1847 and 1900, a total of 26 different shipbuilding firms operated in the Manitowoc-Two Rivers area at one time or another. Together they built a total of 204 wooden sailing ships, barges, tugs, and steamers. Much of the work was done by hand, since wooden shipbuilding remained a strongly craftsmen oriented trade which required a host of variously trained craftsmen and artisans (Valli 1984:11-13).

The first ships (pre-1850) built for the Great Lakes trade were constructed in the mold of typical oceangoing ships. In 1851, William Bates, a New England shipwright transplanted to Manitowoc, designed and built the first of a long line of Great Lakes vessels specifically constructed to handle the intricacies and vagaries of Great Lakes travel. Built with sharp ends below the water line, a clipper (overhanging) bow, and a shallow draft and centerboard, the ships were especially well adapted for entry into many of the Great Lakes' narrow channels, shallow harbors, and waterways without demanding a reduction of speed or carrying capacity. Bates' design was soon copied by shipyards throughout the Great Lakes region and rapidly became an accepted standard. In its most productive year (1873), Manitowoc produced 16 large Great Lakes schooners totalling 5,300 tons (Valli 1984:11-13, Falge 1912:347).

In the isolated Door County community of Sturgeon Bay, shipbuilding developed in the mid-nineteenth century as an economic necessity. Without substantial railroad connections or major roadways and with an economy based strongly on local fishing and lumbering operations, boat repair and shipbuilding concerns remained an important and highly visible aspect of local business growth. It was not until the 1880s, however, that the area rose from its modest beginnings as a local center into a truly major lakefront shipbuilding port under the leadership of such firms as Leathem and Smith (now the Bay Shipbuilding Corporation) and Riebolt and Wolter. In addition, lakeshore communities such as Racine, Green Bay, Fort Howard, Marinette, Sheboygan, and Port Washington also retained minor boatyard and repair facilities, all of a relatively modest scale and tied to local trade.

Between 1840 and 1880, the shipyards of Manitowoc, Milwaukee, and Sturgeon Bay launched more than 300 graceful sailing schooners (Bowman 1948:204). By the 1870s, however, the era of sailing ships was drawing to a close on the Great Lakes as steam power began propelling more and more lake-going vessels. Manitowoc produced its first wooden steamer in 1861 and in Milwaukee the yards of the Milwaukee Shipyard Company (formerly Allan, McClelland and Company) and the Milwaukee Drydock Company (formerly Wolf and Davidson) designed and completed numerous steamships by the 1870s and 1880s. After 1870, "each year saw more and more old sailing ships (stripped of masts and sails) turned into sea going barges, hauled along by powerful steam tugs. By 1900, the wooden sailing ship was a thing of the past on the lakes" (Cuthbertson 1931:242). The last sailing ship built on the Great Lakes was manufactured in Manitowoc in 1889.

The first steamships operating in Wisconsin were actually constructed for inland use. As early as 1844 in Oshkosh and later in LaCrosse, shipbuilding facilities were established for the construction of steam powered sternwheelers, tugs, and packets for use on the Mississippi and Wolf-Fox-Wisconsin River waterways. With the opening of the Green Bay-Mississippi canal in 1856 and until about 1908, Oshkosh shipyards, together with smaller ventures in Ripon, Winneconne, Omro, De Pere, and New London, built an average of one to two boats a year. Mainly for use in the lumber and grain trade, the vessels were diminutive when compared to the lake going ships being built on Lake Michigan. The longest design was only 146 feet in length. Nevertheless, their design, erection, and repair kept considerable numbers of skilled boatwrights employed year round. At LaCrosse, the c.1855 concern of W.F. and P.L. Davidson flourished for a period

of 15 years as one of the leading boatyards on the upper Mississippi (Bowman 1948:203-205).

In the 1880s, the shipbuilding industry experienced changes even more dramatic than those wrought by the introduction of steam power. The Civil War had stimulated the construction of the iron-clad Monitor and Merrimac warships. By the last decades of the nineteenth century, iron and steel shipbuilding for commercial use gradually became an accepted and well promoted fact. In Wisconsin, the cities of Manitowoc, Milwaukee, and Superior became major centers of steel shipbuilding. In Manitowoc, the Manitowoc Shipbuilding Company/Manitowoc Drydock Company produced very large iron and steel vessels. In Milwaukee, with its growing iron and steel foundries nearby, the Milwaukee Drydock Company became a major contributor to the new lake fleet. But it was in the once isolated Lake Superior community of Superior that iron and steel shipbuilding rose to its highest prominence in the state.

