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THE CUT NAIL INDUSTRY 1776-1890: TECHNOLOGY, COST ACCOUNTING AND THE UPPER OHIO VALLEY

The Ohio State University PH.D. 1979

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THE CUT NAIL INDUSTRY 1776-1890
TECHNOLOGY, COST ACCOUNTING AND THE UPPER OHIO VALLEY

DISSERTATION

Presented in Partial Fulfillment of the Requirements for

the Degree Doctor of Philosophy in the Graduate

School of The Ohio State University

By

Amos John Loveday, jr., B.S., M.A.

* * * * *

The Ohio State University

1979

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Dedicated to

Mary Jean, Amy, and the "Colonel"

SPECIAL ACKNOWLEDGMENT

I wish to thank the Wheeling-Pittsburgh Steel Corporation and especially Mr. Roger McLean, Mr. Harry Sykes, and Mr. Joseph Wurtenberg, who located and made available records of the firms in and around Wheeling, provided technical information on nailmaking, and generously allowed me to tour one of the last operating cut nail mills. Without the cooperation of these gentlemen and the Wheeling-Pittsburgh Steel Corporation, this study would not have been possible.

PREFACE

My interest was attracted to the history of nail manufacturing in 1975 while directing research for a museum on the Ohio Valley ceramic industry. As a part of the background research, the staff of the Ohio Historical Society identified several major industries--ceramics, textiles, glass, iron, and coal mining--that either existed or had existed in the area between the Ohio-Pennsylvania line and Portsmouth, Ohio. A report on each of these industries, identifying specific products, developmental patterns, and overall importance as measured by the number of people employed, capital investment, and value of product was prepared. Quite by chance I undertook the research report on the iron and steel industry.

Since I was familiar with the past of the upper Ohio Valley, at least the local rural traditions and the county histories, I was surprised to find that the steel works in and around Wheeling, West Virginia, and Steubenville, Ohio, had their beginnings as nail mills. Moreover, I discovered that these nail mills, after the mid-nineteenth century, were not only the largest in the country but also were almost two times as efficient as competitors in the East.

Having learned this I decided to explore the origin and development of nail manufacturing in more depth. Assuming that the Wheeling mills had obtained some technological advantage, I began my research with the technology of nailmaking. After examining both

secondary and primary sources, I concluded that this assumption was incorrect. Instead of new technology, business structure and technique applied to the technology appeared to be responsible for the rise of the Wheeling firms to leadership in the industry. What had begun as a technological study was transformed into and completed as a business history with an emphasis on the relationship between management practices and technology.

In order to study the Wheeling firms effectively it was necessary to examine the history of the cut nail in general. I have included a chapter on the development of the cut nail before 1833, the date taken as the founding of the first Wheeling nail firm. This period deserves a more comprehensive treatment than is possible in connection with the technology of nail manufacturing in the Wheeling area because it was in the era between 1776 and 1832 that the great technological advances were made.

Throughout much of the study nail manufacturers outside of Wheeling are noted for comparison and context. Most conspicuous are those firms located in and around Pittsburgh, but occasional reference is made to Eastern firms. Since there is no comprehensive history of nail manufacturing, the information on both the early history of nail-making and the firms outside of Wheeling may be of some use to researchers who have an interest in the general history of cut nail manufacturing.

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INTRODUCTION

In modern times the nail was of particular importance in the United States. The abundance of timber in America, the scarcity of skilled labor, and the demands for housing and transportation in an expanding economy made Americans the preeminent consumers of nails. During the waning years of the eighteenth century and the first half of the nineteenth century, American inventors and manufacturers revolutionized and perfected the technology of nailmaking. A new machine made nail, the "cut nail," was developed and marketed in America. It was far less expensive, far superior, and more widely available than the traditional wrought nail.[1] What follows is the account of the rise and fall of the industry that was devoted to the development and manufacture of the cut nail.

The story of cut nail technology as well as the institutions and processes that it engendered is important. Nailmaking provides significant and instructive variations on the familiar themes of the shift from owner mechanic to impersonal corporation, from skilled worker to production line help, with the interplay of geography, economics, organizational skill, and leadership with technological change. But events in the history of the cut nail are of particular importance because they show what happened when a new technology confronted the social structures of an already established technology just as business

structures were taking on a more contemporary form. These events raise questions as to the dynamics of obsolescence as well as innovation, particularly as they involved the business management practices that grew up to match the technology.

It was during the early years of the nineteenth century that the handmade wrought nail gave way to the machine made cut nail. The cut nail in turn was supplanted by the wire nail in the 1890s. Firms devoted to the cut nail technology grew up particularly in New England, the Middle Atlantic states, and the upper Ohio Valley. The nail manufacturing industry progressed through three identifiable stages during the nineteenth century. The first stage, when the full forces of the technological developments were being felt, lasted until the 1850s. During the two decades that followed, the industry continued to grow, but at a much slower rate. By the late 1860s the industry expanded, the number of units increased, and the Western manufacturers began to challenge the dominance of the old Eastern factories. The final era (1870-1890) was one of disproportionate growth. It was marked by rapid expansion of the Western manufacturers and a slow decline of those in the old established areas of the East. This period was also the one during which the wire nail was introduced into the American market and the production of cut nails began to decline.

Both cut nail technology and associated business techniques reached their highest development in a small segment of the upper Ohio Valley between Wheeling, West Virginia, and Steubenville, Ohio, and these firms became known among nail makers as the Wheeling industry. Although other manufacturers provide comparisons and affirm

generalizations, the history of the Wheeling nail makers is in effect the history of the cut nail industry, and so it is treated in the present work.

The following account is based on material in the general and local periodic press, the hardware specialty journal, The Iron Age (beginning in 1872), and a variety of memoirs, business records, artifactual material, and secondary accounts. Except for the Burden Iron Works of Troy, New York, and the Tremont Nail Works of West Wareham, Massachusetts, the firms of the Middle Atlantic and New England states left few records. Many of the major manufacturers, such as the Phoenixville Nail Works of Phoenixville, Pennsylvania, and the huge Boonton Nail Works in Boonton, New Jersey, disappeared completely during the late nineteenth century, and no records survived, either in research archives or in the records of succeeding corporations. Even the firms that existed in the Pittsburgh, Pennsylvania, area have left few traces. Some simply went out of business, and many switched to other products and were caught up in the Carnegie and United States Steel conglomerates, again leaving few records behind.[2] But where cut nail manufacturing reached an apogee, in the Wheeling district, records of four firms have survived, and together with national and local journalistic accounts they reveal forces that transformed small specialty manufacturers operated by mechanics, into large, integrated firms operated by corporations--and then what happened when wire nailmaking presented a challenge.

The nail is an ancient implement that was developed by man whenever and wherever he possessed the technology to fashion artifacts from metal. Although a metal product, the nail properly belongs to

periods and cultures that have relied heavily on wood, for the chief virtue of the nail was and is efficiency in fastening wood to wood. In this capacity the nail was a central feature in architectural advances and in the development of many implements and even technologies, such as those based on wooden vehicles. Of course, the nail has also been used in other capacities such as affixing shoes to the hoofs of animals or in general and military construction work where wood was employed.

Historians have all but ignored the nail. Except for the references to the industry in standard works such as Clark's History of Manufacturers in the United States, Temin's Iron and Steel in 19th Century America, and Boorstin's The Americans, there are few secondary sources that deal with the subject. A few antiquarians have from time to time taken an interest in the nail as an object and have done some research into early manufacture and distribution. Henry C. Mercer, in his booklet, "Dating Old Houses," did some basic and pioneering research on the topic in the 1920s. During the last decade, the interest in historic preservation has prompted architectural historians to study nails and nailmaking. Lee H. Nelson, an historian for the National Park Service, published a pamphlet entitled, "A Nail Chronology," in the early 1960s; Susan Buggey of the Canadian Conservation Institute at Moncton, New Brunswick, published a catalogue of nails in the Bulletin of the American Association for Preservation Technology in 1976; and Peter Priess published an article on the wire nail in the same journal in 1974.[3]

Even in the nineteenth century, relatively few people wrote on the subject. The first American writer to give any attention to nail manufacturing was J. Leander Bishop. His History of American

Manufacturers from 1608 to 1860, published in 1864, contains much information about the early history of nailmaking in the United States. A few other nineteenth century writers, such as Horace Greeley, also made reference to the manufacture or use of nails. For the most part, however, information on the subject is confined to sources in which nailmaking was strictly incidental, such as census reports, or to the usual, and in this instance scarce, primary sources.[4]

Comparatively speaking, nailmaking was never a large industry. But at one time the nailers of the country consumed almost fifteen percent of the wrought iron and steel, although in the twentieth century the proportion dropped to less than two percent. Likewise the industry never employed great armies of workers, although it was often of very great local importance. Furthermore, nailmaking has not had the "sparkle" of other industries. The "common nail" as it was and is called was a fairly unimposing object that was hidden from view when it was used. As an industry, however, nailmaking was significant. The unique relationship of the industry to America, the rapid development of nailmaking technology between 1775 and 1830, and the resulting revolution in the industry, had far-reaching consequences--not least of which was the widespread availability of cheap nails so important in shaping American architecture during the middle of the nineteenth century.

As nail machines came into use, nailmaking ceased to be a cottage industry and became more concentrated in factories. Mechanization also transformed the nailmaking task. Whereas wrought nails were manufactured by single individuals, the cut nail machines initially reduced the

nailmaking process to three specialized tasks--feeding the nail plate into the cutter, operating the machine, and forming heads on the nail. Eventually these three specializations were reduced to one with the development of the automatic header and feeder. Finally, it may be said that machines centralized the industry. Over the course of the nineteenth century the number of production units declined, and correspondingly the remaining units grew in size. These changes and others noted in the following chapter show clearly the dramatic impact that the new technology had on every aspect of the nail industry and cast some light on the relationship between technological development and other facets of industrialization.

The technological aspects of nailmaking were crucial in shaping the way in which an industry developed. Nailmaking was a basic industry that was directly linked to the nation's iron manufacturing enterprises. Nails were one of many finished iron products, and, as noted above, the industry did during the nineteenth century consume a significant proportion of the wrought iron produced in the United States. But relationship between nail manufacturing and other components of the iron industry changed during the second third of the nineteenth century. Generally speaking, nail manufacturing had grown up and flourished in the early decades as a small, separate enterprise or as one of many carried on in conjunction with the manufacture of other finished iron products. After 1830, this configuration began to change. Nail manufacturing firms grew, integrated vertically, added rolling mills and blast furnaces, and became important components in the iron and steel industry.

Nail production was also directly related to two other important industries. The rapidly developing nation needed a type of building that unskilled laborers could erect quickly, easily, and inexpensively. When builders replaced the mortised joint with one secured by nails, they created a structure that fully met the needs of the growing population. While several innovations helped effect the new building, the cut nail was unquestionably the most important. The second economic unit in which the nail had an important role was, curiously enough, transportation. American railroad construction during the period between 1830 and 1890, for example, consumed an estimated 650 million spikes for new construction alone and at least twice that number for track replacement and trestle construction.[5]

This study, then, is both an overview of nail manufacturing in the United States from 1776 to 1890 and a case study of one of the most important segments of the industry. One major objective is to trace the evolution of the entire industry noting three general changes. First, and of primary importance, are the technological changes and impact they had on the organization of the industry. Second, nontechnical influences, such as government policy and market growth, also affected nail manufacturing. Finally, the cut nail industry, as already suggested, had a profound effect on architecture and construction during the nineteenth century.

Significant and instructive detail comes from the records of the nail manufacturers in the Wheeling district. Beginning in 1834, with the establishment of a single nail factory in Wheeling, the industry expanded first in Wheeling but by 1860 to other towns--Bellaire, Martins Ferry,

and Steubenville, Ohio, and Benwood, West Virginia--in the area. By 1870 these were the nail factories that formed the largest definable group of manufacturers in the country. Particular emphasis is given to factors, such as mineral deposits, transportation facilities and key individuals, that influenced the growth of the industry. After the Civil War the character of the Wheeling area manufacturers changed as economic forces prompted them to reevaluate the structure and nature of their enterprise. A considerable portion of this study examines changes that resulted. The development and use of a cost accounting system, emphasis on efficiency, and the move toward vertically integrated enterprises provided a significant advantage to Wheeling district manufacturers. Using this advantage, they came to dominate the industry. However, as the Wheeling district firms became more complex, their singular interest in nailmaking weakened and by the mid-1880s they no longer specialized in nail production. They had become a part of the larger iron and steel industry and looked upon nails as a finished product, rather than the only product.

The central feature of the period between 1870 and 1890 was the constant move towards integration. At first the integration was vertical. Individual firms added blast furnaces, coal mines, keg factories, riverboats, and even railroads to their holdings. Later, beginning in the mid-1880s, the firms moved towards horizontal integration. The final chapter of this study will examine this move towards horizontal integration, explore the impact of the "wire nail" on the industry, and conclude with the combination of several nail firms into

the Wheeling Steel Corporation, a firm that was to become one of the major steel manufacturers during the first half of the twentieth century.

Many scholars have examined industrial and economic development through broad general studies, by means of case histories, or through horizontal studies that examine a particular facet, such as marketing or entrepreneurial leadership, that cut across many industries. All have recognized the importance of technology as a major ingredient in the economic development of manufacturing enterprises in general. At base, this study proposes to examine the technology that revolutionized one industry and explore the relationship between that technology and various other factors that have been regarded as important to basic industrial development.

As the evidence shows, technology cannot be divorced from management, competition, marketing, and many other facets of the enterprises that formed the nail industry. Furthermore, technology is not solely a matter of invention or even of machines and processes, but, rather, it is a far more complex process. As will be noted later, technology was directly related to cost accounting, form of management, labor relations, and a host of other areas. In the final analysis, the application of machines to the nailmaking process supplanted an ancient technology, reorganized production, played a basic role in creating a market for nails--and set the stage for obsolescence.

FOOTNOTES

INTRODUCTION

[1]One of the stronger assertions of the American role in the development of the cut nail appeared in The Iron Age, September 22, 1881, p. 12.

[2]Insofar as could be determined, records of the nail companies mentioned above do not exist. Standard bibliographic sources were consulted, depositories in the states were contacted, and where successor corporations could be determined, they were contacted. It is possible that, despite disclaimers, some records do exist in corporate depositories. The Tremont records were not consulted for the present study.

[3]Victor S. Clark, History of Manufactures in the United States 1607-1860 (3 vols., New York: Peter Smith, 1949); Peter Temin, Iron and Steel in 19th Century America (Cambridge, Mass.: The MIT Press, 1964); Daniel J. Boorstin, The Americans: The National Experience (New York: Random House, 1965), pp. 155-158; Henry C. Mercer, "Dating Old Houses," Old Time New England, April, 1924, n.p.; Henry C. Mercer, Ancient Carpenters' Tools (Doylestown, Pa.: The Bucks County Historical Society, 1929); Lee H. Nelson, "A Nail Chronology," The American Association for State and Local History, Technical Leaflet #48; Susan Buggey, "Supplying Building Materials to the British Army in the Colonies: An Illustrated Document," The Association for Preservation Technology Bulletin VIII (1976), pp. 89-118; Peter Priess, "Wire Nails in North America," The Association for Preservation Technology Bulletin V (1973), pp. 87-92; Ronald L. Michael, "Cut Nail Manufacture: Southwestern Pennsylvania," The Association for Preservation Technology Bulletin VI (1974), pp. 99-108.

[4]J. Leander Bishop, A History of American Manufactures from 1608 to 1860 (3 vols., Philadelphia: Edward Young & Company, 1864), I, II and III; Henry Dickerson Scott, Iron and Steel in Wheeling (Toledo: Caslon Co., 1929); Horace Greeley, et al., The Great Industries of the United States (Hartford: Wm. Burr, Hyde & Co., 1872).

[5]This figure is an estimate based on the miles of railroads constructed. See Committee on Historical Statistics of the Social Science Research Council, The Statistical History of the United States from Colonial Times to the Present (Stamford, Conn.: Fairfield Publishers, Inc., 1965), p. 428.

CHAPTER I

THE TECHNOLOGY AND THE MARKET

> . . . cut nails . . . being an American invention substituted machinery for manual labor.
>
> J. Leander Bishop
> A History of American Manufacturers

The history of nailmaking in Western Europe dates from the Roman invasions. Excavations of Roman camps at Kiserlentern, Germany and Reading, England have yielded both nails and examples of nailmaking tools. A special anvil from the Kiserlentern site and heading tools from the English site provide evidence that the process of nailmaking was well developed as early as the third century A.D.--so well developed, in fact, that the same basic equipment existed in colonial America.[1]

During the fifteenth century, English artisans made two major contributions to nailmaking. Most notably, the English introduced the slitting mill, a device for cutting metal plates into thin strips which in turn were cut into nails. English ironmongers also developed a standard "penny" pricing system that continues, albeit quite modified, today. They priced their nails by size. An eight pence, or eight penny nail, referred to the length of nail that sold for eight pence. With the arrival of mass production, length and weight became firmly related, and by the middle of the nineteenth century nails were quoted on the basis of price per pound, with a firm relationship existing between weight, number, and length.[2]

Just when the first nails arrived in America is uncertain. Ships of Norsemen who explored the east coast probably had nails in their hulls. These seafarers, like those from other western European countries, most certainly carried with them ready-made nails or materials from which nails could be made for use in making temporary repairs to their ships.

Records from the earliest expeditions to America indicate that the settlers at both Jamestown and Plymouth brought nails along with other commodities that were needed for survival in the New World. The records of the London Company show that the managers regarded nails to be as important as food, clothing, and weapons. An entry dated June 18, 1623, and entitled, "a portion of the charges to furnish and transport six men to Virginia," listed nails as one of several essential items. Other entries in the company records also show quantities of "nayles" being shipped to Jamestown from time to time.[3]

By all accounts nails were an important and often scarce commodity well into the eighteenth century throughout the colonies. In 1645 the House of Burgesses of Virginia prohibited the burning of houses for nails. This practice was a common one throughout the colonies and on the American frontier even at a later date. In 1691, the supervisors ordered the old county courthouse in Kent, Delaware, burned in order to "get the nails." Similar instances of destroying buildings for nails are recorded in Pennsylvania and other states. On the American frontier during the early nineteenth century there are many hints of structures being deliberately ignited for nails. Frontier forts, structures that

often contained large numbers of nails and were abandoned as settlers arrived, had an uncanny record of destruction by fire.[4]

It is impossible to assign a date to the first nailmaking venture in the New World, for the tools and techniques were commonplace among the colonists. During the age of wrought nails, the nailmaking process was a two-phased operation. Wrought iron nail plates produced by tilt hammers (later by rolling mills) were cut into thin rods corresponding in thickness to the size of the nail shank at slitting mills. Once the nail rod had been made it could be cut and headed at the slitting mill or shipped to its destination and converted into nails by the purchaser. Since the cost of shipping nail rod was cheaper than shipping nails (because of lack of packing), substantial amounts of imported nails used in the colonies probably came as rods that blacksmiths converted into nails upon arrival. Furthermore, nail rod found many uses other than nails. Colonial craftsmen fashioned nail rods into such diverse objects as cooper's cressets, fire baskets, "mud spoons" (a stonemason's tool), trivets, various "S" hooks, gridirons, etc.. Just what proportion of the imported nails were finished and what portion was nail rod is difficult to determine. The number of artifacts fashioned from nail rods that have survived to the present day indicates that a significant portion of the nail rod was used for purposes other than nail manufacture.[5]

Except for specialty nails, nailmaking did not require either high levels of skill or high levels of capital investment. Nail rod could be cut with a hammer and chisel on a common anvil using any fireplace as a source of heat. Heading was a bit more complicated,

however. A simple tool formed from wrought iron could be made very easily for this task. During the late colonial period there is ample evidence to suggest that most of the nails for domestic use were made either by the user or by local cottage industries, while commercial naileries specialized in making nails for shipbuilding. Even large users, such as military engineers and large scale builders often employed nailers to convert nail rod to nails on the site.[6]

British mercantile policy was designed to discourage the development of the capacity for manufacturing nail rod in the American colonies. Parliamentary Acts of 1669, 1719, and 1750 specifically outlawed the manufacture of nail rod or the construction of the slitting mills that were necessary for nail rod production. For example, a parliamentary act of 1750 stated that "From and after the 24th day of June, 1750, no mills or other engines for slitting or rolling iron . . . shall be erected or hereafter such erections continue in His Majesty's colonies in the Americas."[7]

Like many of the other parliamentary laws regarding trade, these laws prohibiting nail rod manufacture were ignored by the colonists and by the local British authorities. Both entrepreneurs and the colonial legislatures found it to their advantage to manufacture nails. In May of 1722, Ebenezer Fitch petitioned the General Court of Massachusetts for a license to operate a slitting mill. The Court's response showed that colonial authorities ignored the existing parliamentary prohibitions.