In the last 15 years of the nineteenth century, the harbor at Superior, as the westernmost terminus of traffic on the Great Lakes system, became a major transshipment point for lake trade. Shipbuilding had been carried out in Superior on a limited scale since the 1850s (mostly tugs and fishing crafts), but the production of steel vessels to handle the expanding Great Lakes trade allowed the city to take its place among the top shipbuilding ports in the United States. Able to use steel fabricated at the local West Superior Iron and Steel Company (1887), the city employed between 2,000 to 3,000 shipyard workers by 1896. By 1900, contemporary reports stated that two-thirds of the new ships being built on the upper lakes were being designed and constructed in Superior.

The firm of Captain Alexander McDougal, who came to Superior from Duluth in 1889, was at the heart of the local shipbuilding trade. Under the name of the American Steel Barge Company (partly owned by J.D. Rockefeller and Colgate Hoyt), the McDougal shipyard produced a total of 48 vessels between 1889 and 1899. Among these were 41 of the most oddly shaped, most extraordinarily designed ships ever created--the McDougal "whalebacks." A cigar shaped, steel hulled vessel (366.5' by 45' by 26' deep) with only a small wheeldeck and crews quarters located above the waterline, the whaleback could carry grain, ore, coal, oil, or any other bulk cargo in massive quantities. The S.S. Meteor (1896) is the last remaining whaleback in existance and is now docked at Superior and functions as a maritime museum. During the next several decades (1900-1920), a series of firms established themselves in the Superior area and constructed an assortment of steel bulk carriers, tugs, tenders, and freighters. Among these firms were the Superior Shipbuilding Company (a branch of the American Shipbuilding Company of Cleveland), the Whitney Brothers Company, and the Globe Shipyards (Lusignan 1983:91-93).

The manufacture of steel ships required significant operational and managerial changes from the earlier, rather craftsmen-oriented days of wooden shipbuilding. New facilities for metal storage and fabrication were necessary; the size of drydock and erection areas were greatly enlarged. Welding and machine shops were built, and the labor force employed grew dramatically. Even the largest yards in the early 1800s seldom used more than 100 men. But by the turn of the century, it was extremely uncommon to find a major yard that employed fewer than 300 men. At times, up to 3 separate shifts were in operation. Among the largest man-made products produced in Wisconsin, the ships required massive amounts of material and equipment for their construction. Easy accessibility to this material was a major concern to the shipyards. Sizable railroad facilities, storgage areas, and a host of local manufacturing concerns producing equipment, engines, technical devices, and finished products commonly developed in a community to support the local shipbuilding firm.

In addition to being labor intensive, the steel shipbuilding industry also required a large amount of investment capital and operating money. Only a few concerns could generate the necessary financial backing dictated by the industry's new constraints. For the others,

repairwork and the construction of smaller fishing boats, pleasure craft, and tugs remained a viable alternative. During the turn of the century, the development of a series of multi-yard shipbuilding concerns arose. Many were often owned directly or indirectly by the largest users of lake shipping--the steel and coal companies. In 1884, there had been 193 shipbuilding firms operating on the Great Lakes. Twenty years later, at the height of steel ship manufacture, only 23 firms were in production. The longer life and greater carrying capacity of the steel ships rapidly effected a transition from quantity production to quality production. The construction of the longest, fastest, or largest ship was a record continually sought after. New innovations such as the screw propeller and the diesel engine sent many yards scurrying after reconstruction/conversion contracts as well.

In 1917 and again in 1941, the United States government issued nationwide appeals for ships and boats of all sizes and descriptions. Tugs, tenders, freighters, supply ships, submarines, submarine chasers, mine sweepers, rescue boats, and landing craft were all the subjects of gargantuan war time contracts that brought incredible production and employment levels to Wisconsin's shipyards. As many as 6,000 workers during World War I and 14,000 workers during World War II filled the Manitowoc and Sturgeon Bay shipyards of the Riebolt and Walter Company, the Sturgeon Bay Shipbuilding and Drydock Company, and the Manitowoc Shipbuilding Company. In Superior, the Walter Butler shipyard produced 52 coastal freighters and U.S. Navy corvettes during World War II, while the Globe Shipyard Company constructed 29 vessels. Total employment in the Superior yards during the war years averaged from 7,000 to 10,000 men and women. At its peak in 1944, 22 completed ships left the Superior harbor (Lusignan 1983:91-93, Bowman 1948:208).

The war time booms represented the greatest production eras within the Wisconsin shipbuilding industry. Rising costs for labor and materials, coupled with a general decline in shipping and the demand for new ships, dramatically affected the state's yards after World War II. At present, the Manitowoc Corporation, operators of yards in Sturgeon Bay and Manitowoc, is the largest shipbuilding concern in the state. The company's Sturgeon Bay yards, a merging of several earlier shipbuilding sites now known as Bay Shipbuilding, is the second largest shipyard facility on the Great Lakes and contains one of the world's largest inland dry docks (Knuth 1971:70-71). Smaller yards in Superior and Sturgeon Bay also function at various levels. The Peterson Builders and Palmer-Johnson yards in Sturgeon Bay are two of the largest specialty boat (yachts, wooden and metal ships, amphibious vehicles) producers in the state.

In addition to the shipbuilding industries, Wisconsin supported a series of accompanying business enterprises such as sailmaking, chandleries, block, pump, and tar manufacturers, and cordage and twine production plants during the era of wooden shipbuilding. Throughout much of the twentieth century, foundries, metal fabrication plants, and engine and navigation equipment manufacturers have been closely associated with shipbuilding concerns. Little documentation has been done at this time concerning these industries.

IDENTIFICATION

Resource Types. Shipyards, drydocks, powerhouses, fabrication and erection shops, offices, storage areas, machine shops, wood milling shops, cordage factories, sailmaking shops, equipment manufacturers, owner and worker residences, ships.

Locational Pattern of Resource Types. The overriding condition is a waterfront location, preferably within a protected part of a harbor or slackwater area. Modern facilities usually occupy expansive sites, allowing for the storage of waiting vessels and simultaneous construction/repair efforts on various crafts at one time.

Previous Surveys. The Sturgeon Bay, Superior, and Manitowoc Intensive Survey Reports document extant shipyard resources in their respective communities.

Survey and Research Needs. Further research and field work is necessary for the Manitowoc-Two Rivers areas as well as for Milwaukee to document any extant resources. In addition, more research into the location of smaller yards and facilites along the remainder of the Lake Michingan and Lake Superior coasts (as well as along Lake Winnebago and the Mississippi River) might prove of value.

EVALUATION

National Register Listings and Determinations of Eligibility

Whaleback Carrier METEOR (1896), Northwest tip of Barker's Island, Superior, Douglas County (NRHP 1974)

Context Considerations. Due to the great changes in shipbuilding technology between the nineteenth and twentieth centuries, few resources associated with the great wooden shipbuilding days are likely to be extant. However, the evaluators of shipbuilding complexes should be alert to any resources from this era. The shipyard is a well integrated working complex and should be evaluated as such, although in some cases, a particular building or structure may have particular significance by itself, e.g. the first office building for a yard or an early drydock facility.

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ICE HARVESTING INDUSTRY

Temporal Boundaries: 1860-1920.

Spatial Boundaries: Lakes of the southeastern quadrant of the state and the Green Bay and Door Peninsula.

Related Study Units: Meat Products, Brewing, Early Rail Line, Later Rail Lines.

HISTORICAL BACKGROUND

Wisconsin's many lakes at one time provided communities across the state with a busy wintertime activity--that of natural ice harvesting. It was in the southeastern communities of the state, however, that this seasonal business evolved into the large scale industry that is the focus of this study unit.

The large scale harvesting, sale, and transportation of natural ice as a commercial activity began in Boston in 1807 with the shipment of large quantities of New England ice to the West Indies to help quell an outbreak of yellow fever (Lawrence 1965:257). As technical improvements in harvesting, storage, and shipping progressed, new markets were exploited in such southern cities as Charleston, Savannah, and New Orleans as well as in the expanding western frontier. As the Midwest developed, the industry slowly made its way across the country. Small, local ice harvesting concerns existed in Wisconsin as early as the 1850s, with farmers and small businessmen cutting ice for their own use in the home and in local breweries. The federal census for 1860, however, shows only two Wisconsin concerns whose main pursuit was ice harvesting (one in Dane County, the other in Milwaukee) (Eighth Census of the United States, 1860: Manufactures of the United States, 640-655). The large scale "production" of ice in Wisconsin arose in the 1870s and 1880s with the increasing demands of the expanding brewing and meat packing industries.

By 1880, the national harvest of ice was estimated at eight million tons, and breweries were the single largest consumers, utilizing over three million tons per year throughout the United States (Lawrence 1965:257). In Wisconsin, the explosive growth of both the brewing and meatpacking industries in Milwaukee and Chicago was the primary focus of attention for ice harvesting concerns throughout the latter part of the nineteenth century. During the 1880s, Milwaukee's numerous breweries produced light, effervescent lagers, using an average of 335,000 tons of ice per year. Vast amounts of ice were required for use in the processing, storage, and distribution of their product. The Best Brewing Company, alone, used a reported 60,000 tons in 1880 (Lawrence 1965:257).