> Whereas, Mr. Ebenezer Fitch represented to this court that divers gentlemen in company with himself are willing and desirous to set up a slitting mill upon the river called

> Stoneybrook . . . to slit and draw out nail rods for nails and other artifacts of iron . . . and this court considering the great advantage such a mill will be to this government as well as to the neighborhood, have thought it fit to encourage the same . . . .[8]

To encourage Fitch, the Connecticut officials granted him a fifteen year monopoly and included a provision that allowed him to erect a second mill if "any tax or duty shall be set upon the iron so slit . . . ." The final provision of the Court's resolution probably indicated that nails were also being produced in Massachusetts, the neighboring colony. The existence of a mill in Massachusetts was confirmed by a 1732 report to the House of Commons in which the Governor of Massachusetts referred to one slitting mill and one nailery located in the colony. By 1750, when Parliament, in conjunction with the passage of an Act for the Encouragement of the Importing of Pig and Bar Iron, ordered a report on ironmaking establishments, the Governor of the colony noted that the rolling mills of Massachusetts were chiefly employed in making nail rod from which spike and large nails were already made in "great abundance and cheaper than they could be imported . . . ."[9]

Various other sources contain information that confirms that iron works and nail mills existed in Massachusetts, Connecticut, and Pennsylvania during the two decades before the Revolution. North Canaan, Connecticut, had three slitting mills; Sharon had several "nail shops"; and East Hadden, in Middlesex County, had a "nail factory." In Pennsylvania, nailmakers could be found as early as 1703. By 1770, John Little in his "Account of Smiths and Nailers," noted dozens of nail manufacturers producing nails ranging in size from three to thirty penny.[10]

The geographic pattern established before the Revolution continued well into the nineteenth century. Massachusetts, Connecticut, and Pennsylvania dominated the nailmaking industry until the western nailers, specifically those in the Upper Ohio Valley, became the largest manufacturers in the 1850s. Even as late as 1870 Massachusetts and Pennsylvania still accounted for a substantial proportion of American nail output.[11]

By the outbreak of the American Revolution the colonies had developed a substantial nailmaking capacity. How nearly self-sufficient the colonies were is debatable. Records from 1770 show that 22,238 tons of nails or nail rod were imported that year, a small fraction of the quantity necessary to meet the demands of the American market. Furthermore, large quantities of Russian and Swedish iron, the most preferred for making nails, were being imported during the late Colonial and Federal periods, further suggesting the existence of a sizeable industry. Congressional debates in 1789 shed some light on the status of nail production. Thomas Fitzsimmons, a Representative from Pennsylvania, claimed that America was self-sufficient in the production of spike and ship nails. Other congressmen, particularly the Southerners, objected that while it was true that the Northern states were self-sufficient, the Southern states still imported large quantities of nails and nail rod from abroad. In 1791 Alexander Hamilton noted that the United States was importing 900 tons of nails or nail rod. In short, the precise degree of self-sufficiency is difficult to determine. The most that can be said is that a sizeable American nail industry had evolved by the Revolutionary War period.[12]

Even so, nails continued to be a precious commodity used sparingly because of their relatively high cost. In 1800, for example, common size nails sold for 10 cents to 14 cents a pound along the eastern coast and considerably more in the interior. Translating the cost or even the number of nails from the number of pounds produced is quite difficult. Each nail was a unique object varying in weight and length. In John Little's "Accounts of Smiths and Nailers," for example, 10d (penny) nails made on January 5, 1778, weighed out at 58 to the pound. Three days later, the same size nails weighed out at 63 to the pound.[13]

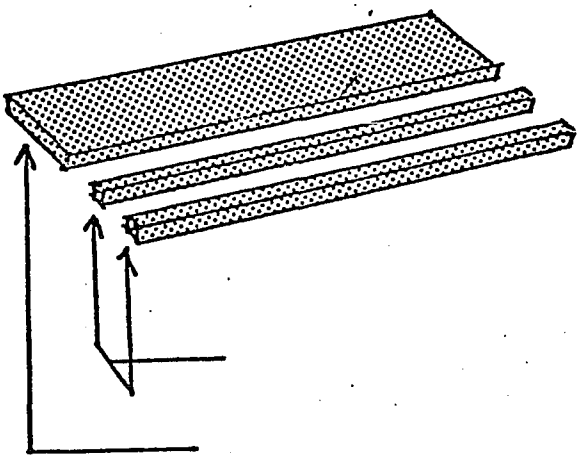

Fig. 1. Nail plate was cut into rods at a slitting mill.

The manufacture of wrought nails was a labor intensive job that required semi-skilled workers to spend hours doing tedious work. The true nature of the work may be best comprehended by pointing out that nail manufacture was left, whenever possible, to slaves (in the South) and children. As noted previously, the process required two steps. Slitting, the first operation, occurred in a mill and was often divorced from the actual manufacture of nails. This operation consisted of

cutting the wrought iron nail plate lengthwise, producing a series of rods. Nathan Read, a Connecticut nailmaker, in 1795 estimated that it required five men one day to slit and bundle three tons of nail rod. He further noted that the customary price for slitting was $1.00 per 100 pounds. Consequently the slitting phase added substantially to the cost of the finished product.[14]

The second step of the process required three separate tasks--pointing, cutting and heading. In the first task, pointing, one end of the nail rod was sharpened in one of several ways. The most common form of point was produced by working the four surfaces of the nail rod to a point. Other nails were pointed by flattening the end of the rod to produce a "bill," and still others received chiseled points which required that only two faces of the nail rod be brought to a point. Each type of point required the nailer to heat the nail rod and strike several blows with the hammer.[15]

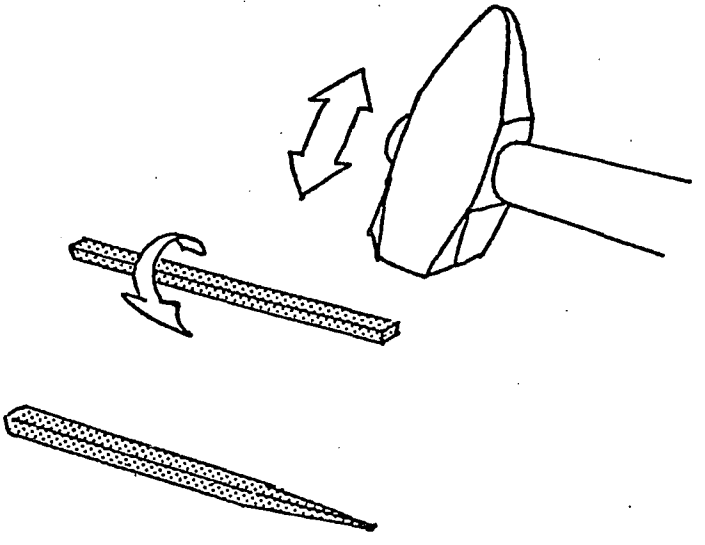

Fig. 2. The nailer worked the heated nail rod to a point. After each blow of the hammer, the nail rod was turned.

Once pointed, a section of the rod corresponding to the length of the nail, with proper allowances for the head, was cut from the bar. Finally, the other end of the nail was headed by working it into one of many types of heads. The Royal Engineers Catalogue of 1812 listed

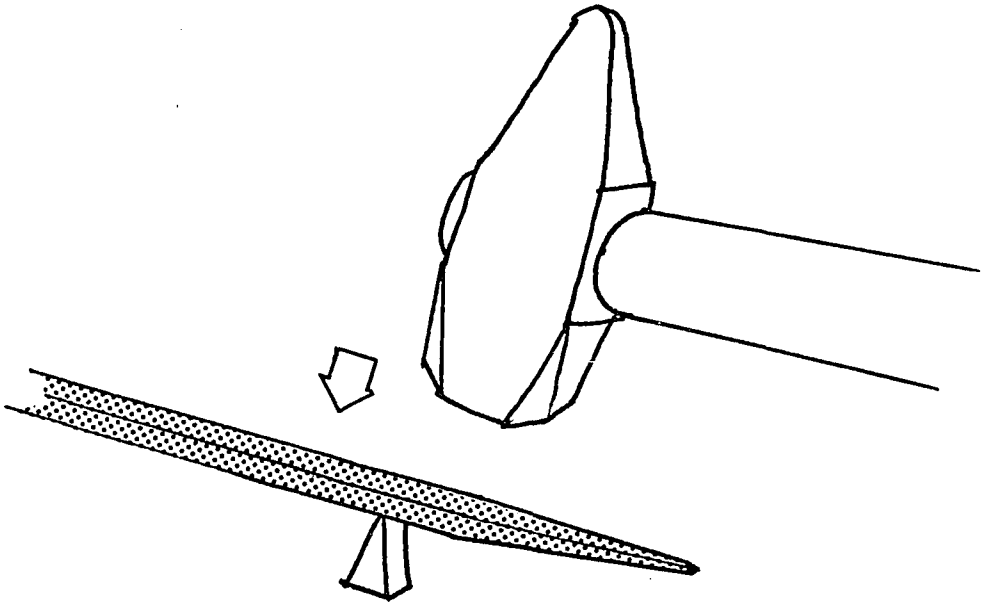

Fig. 3. After the rod was pointed, the nailer, using his hammer and a "hardy," cut the pointed portion of the rod away.

fourteen head types. (See Fig. 6). The nail blank was placed in a tube that had a tapered hole large enough for the pointed portion of the nail but too small for the entire nail to fall through. After the nail was inserted, the nailer, using a hammer, forged the head. Rosehead, a common head, required that the metal be flared around the shank, producing a head with several facets. The common "T" shaped head required the nailer to split the upper portion of the shank, parting it, then flattening the two appendages to a "T" shape.[16]

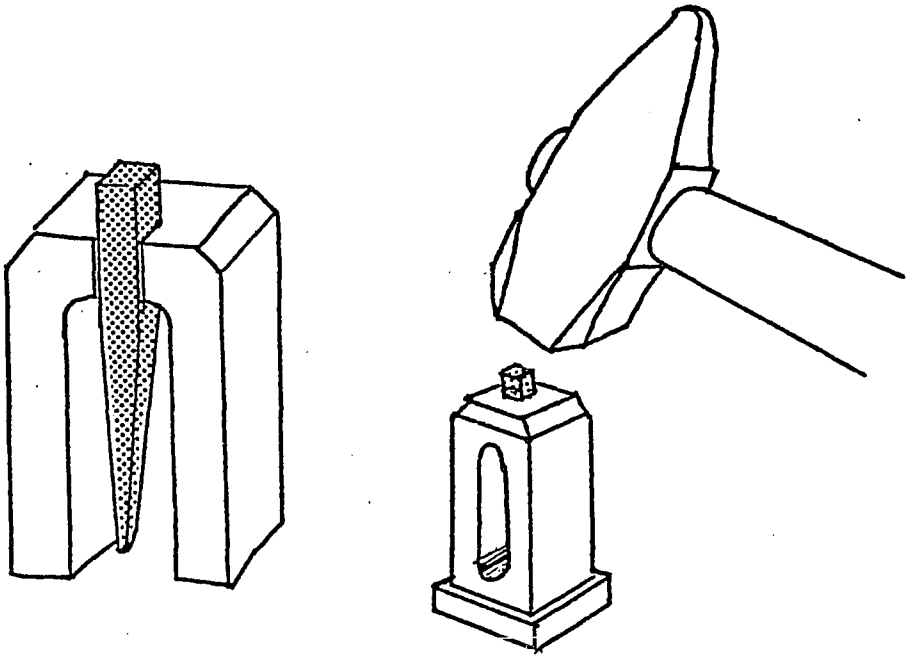

Fig. 4. Using a device known as a header, the nailer flattened the upper portion of the nail rod. This illustration shows one of the common headers. The device had a tapered hole in the top that allowed the pointed portion of the nail to be inserted but held the unpointed portion above the surface.

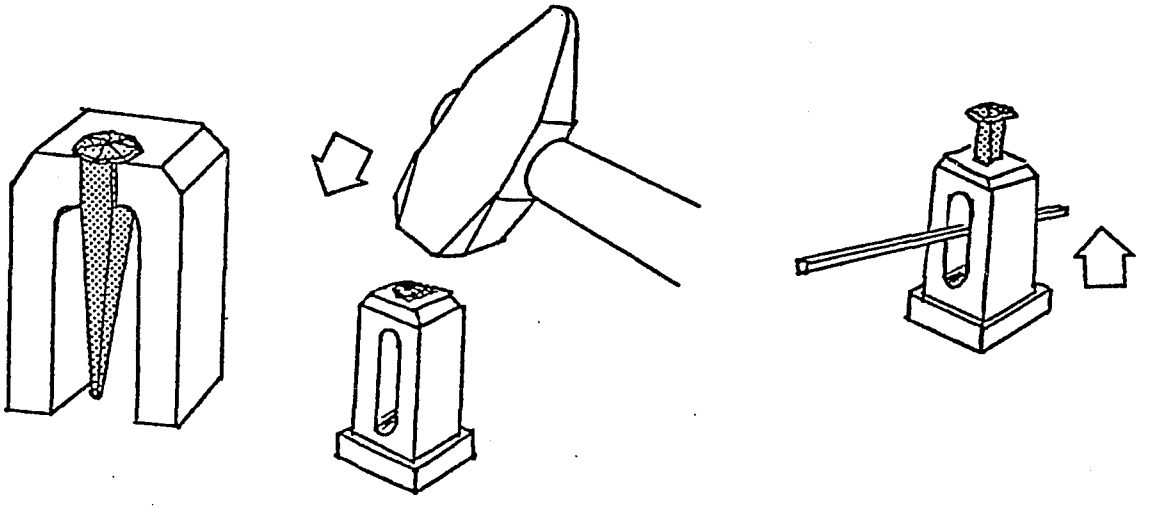

Fig. 5. Once headed, a chisel or other device was inserted into the slot and forced up, releasing the nail.

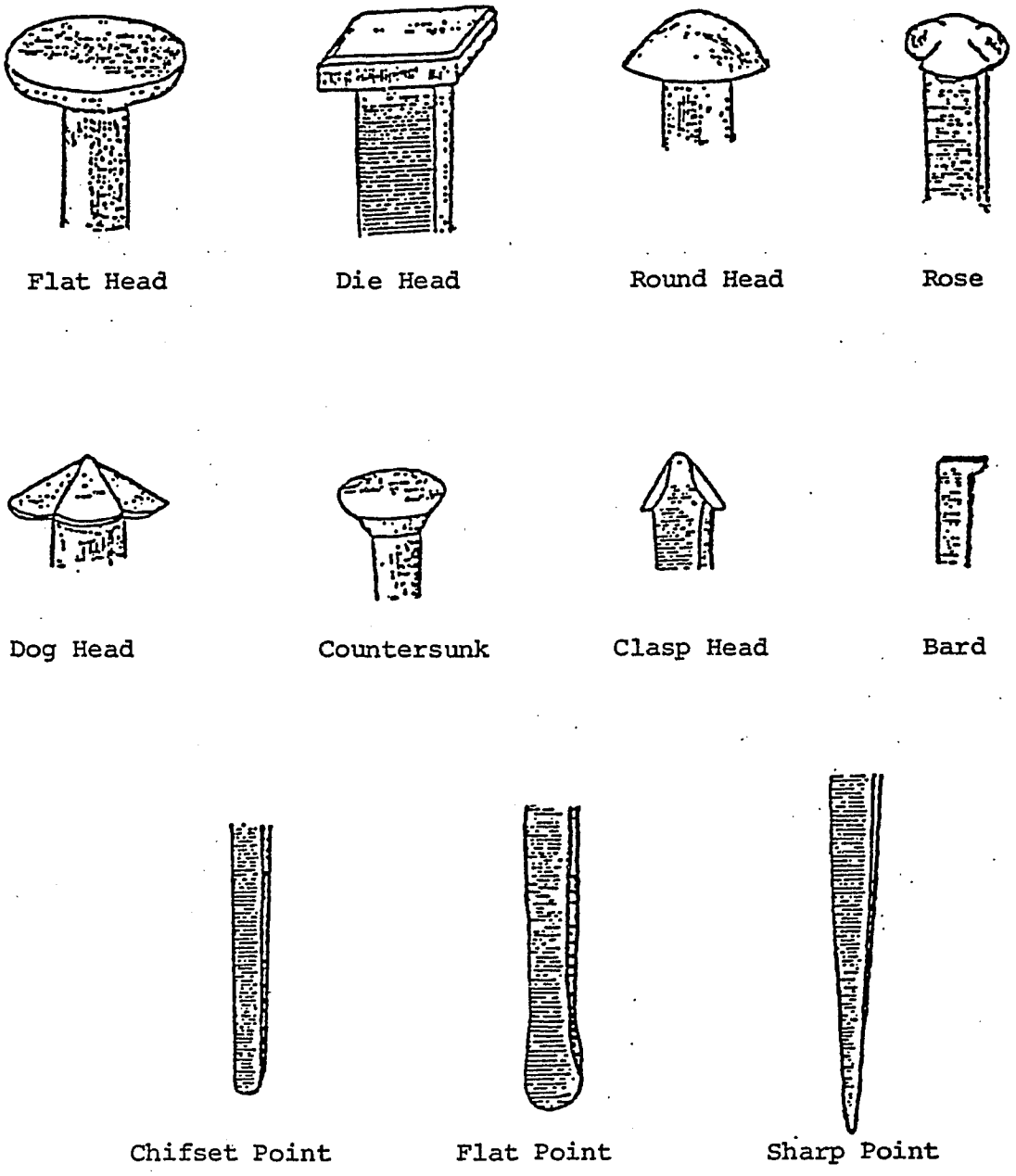

Fig. 6. Head and point styles.

Each type of head required varying amounts of metal and therefore made a difference in weight of nails, even of common length. Each type of head also required slightly different amounts of time to produce, therefore affecting the rate of production and the cost of the finished nail. Obviously the rate of production varied with the type of head and type of point applied to the nail. At most, a skilled nailer turned out a few thousand nails per day.[17]

This labor intensive and expensive system of nail manufacturing essentially tied the volume of nail production to the number of workmen who could engage in the work and as H. J. Habakkuk observed in his comparative study of American and British technology, labor shortages in North America were a severe problem. After the Revolution interrupted trade with Great Britain and disrupted the supply of imported nails American inventors began to search for alternate ways of manufacturing nails. Jeremiah Wilkinson, of Cumberland, Rhode Island, traditionally has received credit for developing the nail cutting technique. In 1775, Wilkinson produced textile card tacks by shearing thin slivers of metal from the ends of a metal plate instead of cutting them from a rod. So far as can be determined Wilkinson never used this process to produce nails, however. Bishop says that the process was picked up by nail manufacturers in the area and applied to nail-making.[18]

Whether Wilkinson or someone else deserves the credit for transforming his cutting process it is difficult to say. At all events, the process was adopted and refined by inventors and manufacturers during the Confederation and early National periods and by 1820 was

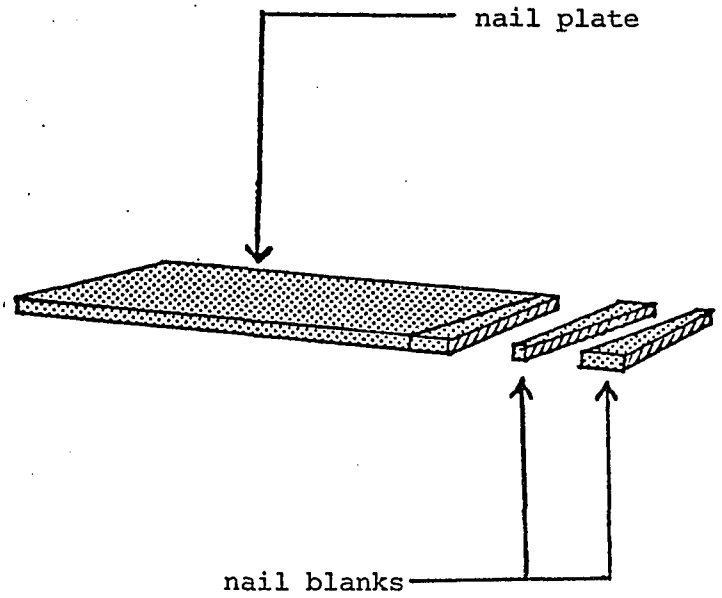

Fig. 7. The Wilkinson process. Nails were cut from the end of the nail plate already pointed. This process eliminated the need for slitting the nail plate into rods.

widely applied to nailmaking. In 1798, for example, two Pennsylvanians, Samuel Briggs and David Folsom, petitioned their state legislatures to grant patents on nailmaking machinery. Such devices also were submitted to the national patent office. In 1796, for example, fully two-fifths of the patents granted were for new or improved nailmaking machines. Between 1790 and 1820 patents for nailmaking machines and improvements accounted for slightly more than two percent of all of the patents granted by the United States Patent Office.[19]

The inventors moved in two directions in their attempts to devise machines that would eliminate several of the manual steps in the nail manufacturing process and thereby speed up production. One direction taken by inventors was improvement in the wrought nail process. Inventors of this type of machine typically used dies to strike nails from the rod as it passed through the machine. One such machine

patented in 1790 squeezed a bar of iron into nails as the bar passed between heavy rollers with molds incised into their faces. Since only few samples of this type of nail have survived, it is apparent that large numbers were never produced.[20]

Most of the inventors chose a second path, one that built upon Wilkinson's machine, and literally turned the nailmaking process around ninety degrees. These machines were basically cutters that sheared nails from plates, thus eliminating the need for slitting mills to cut nail rod. Instead, nail plates were cut into widths corresponding to the length of the nail. Workmen then inserted the plate into a cutter, a machine that consisted of a fixed bed and a reciprocating blade (see Fig. 8). As the blade struck, a small sliver of metal was cut from the nail plate. By constructing a cutter with a blade that struck at a slight angle to the path of the nail plate, workmen could cut and point nails at the same time if the nail plate was flipped after each strike of the machine. The same end could be achieved with the blade perpendicular to the path of the nail plate if the plate were moved from side to side at an angle to the direction of the plate's movement.[21]

By 1800 a new kind of nail, the "cut nail" began to replace the old wrought nail in the market place. In 1797 Nathaniel Read, a nail manufacturer from Danvers, Massachusetts, described to Timothy Pickerington, Secretary of State, a machine that he had invented.