Meat packing concerns also required large amounts of ice for the storage of meats and for the shipment of their product to distant markets. "Refrigerated" meats meant consumers were no longer resigned to consuming salted porks and beefs preserved in various brine mixtures. Instead, fresh meats were now available for consumption, and markets experienced expansive development. The refrigerated rail car, which was first utilized on a broad scale by Gustavus Swift of Chicago in the early 1870s, required massive amounts of ice to deliver its "fresh meats" to markets across the country. The Milwaukee firm of Philip Armour quickly adapted the rail car service for their own use as did a host of other packing concerns in the area.

Prior to the mid-1870s, Milwaukee and Chicago received most of their ice from local sources, cut from small ponds, flooded quarries, rivers, and marshlands, all in close proximity to the cities. Increasing pollution of local waterways, which accompanied uncontrolled industrial expansion in cities during the 1870s, forced many firms to seek out

new supplies of ice in more outlying areas. Warm winters in 1877-1878 and 1879-1880 also induced Chicago and southern consumers to look increasingly to Wisconsin as a dependable source of high quality ice. (Ice taken from lakes was considered the most satisfactory, with a lesser amount of trapped air and contaminants than ice obtained from still ponds, swamps, or rivers. Wisconsin lake ice in fact was favorably compared to that of Maine, one of the earliest and most steady suppliers of eastern ice).

The lakes along the Illinois and Wisconsin border west of the communities of Kenosha and Racine, the lakes around Waukesha, and those south of Madison were all rapidly exploited by a host of competing firms. Many of the larger meat packing firms actually organized their own harvesting companies rather than having to rely on independent suppliers of ice.

The Best Brewery of Milwaukee was the first large scale concern to utilize inland Wisconsin lakes for their own needs, erecting a permanent site on Lake Pewaukee, Waukesha County, in the winter of 1878-1879. The firm's enormous 400' x 50' main icehouse contained a storage capacity of 50,000 tons. In the mid-1880s, the site was sold to the meat packing concern of P. Armour, and the brewery returned to purchasing its ice from private concerns as was the normal practice with most of the larger brewing concerns. Smaller, outlying breweries probably retained the practice of harvesting their own ice and storing it at on-site icehouses longer than did larger concerns.

Under Armour, the Lake Pewaukee site expanded in the late 1880s to include a 1,200' x 200' icehouse with an amazing capacity of 175,000 tons of ice. Within a short time, a host of other firms set up concerns on the lake as well, including the wide-reaching Knickerbocker Company of Chicago, the Cudahy Meatpacking Company of Milwaukee, and the Wisconsin Lakes Ice and Cartage Company, also of Milwaukee (Lawrence 1965:262). The Armour site was destroyed by fire in 1905 (Wieland 1981).

Among the other important, large scale concerns located in the southeastern portion of the state were firms situated on Brown's Lake in Racine County (operated by the Swift Meatpacking firm of Chicago and the largest of Swift's Wisconsin holdings), Lake Geneva in Walworth County (operated by two independent Chicago firms), Okauchee and Fowler Lakes both west of Milwaukee (operated by the Knickerbocker firm), a number of small lakes in Washington and Waukesha County (all operated by the Wisconsin Lakes Ice and Cartage Company), the Rock River at Watertown, Rock Lake and others in the Lake Mills area (all operated by Chicago based concerns), and even on waterfronts as far north as Fond du Lac and Oshkosh, which because of their direct access by rail to the Milwaukee area allowed their sites to be utilized in seasons of poor harvest or increased demand (Lawrence 1965:263).

The Madison area, which was served by three separate rail lines and contained large areas of lake frontage, was exceedingly attractive to Chicago concerns. The first heavy use of the area occurred in 1889-1890 when the Knickerbocker firm began operations on Lakes Monona and Wingra. The Swift Company followed with plants on Lake Waubesa to the south, and other Chicago firms quickly followed, operating an extensive series of plants along the lakefronts. Lake Mendota was too large and too distant from the important rail lines to be economical for the large firms to harvest. Instead, a number of smaller local concerns such as Conklin and Sons Company used the northern lakefront. Horsedrawn transportation was the basis of these smaller concerns (Lawrence 1965:263).

As seen above, an important aspect of large scale harvesting concerns was rapid, efficient access to the market centers in Milwaukee and Chicago. For most major sites, shipment was a one day journey on an ever expanding network of rail lines. Ice harvesting sites further from the markets or with no available rail access were limited to serving local markets. One exception, however, was the Green Bay-Sturgeon Bay area which in the late 1880s and 1890s was being widely exploited by a number of Chicago firms. Ice from the region could be economically transported aboard sailing schooners down Lake Michigan

to markets in the south, affording a highly dependable supply. The area was served, until about 1898, by a group of five Chicago firms in addition to the local concern of Koenig and Helms which was established in 1876. Among the Chicago firms was the Washington Ice Company which harvested an average 100,000 to 300,000 tons of ice per year. During most of the 1890s, a total of 12 massive icehouses operated in the region according to contemporary reports (Lawrence 1965:260).

The large ice harvesting concerns established on Wisconsin's lakes in the late nineteenth century occupied extensive sites along local waterfronts. The main structure of a site was the huge, multi-story icehouse. Normally of thick-walled, wood-frame construction, and commonly insulated with hay, sawdust, cork, or tile inside a cavity wall design, the large capacity structures contained elaborate inclined elevators and conveyor systems powered by steam engine or horsepower which drew the ice up from the lakefront harvesting areas to the house for storage, sometimes extending through the summer. Expansive buildings like the 1,200' x 200' Armour plant on Lake Pewaukee were often designed as two separate structures, one within the other with an air space/insulation space the width of a man in between.

The icehouses were usually capped with low pitched roofs which often contained ventilators, and interior rooms could run as large as 30' to 45' in height. Simple wooden barns and storage sheds for horses, equipment and repair shops, powerhouses, and offices were located on the more developed sites. Long, narrow bunkhouses were often erected as well to serve the seasonal labor force of farmers, construction workers, and others who flocked to the lakes seeking wintertime employment during the six week, 24 hour per day harvesting season. Among the most important features to an expanding concern was direct access to rail lines which tied the icehouses to their major regional market centers. Most sites included rail lines on spurs which ran directly along the waterfront beside the icehouse which allowed for the loading of cars from both the storage area or the lakefront itself during the winter. Smaller firms involved in local marketing were less dependent on rail service and depended more on a reliable stable of draft horses and wagons.

The small, independent operators, scattered across the countryside serving local needs in the form of ice for breweries, creameries, and the home icebox of the late nineteenth century, were less interested in constructing a building able to house 100,000 tons of ice. The icehouse built by local farmers and operators was more likely to be a simple thick-walled barn or storage warehouse with a moderate amount of sawdust or hay insulation. Two or maybe three stories tall, the simple wood-frame structure was often adjoined by a stable or garage area. Several small breweries sited their complexes on the waterfront and operated their own ice concerns, adjacent to their often waterfront sites.

Another aspect of the large scale ice harvesting industry which emerged in more outlying communities was the erection of large, squat icehouses along rail corridors and at rail centers to supplant the needs of the refrigerator cars crossing the state for distant markets. Of particular note is the painting of these structures to indicate their ownership (i.e., grey for the Swift Company, or yellow for Armour) (Lawrence 1965:258).

Throughout the late 1800s and into the first decade of the 1900s, competition within the ice industry was extreme. Lowering of water levels, disruption of rail service, and the destruction of machinery was common, including a 1901-1902 episode in which a novice Milwaukee firm outfitted a metal plated "excursion boat" to break up the competing ice fields along a section of the Milwaukee River above the North Avenue Dam. In 1898, competition decreased considerably with the merging of all the independent Chicago firms operating in Wisconsin under the Knickerbocker Ice Company. The individual meatpacking concerns, however, remained separate.

By the turn of the century, competition was coming from another source. Refrigeration technology was advancing rapidly, and the breweries and meatpacking firms which had

once depended so heavily on Wisconsin ice were increasingly adopting mechanical methods of cooling and producing ice. As well as being supposedly purer, the mechanical processes were also less susceptible to seasonal fluctuations. By the end of World War I, the large ice harvesting firms had left Wisconsin, and artificial ice and mechanical refrigeration was common. The warm winter of 1920 is usually designated as the end of the ice harvesting industry in Wisconsin.

ICE HARVESTING PROCESS

The preparation of the ice field consisted of the continual clearing and scraping of the surface to maintain proper ice formation. Upon reaching a thickness of 12 to 14 inches, the ice was scored and then cut into blocks or cakes averaging 22 square inches using a variety of handtools, including saws, drills, and pikes, and later, power saws. The blocks were then floated onto horse, steam, or electrically powered conveyors which lifted the blocks from the waterfront to various levels of storage in the icehouse. In winter, ice was also loaded directly onto waiting rail cars. Once inside the massive icehouse, each cake was packed by hand, using sawdust and hay as insulation, into huge stacks to await shipment to local or distant markets throughout the summer and fall.