> My nail machine consists of a cutting lever of common form . . . a stage upon which the nail plate is placed and forced into the jaws of the cutter by a pair of rippers and a small pulley. Directly under the cutting tool is a small trough into which the nail drops . . . the capacity of the machine is about 10,000 nails daily. With the same machine, nails of any size from 4d to 20d can be made . . . .[22]

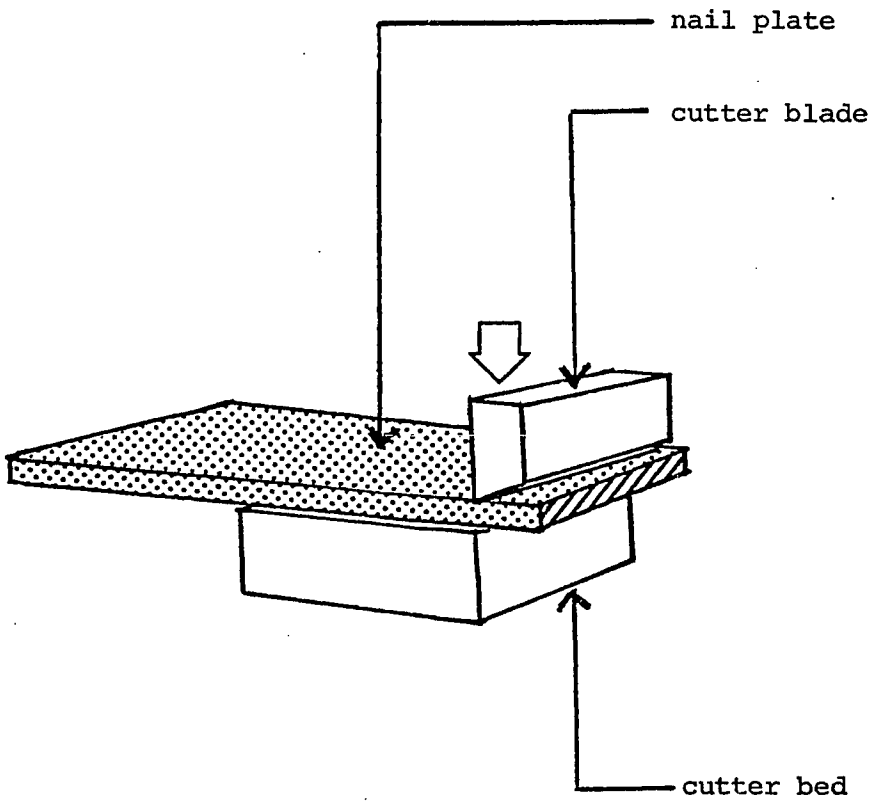

Fig. 8. Schematic of nail cutting machine.

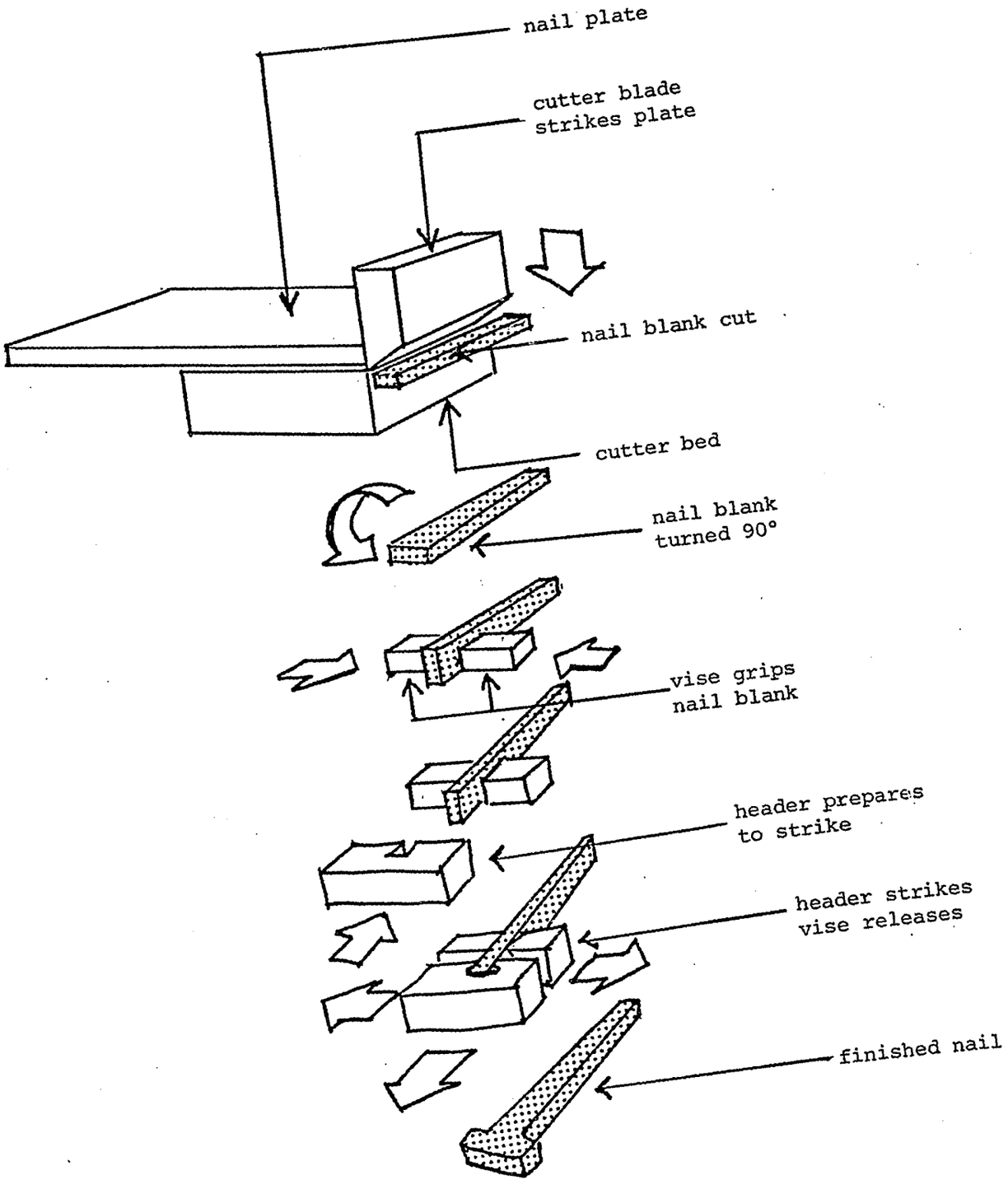

Fig. 9. Cutting and heading steps.

The period between 1775 and 1790 was critical in the establishment of the cut nail. During this period the British policy that discouraged nail manufacture was replaced with a state and national policy promoting the industry. This new policy, combined with the technological revolution that was taking place, encouraged the reshaping of the American nail industry.[23]

As was the case with many manufacturing and transportation enterprises, encouragement of nailmaking first occurred at the state level.[24] Three states attempted to stimulate the manufacture of nails during and immediately after the Revolution. In December of 1774, the Provincial Assembly of Massachusetts recommended the manufacture of nails to the population of that state. This encouragement was meant to extend the existing craft system that had evolved in Massachusetts during the previous decades. Fisher Ames, a Massachusetts representative to the United States Congress in 1789, described this system:

> It has become common for country people in Massachusetts to erect small forges in their chimney corners and in the winters and on the evenings when little work can be done, great quantities of nails are made even by children. These people take the nail rod from the merchant and return him the nails; in consequence of this easy mode of barter, the manufacture is prodigiously great.[25]

South Carolina, the second state to encourage the production of nails, acted in November of 1775 with an offer of a 700 pound sterling prize to the first citizen of that state who could slit 1,000 pounds of nail rods. No record of who, if anyone, collected the premium has survived. As late as 1810 census returns showed no slitting mills in that state.[26]

During the post-Revolutionary period the legislature of Connecticut twice considered nail manufacturing. In 1786 the Legislative Council of Connecticut considered offering a premium for nail manufacturers, but the idea was rejected on the grounds that the industry in that state was well established and did not require stimulation. Nine years later, in 1795, the Council did act passing a law to regulate the industry. In what was the first attempt to regulate nailmaking, the Connecticut legislators established fixed weights and lengths for wrought nails in the 2d - 20d range that were being manufactured for sale or export. This law implicitly favored "cut nail" production. Because "cut nails" were of uniform size, they easily met the standards, while the all wrought nails had to be manufactured much more carefully under the law.[27]

Official encouragement of nail manufacturers in the post-Revolutionary period was extended further in 1789, when Congress passed legislation placing a tariff upon imported nails. Even though several Congressmen objected on the grounds that the country was nearly self sufficient and therefore the industry did not need protection, a tariff of one cent per pound was placed upon spikes and ship nails. This rate, set at 7 percent of the value, as opposed to 5 percent for other finished iron products, established a pattern of high tariffs that held throughout the next century. Nails continued to be protected under the Tariff Acts of 1816, 1818, 1833, 1842, 1846, 1857, and 1862. The rate fluctuated from as low as 75 cents per hundredweight to a high of 30 percent of imported value in 1846 and one cent a pound in 1862.[28]

The official position that held the nail to be "an article of indispensable necessity" influenced the growth of the industry during

and immediately after the Revolution. State level encouragement and the high tariffs passed by the national government stimulated interest in the industry and undoubtedly had an impact on American interest in the industry. The congressmen who voted for the tariffs, and probably the state legislators who acted to encourage the industry, believed that they were encouraging a cottage industry. They failed to recognize that a major change was underway and that their acts were encouraging a new system of manufacture. When Fisher Ames spoke of the chimney corner forges in the kitchens of Massachusetts farm homes, he described a system that was labor intensive, could not supply the quantity of nails the growing nation required, and was even at that date becoming obsolete.[29]

By 1800 the cut nail was not only finding a market but the term, cut nail, had entered the American language. As early as 1790 cut nails were specified in the construction of portions of Ft. Campus Martius in Marietta, Ohio. By 1810 the impact of the cut nail machine was being fully noticed. In his Arts and Manufactures of the United States, Tench Coxe noted:

> The improvement of the system and tools and particularly the labor saving machines in their shops would be a very substantial benefit . . . the cut nail machine has been very beneficially introduced into some shops.[30]