IDENTIFICATON

Resource Types. Ice houses, stables, barns, storage sheds, offices, powerhouses, storage warehouses, shops, worker barracks and boarding houses, railside icehouse depots.

Locational Patterns of Resource Types. Large scale sites--major lakes and rivers of southeastern Wisconsin with access to rail service; small-scale sites--lakes, rivers, ponds, flooded quarries. All sites located directly at water's edge or nearest solid ground.

Previous Surveys. None.

Survey and Research Needs. Identification of extant sites adjacent to the lake areas of southeast Wisconsin. Further analysis of the role of smaller, independent concerns across the state.

EVALUATION

National Register Listings and Determinations of Eligibility

Anderson Icehouse and Shed, 10123 N. Water St. and 3084 Anderson Ln., Ephraim, Door County (NRHP 1985, Anderson Dock Historic District, Ephraim MRA)

Context Considerations. The most distinctive aspect of icehouse designs, besides their storage capacity, is the insulated wall construction which was central to their performance of year-round storage.

Major Ice Harvesting Operations, 1880-1900

Source: Lee Lawrence, *The Wisconsin Ice Trade*, Wisconsin Magazine of History 48 (Summer, 1965).

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GREAT LAKES FISHING INDUSTRY

Temporal Boundaries: 1830-present.

Spatial Boundaries: The fishing industry was established along the shorelines of Lake Michigan and Lake Superior, and was concentrated most strongly in the areas of Bayfield, Manitowoc, Two Rivers, Milwaukee, and the Door Peninsula.

Related Study Units: Inland Waterways, Mississippi River Navigation, Great Lakes Navigation, Shipbuilding, Ice Harvesting, Wood Products (cooperages).

HISTORICAL BACKGROUND

Among the earliest commercial enterprises to achieve some degree of success in Wisconsin was the fishing industry. Since early times, Indians fished the rich coastal and inland waters of the region. Abundant natural resources first drew many Indians to the area and later attracted white settlers. With the arrival of the white population, particularly the fur trading companies, the first large scale exploitation of regional fisheries began.

Over the years, the industry emerged from a small, unorganized trade into a relatively substantial industry. Although never a match for the Atlantic coastal fisheries, the rich spawning areas of Lake Michigan, Green Bay, and Lake Superior, as well as the many inland riverways, provided large numbers of skilled fishermen with a livelihood during the nineteenth and twentieth centuries. The specific regions of the state that experienced the strongest development in commercial fishing included the prominent Door Peninsula, the Two Rivers-Manitowoc area, and the Bayfield-Apostle Islands area. (Early Milwaukee, Superior, and other lakeshore communities also displayed development, albeit on a smaller scale). The success of fishing in these areas was due in part to a combination of interrelated factors, including the availability of a protective shoreline/harbor area, the lack of heavy industrial growth, and a rich aquatic environment.

The early years of fishing in Wisconsin were dominated by independent fishermen, each working his particular site and supplying mainly local market needs. The fur trading companies soon grasped the true potential of the industry and began establishing networks of local fishermen (whites and Indians) who provided the raw fish that the companies packed and marketed in the East. Originally meant as a supplement to the fur trade, fishing quickly became a major enterprise in some areas. One of the earliest commercial firms was the American Fur Company, whose La Pointe, Madeline Island headquarters quickly became the fishing and warehousing center for the entire Lake Superior and Upper Mississippi region by the mid-1830s (Holzhueter 1974:31).

Fishermen spent the season fishing from small island and shoreline camps and turned over their catch to the company when its collection boat made its regular calls. At La Pointe, the fish were salted and packed in barrels to await shipment to distant markets. In 1836, 1,000 barrels of salted fish were shipped from that outpost. The next year, the shipments totaled nearly 2,000 barrels; by 1839, over 5,000 barrels were shipped to market annually. During the 1840s, the American Fur Company's interest in the fish industry was succeeded by several local companies and the packing-shipping center was eventually moved to Bayfield (Parnes 1975:4; Holzhueter 1974:43-44).

For the next several decades, the fishing industry remained a significant part of the local economy in the Bayfield area, although little actual growth or expansion occurred. The industry experienced a dramatic revival beginning in the late 1880s, encouraged by the arrival of the railroads and increased state governmental interest. Production in 1888

reached a total of 1,766,655 pounds (approximately 8,000 barrels) valued at $42,281. Over 147 people were involved in the local industry. By 1896, over 7,880,200 pounds of fish were caught and packed, and the industry employed around 160 men and women. Among the local names associated with early fishery concerns in Bayfield were Dormer, Boutin, and Booth. The year 1895 also marked the first appropriation of funds by the state legislature for the development of fish hatchery programs, including one in Bayfield (Holzhueter 1974:45).