In the same report, Coxe noted that the nation had 410 naileries producing 15,727,914 pounds of nails, thus providing the first national census of naileries and rates of production. Coxe did not distinguish between wrought and cut nail manufacture. Therefore it is impossible to determine precisely what portion of the 15,727,914 pounds of nails were made by the new process.[31]

The cutter had several advantages over the wrought nail and wrought nail machines that permitted the cut nail gradually to replace the wrought nail. Foremost, the cutter was less expensive to make. Simply put, the reciprocating blade cost less than a die. Read in his letter to Pickerington, for example, said that it cost him only about $400 to make a prototype of his machine. The cut nail machine also had other attractive characteristics. As Read, quoted above, had noted, the size of the nail being produced could be varied by simple adjustments, whereas new dies had to be made and installed with each new size made on the wrought nail machine. Read emphasized this point when he noted in another letter to Pickerington that only simple adjustments were necessary with his machine to make various sizes. Finally, the cutting machines reduced significantly the number of times nail plate had to be slit. This reduction not only reduced labor costs that went into the price of the production of nail rods but also allowed savings on material. Read noted, for example, that "the loss upon a quantity of iron slit into nail rods is about 8 percent."[32]

Nevertheless, throughout much of the nineteenth century wrought nails, generally produced by hand, continued to be made for specific uses. The result was a dual market. Wrought nails, cut with the fiber of the nail plate running lengthwise in the shank of the nail, tended to bend very well, whereas cut nails, cut across the grain of the metal, tended to be brittle and broke very easily. Wrought nails were used for many decades for such purposes as door battens.[33]

The cutter was the most revolutionary innovation in the nail industry during the late eighteenth and early nineteenth centuries.

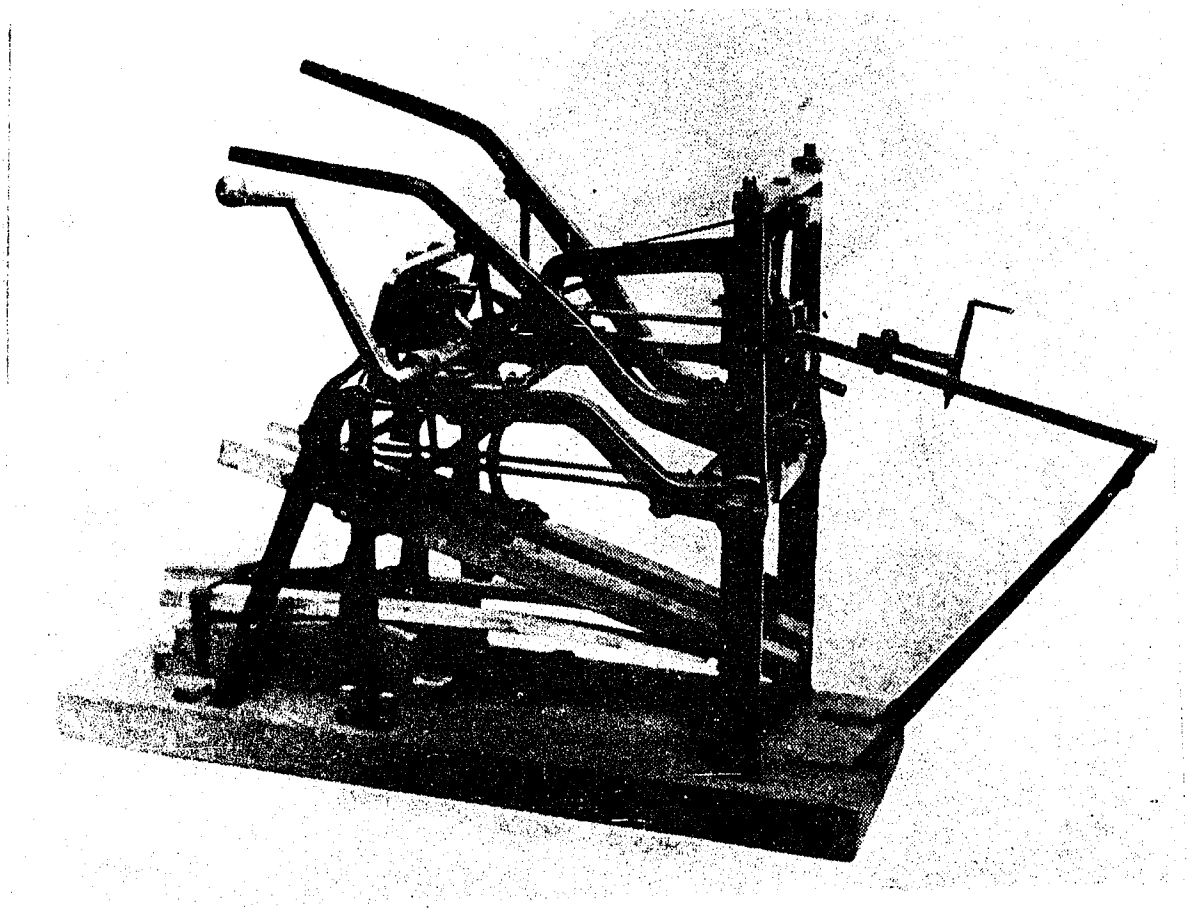

Fig. 10. Model of Read's nail cutting machine. (Bradlee, p. 96)

It was, however, by no means the only one. Several other improvements increased the effectiveness and speed of the cutter and the quantity and quality of the finished product. By the mid-nineteenth century the nail could be classified as a mass produced item untouched by human hands until a carpenter seized upon it to use it. From the very outset the goal of the inventors was a machine that automatically fed the nail plate into the shears, cut the nails, and automatically headed them. Read claimed to have accomplished this in 1797. He said that his machine "feeds itself and cuts and heads the nails without any manual labor."

Read did receive a patent for such a machine and the model does exist to substantiate his claim. But there is evidence, in the form of an eyewitness account, that indicates the heading device and the feeder simply did not work very well. Wilson Bentley, a minister from Salem, Massachusetts, paid a visit to the Read factory in 1810, a full decade after the invention was made, and recorded the following observations:

> The cutting machines are of different sizes with different motions. The large machine is fed by tongs led by a pulley, the smaller is fed by hand, and can give 1,400 strokes per minute. The machine for heading is not used since the first experiments, as it is found, heading is done better by hand than by any machine as yet invented, both as to the time and goodness of execution.[34]

Other accounts leave little doubt that the automatic headers were not used in other nail factories. John Whittaker, a Philadelphia nailer, used hand heading as late as 1820. The Digest of Accounts of Manufacturing Establishments in the United States in 1823 listed 40 nail manufacturers. Under the equipment listing, many of the establishments

listed nail machines and heading tools separately, suggesting that the automatic header had not been perfected at this date.[35]

Precisely when the automatic header became practical is unknown. Both Henry Mercer and Lee Nelson, the only two researchers to study the subject, agree that machine headed nails were not available in large quantities until the 1830s. Both men based their conclusions on data gathered from the examination of nails from dated structures. Similar examinations undertaken as a part of this study confirmed their findings. During the course of preparing this study, about 4,000 nails were examined ranging in manufacturer's date from 1778 to examples that were taken directly from a currently operating cutting machine at the LaBelle Nail Works of the Wheeling-Pittsburgh Steel Corporation in Wheeling, West Virginia.[36]

As the photograph shows, there are distinctive markings that make identification relatively easy. A few samples of nails from early structures appear to have been the product of attempts at automatic heading. Heads were irregular and the upper part of the nail shank gives evidence of being damaged. The damaged portion resulted from the heading vise gripping the nail along the narrow sides (see Fig. 11). Automatic headers became feasible after nail machines were designed that turned the nail blank ninety degrees after it was cut and thus allowed the vise to grip the wider surface of the nail. This allowed a firmer grip and at the same time prevented the upper portion from being crushed.

Pricing data also suggest that automatic headers were perfected in the 1830s. No matter how efficient the cutters were, as long as

Fig. 11. The nail to the left is a machine made nail. Markings on the nail provide much information about the manufacturing process and can serve to date the manufacture. Die marks that show clearly along the edges of the lower one-third of the nail indicate that the plate was moved from side to side (wiggled), a feeding method that was most prevalent in the late eighteenth and first two decades of the nineteenth century.

The head of the nail and the portion of the shank just below the head clearly indicate that this nail was headed by an early automatic header. The vise of the header gripped the nail shank partially crushing it, a common problem with early automatic headers. (The nail to the right was headed. Hand headed nails frequently have a bulge just below the head that resulted from a worn heading tool.) Because header markings suggest an early, imperfect heading machine was used, this places the probable date of manufacture for the nail on the right to have been in the 1820s or early 1830s.

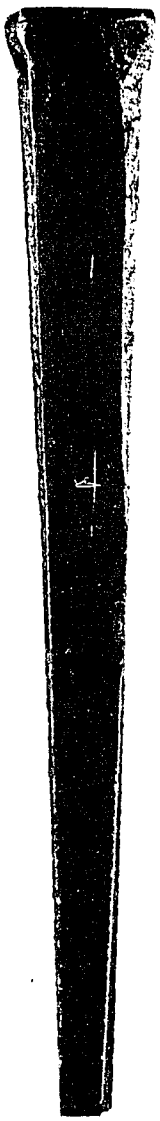

Fig. 12. Steel cut nail made by the flipped plate process. This nail was manufactured in 1978 at the LaBelle Nail Mill. The machine used to make this nail was the same type used in the Wheeling mills from the 1870s until they went out of existence. Note the difference in the head on this nail and the one in Fig. 11. Once perfected, the automatic headers did not crush the shank.

heading was done by hand, nailmaking remained labor intensive and nails remained expensive. Between 1820 and 1825 nail prices held steady between 9.8 and 9.9 cents per pound, generally a price that prevailed, except for the war years, after 1805. Beginning in 1826 prices started a decline that continued until 1835 when prices reached an average of five cents per pound. Part of the price decrease resulted from declining iron prices. But during the period pig iron prices dropped by only 34.9 percent, and the price of nails dropped by almost 50 percent.[37] This decline in prices taken in conjunction with the physical information suggests that automatic headers came into the industry in significant numbers.