At the turn of the century, Booth Fisheries, with branches in Green Bay and La Crosse, had become the dominant packing concern in the region. The increased stability that resulted from a secure nationwide marketing network brought about increased activity. By 1905, the cooperage established by the Booth firm in Bayfield was producing approximately 10,000 to 15,000 kegs and barrels a year for the Lake Superior fishing industry. The entire Lake Superior fishing region experienced highly productive years from the end of World War I through the 1930s. By the late 1950s, however, the combination of overfishing and predatory species (sea lamprey) began to have a disastrous effect on lake fishing, and the industry began a steady decline. (The sea lamprey were introduced to the Great Lakes area with the opening of the Welland Canal that linked the Great Lakes region to the St. Lawrence riverway and the Atlantic coastal areas, the sea lamprey's natural breeding grounds).

The first settlers on the Door Peninsula came because of the promise of superior fishing banks. On Rock and Washington islands at the northern tip of the Peninsula, significant fishing camps operated by 1836. Nearby markets in Green Bay, along the southern shore of Lake Michigan, and in the lumber/copper camps of the Upper Peninsula of Michigan allowed the region to remain a significant regional fishing center throughout the nineteenth century. The areas around Sturgeon Bay, Algoma, Kewaunee, Ephraim, Fish Creek, Washington Island, and Bailey's Harbor all supported fishing concerns of various sizes and forms. At Jackson Harbor on Washington Island, many buildings associated with the fishing industry are extant. Because of the lack of growth of heavy industry within the region, the Door Peninsula remained a rich commercial and sport fishing area well into the twentieth century.

Captain J.V. Edwards became the first to take advantage of the protective harbor at present day Two Rivers, establishing a fishery in the year 1837. A year later, Edwards was joined by J.P. Clark (operator of fishing concerns in Detroit and Whitefish Bay), and their firm of 20 produced over 2,000 barrels of salted fish. Supported by a strong contingent of French and French-Canadian fishermen, the area's fishing industry continued to expand in the middle decades of the nineteenth century. As in Bayfield, the arrival of the railroads in 1874 spurred a substantial increase in fishery production. The period from 1880 to 1900, however, was marked by decline as both overfishing and depressed markets lowered production levels considerably. The early twentieth century (1900-1930) exhibited renewed growth, but the devastation of whitefish and trout populations by the lamprey and other environmental factors shattered much of the newly reorganized industry by mid-century (Krejcarek 1969:1-4).

Numerous other coastal communities from Marinette to Port Washington to Kenosha also supported commercial fishing operations, mainly to satisfy local market demands. According to the 1840 census, St. Croix County (which included the Bayfield area) produced 4,282 barrels of the fish for commercial distribution; Brown County (comprising present day Brown, Door, Kewaunee, and Oconto counties) produced 2,316 barrels; Manitowoc County produced 2,000 barrels; Sheboygan County produced 420 barrels, and Winnebago County produced 3 barrels. The Winnebago County production figure notes the emergence of inland commercial fishing, albeit on a limited scale. (Sixth Census of the United States, 1840: Compendium of the Enumeration of Inhabitants and Statistics, 346).

In the next several decades, especially during the period from 1870 to 1890, the industry grew most dramatically, both in the number of firms and in total production.

Commercial Fisheries in Wisconsin: 1850-1890

Year	Number of Commercial Fisheries	Number of Men Employed	Value of Production
1850	12	47	17,450
1860	52	210	93,374
1870	105	379	214,190
1880	no data	800	276,605*
1890	no data	1,484	455,030**

*Included 330 ships and 10,194,600 pounds of fish. Wisconsin ranked behind only Michigan and Ohio in Great Lakes fishery production.

**Included 530 ships and 14,774,560 pounds of fish from Great Lakes fisheries, worth $363,026; $92,004 accounts for production from inland fisheries.

SOURCES:

Seventh Census of the United States, 1850: Statistics of Manufacturers, 136.
Eighth Census of the United States, 1860: Statistics of the United States, 550.
Ninth Census of the United States, 1870: A Compendium, 941.
Tenth Census of the United States, 1880: Fisheries, 2.
Eleventh Census of the United States, 1890: Statistics of Fisheries, 5.

Typical of the era was the continual emergence and growth of large scale fisheries which, as they expanded, might ultimately include scattered individual fishing camps, central packing houses, cooperages, icehouses, storage warehouses, ship storage and repair yards, railroad sidings, salt docks and repair shops. However, the fishing industry remained a fairly small scale enterprise in relation to the other industrial pursuits that were emerging in the state during the second half of the nineteenth century.