Next to the automatic header, the automatic feeder was the most important device introduced into the nailmaking process during the nineteenth century. Like the header, the automatic feeder was experimented with from an early date. As noted earlier, Read claimed that his machine could automatically feed nail plate into the cutters. Just how successful this innovation was is debatable. Bentley noted in his 1810 report that Read's machines were manually fed. Feeders, unlike headers, were not totally perfected until after the Civil War. Speaking in 1870 Shubal Wilder, a Newcastle, Pennsylvania, nailmaker, commented on the state of the nailmaking machine by saying, "Machines have been brought to a high state of perfection; the only thing now remaining to be done is the introduction of a reliable self-feeder." There could be no question that automatic feeders did exist as early as the 1830s. Many patents for such devices were granted. These

machines were not used in the upper Ohio Valley and in the Pittsburgh area, however, until after 1875 because of the waste of material they caused.[38]

A final innovation should be noted, although it was not directly associated with the nail machine. This machine, known as the rotary squeezer, was used in the manufacture of wrought iron nail plate and made it possible to produce cut nails with the grain of the metal running the length of the shank rather than crosswise. This innovation made cut nails suitable for clinching and thereby increased the impingement of the cut nail upon the wrought nail market.[39]

The rotary squeezer, which was widely used in the production of nail plate, was invented by Henry H. Burden, owner of the Troy Iron and Nail Factory in Troy, New York. After its invention in 1836 Burden applied it directly to the production of metal for spike and horseshoe nails. Burden also developed a spike machine in 1839. This machine has been credited with the capability of producing railroad spike at the rate of 50 per minute. Burden's factory in Troy became a major supplier of spike for the expanding railroad system in the United States.[40]

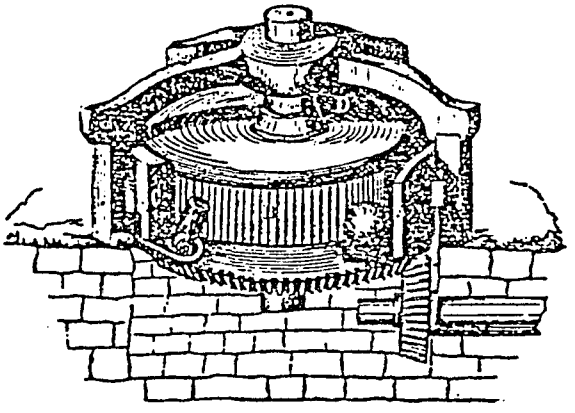

Fig. 13. Burden Rotary Squeezer.

By 1840 the technology of the cut nail was complete except for the feeder. The cutter, the header and the squeezer combined to produce nail plate and nail machines that could turn out large quantities of nails rapidly and economically. A nail machine operating properly could strike 1,400 strokes per minute on smaller nails and 50 strokes per minute on spikes. This rapid production allowed the cut nail to decline in price and therefore dominate the American nail market between 1840 and 1890. By 1870 wrought nails accounted for less than 5 percent of all the nails produced in the United States.[41]

The reign of the cut nail was relatively brief and its demise swift. It was supplanted by 1900 by nails manufactured from cylindrical wires. The "wire nail," as this new nail was called, came into existence almost overnight. The first American patent for the wire nail machine was granted in 1877. By 1900 wire nail production had surpassed that of cut nails. Twenty years later the cut nail accounted for less than 8 percent of all the nails made in the United States.[42]

The invention and subsequent widespread use of cut nail machinery and the related improvements had far reaching consequences for the American nail industry and those industries that relied upon nails. From the 1780s until well into the nineteenth century, efficient nail-making had a noticeable impact on certain sectors of the American economy. The remainder of this chapter will examine the efficiencies of the new technology, explore its distribution, and look at the impact the cut nail had on other sectors of the economy.

At the present time historical research has not advanced far enough to make many of the suggested relationships more than conjectural.

For example, close examination of the relationship between the nail and the architectural style also demands a thorough study of lumber milling. It appears that more than a coincidental relationship existed between the appearance of dimension lumber and the cheap cut nail. Likewise several linkages appear to exist between the nail and transportation. Henry Burden, inventor of the Burden rotary squeezer and the Burden spike machine, produced in the 1830s and 1840s a large portion of the nails and spikes used in the early railroads. The irony of Henry Burden, a horseshoe manufacturer, inventing machinery to make better horseshoes and then applying it to the manufacture of railroad spikes would alone be enough to encourage further exploration.[43]

The nail industry offers a particularly instructive example of the results of mechanization. Major technological changes took place in the industry and had a direct impact not only on the price of the product but, as anticipated above, also on the organization of the industry. Two sets of statistics summarize the impact of the cut nail. By 1890 nails were available at less than 20 percent of their cost in 1800. Along with the declining price there was a marked increase in the number of nails used. In 1810 Americans had used 2.18 pounds of nails per capita. Seventy years later, in 1880, the per capita use stood at 9.61 pounds, an increase of 340 percent. These two sets of statistics and others that will follow suggest the scope of changes that were taking place within the industry during the nineteenth century.[44]

The first national survey of nail manufacturing was conducted as a part of the 1810 census. Four hundred and ten manufacturers were listed, although there were certainly more, for the census did not take

into account the chimney-side forges that Fisher Ames had spoken of in 1789. These 410 nail producers turned out slightly more than 15,700,000 pounds of nails. No record of the number of employees in the industry or the capital invested was made during the 1810 census. During the 1820 census a partial list of nailmakers was made that contained information on the number of employees and capital invested in the industry, but it omitted production statistics. For the period between 1820 and 1850 only scattered information is available, primarily in B. F. French's History of the Rise and Progress of the Iron Trades in the United States. After 1850, statistics abound in census reports and various industry publications.[45]

The most noticeable impact of the new equipment was the increase in the number of nails produced. In contrast to 1810 when American nail manufacturers had turned out about 15.7 million pounds of nails, forty years later production was at 206,500,000 pounds. This gross increase of about 1300 percent and a per capita increase of about 400 percent clearly shows that what Douglass North refers to as "intensive growth" was occurring.[46]

If the technology had an impact on the growth of production, it also affected various other facets of the industry. The number of producers declined and the capital requirements increased. The 410 nail manufacturers listed in 1820 had dwindled to 87 in 1850. At this same time the Digest of Accounts of Manufacturing Establishments in the United States in 1823 listed forty nail firms that had a combined capital investment of about $300,990. The 1850 census lists the capital investment of the 87 firms manufacturing nails in that year as $4.4 million. This increase of 1,470 percent closely parallels the 1,300 percent

increase in productivity suggesting that a close correlation existed between capital investments and productivity.[47]

As the output increased and the number of production units decreased, individual production units grew in size. The forty manufacturers surveyed in the 1823 report employed an average of 9.1 persons. By 1850 the average size had grown to 60.1 employees per plant, an increase of about 660 percent in size. There are no reliable figures showing the total number of employees in the industry for the early period, so that overall fluctuations of employment cannot be charted with certainty. If the 9.1 average figure can be applied to the 410 naileries listed ten years earlier, it suggests that about 3,000 persons were employed in the commercial nail manufacturing industry around 1810. In 1850, 5,237 individuals were so employed. If these figures are approximately correct, production per worker stood at between 4,200 and 5,000 pounds per year in the decade after 1810. By 1850, the average yearly production per employee had risen to 39,511 pounds.[48]

The increasing capital expenditure, decline in prices, and the trend towards centralization and increasing work production suggest that mechanization was taking place. Since these changes were underway at a time when literary and artifactual sources show that new equipment was being introduced, it is safe to conclude that the industry was undergoing a technological revolution of some kind during the decades before 1850.

By the 1850s the industry had attained a technological plateau, and there were no more dramatic innovations to be made until the wire nail was introduced later in the century. The industrial statistics show

this stable situation clearly. Between 1850 and 1870, production more than doubled, from 206,500,000 pounds to 443,000,440 pounds. Although a portion of this increase in productivity came from increasing individual productivity (from 39,500 pounds per employee in 1850 to 54,407 pounds per employee in 1870), a substantial part of it came from an expansion of the industry. During the period the number of manufacturing units rose from 87 in 1850 to 142 in 1870. Capital investment also slowed, rising from only $50,900 per plant in 1850 to $64,000 per plant in 1870.[49]

The statistical trends changed significantly again during the two decades after 1870. Between 1870 and 1886, cut nail production continued to increase, rising from 443,000,440 pounds to 816,000,000 pounds. Unlike earlier periods, when production increases were accompanied by decreasing number of employees and concomitant gains in employee productivity, the 1870-1886 period witnessed a reversal of these trends. While production increased by 84 percent, the number of employees increased by 96 percent and overall employee productivity actually declined by 6 percent.[50]

Several factors contributed to the changes that these statistics reflect. First, by the mid 1880s, the cut nail industry was badly overextended. In 1885 The Iron Age published reports that the capacity of the industry was 30 percent above demand. To cope with this condition manufacturers from 1883 until the end of the decade operated on "short time," closing plants for as much as six weeks per year. This affected the worker productivity figures stated above. Second, throughout the 1870s and 1880s, Eastern manufacturers lagged behind

the more modern Western factories. In 1873, for example, Wheeling nail manufacturers averaged 159,800 pounds of nails per machine while Massachusetts manufacturers managed to produce only 66,300 pounds per machine. Finally, as already noted, there were no new technological developments introduced into the nail factories during the period. The cutter and header were universally in use by 1870, and, except for the automatic feeder that was being introduced during the late 1870s and early 1880s with heavy resistance from workmen, no changes were being made.[51]

The downward trend of prices continued throughout the 1870-1890 period. Prices stood at 4.4 cents per pound in 1870, declining below 2.5 cents per pound during the late 1870s, rose to 3.4 cents per pound in 1883, and then began to drop gradually to two cents per pound by 1890. The decline in prices and relatively constant productive levels are quite the opposite of earlier trends when prices were tied directly to productivity. After 1870, as will be developed in a later chapter, cost savings were related to efficiencies that resulted from industrial organization, refinements of the manufacturing process, and the prices of raw materials.[52]

In summary, then, it may be said that the cheaper prices and increase in production achieved during the first half of the nineteenth century resulted from the application of the cutter and header to the nailmaking process. After the Civil War the increased production resulted from adding more machines (either to existing or new plants) and the price declines came as a result of organization and manufacturing efficiencies. As will appear below, the industry attained a certain

technological maturity in the mid-nineteenth century and the problems faced thereafter were those of organization and (after 1882) over-production.

Sizeable increase in production and the accompanying decrease in the price of nails also suggest that basic changes were occurring in the industry. As the foregoing comments have pointed out, the application of new machines to ancient technology was a key factor. Technology alone however cannot account for all of the growth. Labor, capital, and market conditions all contributed to the growth and development of the nail industry, and each had a relationship to technology.

Few innovations were as perfectly suited to the United States of the nineteenth century as the cut nail. The cutter mechanized an industry that had been labor intensive, and, as H. J. Habakkuk noted, in a nation short of labor this was of first rate importance.[53] Furthermore, the product was sorely needed. America was in the nineteenth century a nation that relied heavily on wood, and the nail allowed wood to be used with maximum efficiency.