In many cases, the growth of other industries forced fishing concerns to move to new locations. In Superior, for example, where limited-scale fishing operations had existed since the 1830s (American Fur Company post), fishermen in 1885 numbered about 195, and small waterfront docks lined large areas of the harbor. By the mid-1890s, however, new, emerging industrial concerns such as grain elevators, flour mills, shipyards, and coal docks had taken over the valuable waterfront locations and forced many local fishermen to move to new areas. The predominantly Norwegian and Scandinavian immigrants who plied the lakes in search of fish moved to quieter harbors along Lake Superior's northern shore and pulled most of the commercial fishing industry out of both Superior and Duluth (Lusignan 1983:82-83). Generally, both Milwaukee and Green Bay experienced the same industrial pressures.
In the early decades of the 1900s, particularly in the late 1910s and the 1920s, dramatic increases in production followed the implementation of new technologies in boat design, refrigeration, and truck transportation. In the early twentieth century, however, less beneficial factors, including over exploitation of fishing waters, industrial growth and the resultant pollution, outside competition from west coast and foreign fisheries, and the depletion of fish population by predators, developed. Only scientific breeding and restocking programs and environmental restraints concerning the harvesting of fish have allowed the industry to maintain its present low key commercial position.

The industry's sustained development in the twentieth century has been possible because

of the vital role played by the state-sponsored fish hatcheries (Bayfield, Sturgeon Bay, Sheboygan) and the Federal Fish Control Lab in La Crosse whose efforts centered on a number of concerns important to commercial fishing in the state (See State Government Study Unit). Fresh water fishing and processing undoubtedly supported a locally oriented cottage industry in many inland Wisconsin communities, most notably those located on one of the region's major riverway systems or lakes. Due to limited documentation and insufficient time, this study unit deals only with the larger, more established Great Lakes fishing industry.

IDENTIFICATION

Resource Types. Fishing camps, including equipment storehouses, repair sheds, net cleaning, drying and winding areas, living quarters, boat docks and storage sheds; central packing houses, storage warehouses, docks, shipyards, rail loading stations/platforms. Associated resources: fish hatcheries, owners and workers quarters, equipment manufacture and repair shops, fish markets, wholesalers.

Locational Patterns of Resource Types. The main packing houses require central waterfront locations easily accessible to collection ships and the independent fishermen/suppliers of the region. Protected harbors are of upmost importance to the fishing fleets of small wooden crafts typical of the fishing industry. Fisheries also required suitable access to markets, first by ship (dockfront locations) and later by rail and truck.

Previous Surveys. Reconnaissance surveys of all lakefront areas have been completed and have identified some fishing-related resources. However, an intensive or thematic survey, including an evaluation of resources, has not been undertaken.

Survey and Research Needs. Information concerning the growth and development of the fishing industry in Wisconsin is scant, particularly for the period after the turn of the century. Although the Bayfield area has been researched to some extent and a number of sites have been discovered, the remaining coastal areas remain only briefly studied, mostly in the opening chapters of county and local histories. Identification problems also arise in distinguishing between small, independent fishing concerns (localized operations) and the larger commercial fisheries that served extended markets.

EVALUATION

National Register Listings and Determinations of Eligibility

Manitou Camp, (Manitou Island), Town of La Pointe, Ashland County (NRHP 1983)
Hadland Fishing Camp (1920), (Rocky Island), Town of La Pointe, Ashland County (NRHP 1977)
Booth Cooperage, 1 E. Washington Ave., Bayfield, Bayfield County (NRHP 1976)
Bayfield Fish Hatchery (1897), Town of Bayfield, Bayfield County (NRHP 1981)
Delafield Fish Hatchery (1907), Delafield, Waukesha County (NRHP 1981).
Hokenson Fishing Dock (1927--1931), Town of Russell, Bayfield County (1975)
United States Fishing Control Lab (1924), Riverside Park, La Crosse, La Crosse County (NRHP 1981)

Context Considerations. Sites associated with the fishing industry should be evaluated almost solely on a local level, taking into account the role the industry may have played in the development of the area. Integrity of site is an important factor in the evaluation of individual resources. Most camps and/or fisheries involved small complexes of individual buildings, sheds, and dock areas. Thus, an important consideration when reviewing a particular site may be the overall orientation and integrity of the buildings as they relate to one another. Except for the boats, the industry required very little mechanical equipment. Mechanical equipment is thus not a prime evaluation guideline.

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