During the first three quarters of the nineteenth century workmen and capitalists alike in the United States did not oppose the introduction of the cut nail machine and related improvements. Unlike England, where a sizeable group of nailers had a vested interest in the labor intensive wrought nail, the United States had received much of its domestic supply of nails from farmers and blacksmiths who viewed nailmaking as a secondary activity. The few full time nailers who did work in New England and Pennsylvania nail factories had little to fear from the nail machine because the wrought nail remained much in demand

for certain uses and, initially at least, was not affected by the cut nail.[54]

Furthermore, nailmaking innovations were regarded with great patriotic pride. When cut nail machines were invented and brought into production, there was a feeling that they demonstrated American inventiveness. Bishop in 1856 emphasized in several places that the nail machine was an American invention. George E. Sellars, a Philadelphia engineer, also commented upon the American origins of the cut nail. In a conversation with an Englishman he recorded the following comments:

> I reminded him of the English prejudices that years before had led to riots that destroyed nail cutting machines . . . I said that it would be impossible to estimate or realize what the rejection of the cut nail had cost England. Mr. Donkin smiled as he said, "I have long been using in my pattern shop the American cut nail" . . . I could give other instances of the fixed ways and prejudices of the old country that kept back improvements.

The nail machine and the cut nail were regarded as reflective of the Americans' talents and their desires to break with the "fixed ways and prejudices" of the old country.[55]

Not only was there no opposition, but there were solid reasons for workmen to accept the machines. Since demand for nails was high, the more nails a workman could make, the greater his income, and, as noted above, the nail machine permitted a dramatic increase in worker output. The cut nail machine and related improvements gave rise therefore to two entirely new occupations that were exceedingly profitable. The most profitable of these occupations was that of nailer, who was in fact a machine operator. The second occupation, feeder, was filled by a person who fed the plate into the machine.

Shubal Wilder, a nailer from Newcastle, Pennsylvania, recalled years later that "From 1825 to 1835, there was a great increase in the number of nail machines in factories in New England, New York, and all through New Jersey and eastern Pennsylvania; consequently, there was a great demand for men to run the nail machines. Almost all the men kept coming to Massachusetts, on a hunt for nailers."[56] In fact, there appears to have been a shortage of trained nailers well into the 1870s. This constant demand for nailers and feeders insured that the jobs for both paid well. In 1874, Alexander Glass, a nailer who worked in Wheeling, earned between $15 and $20 per day depending upon the size of nail he happened to be cutting. James Reeves, in an 1870 medical study of Wheeling, also noted that the nailer's job paid well. He observed that there were few nailers over 50 years of age working in the factories, not because of early death, "but the result of the wealth and independence which a few years in this business insures." The precise nature of the nailer and feeder jobs, the working conditions, and the pay scales will be discussed in some detail later in this study. Suffice it to say here that both were compensated well from the very beginning of the industry and that the cut nail machine meant wealth for all those who worked beside it.[57]

Obviously the workmen's acceptance of the cut nail had some role in the acceptance of the process. But there were other, and perhaps more important, factors. Foremost was the general availability of cutting machines. The cutter was simple and uncomplicated. Once the concept of cutting had been firmly established and its advantage seen, any mechanic could build a machine to do the work. A description of a

machine used in Indiana County, Pennsylvania, in 1818, illustrates just how simple the cutters were.

> The machine was propelled by one person using the right hand on one lever and the right foot on another lever. The left hand was occupied in manipulating the iron from which the nails were cut. Before cutting, the iron was brought to a red heat . . . After the nails were cut, they were taken to a place for heading.[58]

In the eighteenth and early nineteenth century even crude equipment offered substantial savings over the hand wrought process. Even the more sophisticated machines, such as the one developed by Read, could easily be copied. In 1797 Read complained that "A mechanic by the name of Bird . . . obtained in a clandestine manner access to the apartment where I had concealed the model of my machine, examined every part of it, and had its principles fully explained to him."[59]

The widespread acceptance of cut nail technology was also aided by rapid marketing of the machines by their inventors. Jacob Perkins, who invented a cutter in 1790, and Read, whose machine was patented in 1798, had their machines licensed very quickly. By 1809, Read's machine was being used in Massachusetts (22 at Malden), Pennsylvania, New Jersey, and Ohio. Wilder commented that the Read machine and the Perkins machine were the most widely used in 1825.[60]

The cut nail machine was almost ideally suited for use in early nineteenth century America because it could be used successfully in a variety of circumstances. For example, it could be powered by hand, as described by Wilder, by animal, by water, and, later, by steam. One machine or many machines could be worked with reasonable expectation of profit, thus allowing nailmaking to be carried on in small shops or large factory settings.[61]

The diversity of the geographic settings in which the nail machine could be used may be shown by citing a few examples. Massachusetts and Pennsylvania were the two leaders in nail production in 1810. In both of these states the machines were integrated into larger shops at a very early date. The Perkins Ironwork at Amesbury, Massachusetts, for instance, in 1805 turned out 100 tons of cut nails. At the same time, the machines were also used in very different settings. Thomas Jefferson used nail machines on his plantation. A single machine (operated by horsepower) produced nails in Zanesville, Ohio. The New Jersey prison, at Trenton, operated several machines.[62]

The only factor limiting use of the machine was the availability of iron. From the 1750s until after 1800, nailers preferred Swedish and Russian iron for nailmaking. Shortly after 1800 the importation of Swedish and Russian iron declined, and nailers began to look to domestic sources such as the Pennsylvania ores for their supply. With this shift, nailmaking no longer had to rely upon coastal ports, and therefore coastal locations lost much of their advantage and then their preeminence. A second factor that influenced location was the proximity to forges and rolling mills. Coxe noted in 1810 that "the cut nail machinery has been very beneficially introduced into some of these shops, near to the iron furnaces. . . ."[63]

Generally speaking, nail manufacturing developed along one of two lines as the cut nail machinery was introduced. On the one hand, existing metal working establishments added nailmaking capacity. Both Nathan Read and Jacob Perkins introduced their machines in conjunction with other items, such as chains and anchors. Coxe, in the 1810 report

on manufacturers, noted that some shops had introduced nailmaking machines, "insuring the profitable employment of all of the time not otherwise occupied." Ten years later, the census of manufacturers bore out this observation. Eight of the forty manufacturers listed in this census also manufactured other items such as domestic utensils, scythes, hoes, and hoops.[64]

For existing finished metal products manufacturers, the cut nail was an ideal product. The manufacturing process was simple, relatively inexpensive, and could be carried on with simple machinery. Furthermore, the nail market appears to have been relatively stable during the early part of the nineteenth century. Not only did tariff protection protect manufacturers from imported wrought nails but foreign demand even opened an export market for American nails during the second decade of the century. Between 1807 and 1810, for example, Massachusetts nailers exported 280 tons of nails.[65]

While cut nails were second and third products in some manufacturing establishments, there were many factories and shops beginning to specialize in the production of cut nails by the second decade of the nineteenth century. Small and medium size manufacturers grew up in Connecticut, Rhode Island, and Massachusetts, where producers had access to Swedish nail plate. Similarly, in the Pennsylvania iron region many manufacturers began production near the iron furnaces and rolling mills.[66]

By the second decade of the nineteenth century the scale of some of the specialized manufacturers began to increase noticeably, signaling a movement towards the large scale, integrated manufacture of nails.

One of the first large manufacturers of nails was the Amesbury (Massachusetts) Nail Factory, incorporated in 1805, with a capital investment of $450,000. This factory grew out of the Jacob Perkins nail innovation and contained both a rolling mill and nail factory. A disastrous fire and difficulty in obtaining iron caused the mill to cease operation sometime around 1825. In 1809 Thomas Odiorne and several associates purchased the patent nail machine of Jesse Reed (not to be confused with Nathaniel Read) of Boston. Odiorne, in what was probably the first major attempt at large scale nail manufacturing, established three plants--one at Malden, Massachusetts; one at Chester Creek, Pennsylvania; and one at Phoenixville, Pennsylvania. The two factories in Pennsylvania included rolling and slitting mills and had between them 52 nail machines. In 1838 the Phoenixville Ironworks added boiling furnaces, becoming the first specialized nail manufacturer to produce its own wrought iron. Other large manufacturers included the Troy Iron and Nail Factory founded in 1822 by Henry Burden. This factory, significant because its owner was the inventor of the rotary squeezer and the automatic spike machine, developed slowly from a small nail works to one that by mid-century had two forges, two rolling mills, and twenty-four puddling furnaces.[67]

As will be developed below, the first nail factories established in Wheeling were much like the Phoenixville and Troy works. They had boiling furnaces, rolling mills and nail factories combined in a single operation. After the Civil War, the Wheeling nailmakers went even further and purchased blast furnaces (later Bessemer converters), coal mines, iron mines, and transportation facilities.[68]

Lack of opposition to the new cut nail technology and the flexibility of the machinery which allowed it to be used in several settings were chief factors in the spread of the cut nail. Another, and perhaps the most important, ingredient was the existence of a market. A writer for The Iron Age observed in 1882 that "The abundance of timber in America . . . urged the mechanics on in their efforts to make practical nail machines." The reliance upon wood and the need for nails in construction was magnified further by the rapid growth of the nation during the nineteenth century. The demand for housing alone was monumental. During the century the population increased from 5.2 million to 76.1 million.[69]

During the late eighteenth and early nineteenth century, three basic building styles were common in the United States. The log house, which has become so symbolic of the American frontier, was built by laying log upon log to form a wall that supported the roof. This type of construction required little skill, only a minimum number of tools, and few materials not found on or near the site of construction. The structure could literally be built without using a single nail, but many builders did manage to purchase or manufacture enough nails to make doors, window frames, and shutters.[70]

The log house was almost universally regarded as temporary shelter to be improved upon and replaced as soon as possible. The replacement house was often a frame structure. Large timbers were fitted together, usually with mortise joints to form a framework that supported the roof and provided a matrix for affixing the weatherboarding to make the walls. Such construction required a supply of nails for use in

weatherboarding, roofing, windows, doors, interior woodwork, and floors. Even with this type of construction, however, nails could be replaced in many areas, such as the flooring, with wooden pegs.

In some areas, particularly the East, stone and brick construction was also common. Even this type of construction required nails for interior woodwork, roofing, windows, and door frames. For example, Thomas Worthington, the first Senator from Ohio, constructed a sizeable stone mansion near Chillicothe during the first decade of the nineteenth century. His records show that his workmen consumed over 600 pounds of nails in the construction of the roof and interior woodwork. The roofing alone required almost 33,000 shingle nails.[71]

Although the mortise frame and stone or brick structure was popular in the more settled areas, it was not well suited for the needs of the growing country. Both types of building relied heavily upon the ready availability of construction materials at or near the site of construction. In addition, both required skilled artisans such as masons and carpenters and consumed considerable amounts of time in construction.

As the country grew and settlement pushed on to the western prairie, supplies of wood and other construction materials were less available than they had been in the East. The traditional log house that had served eastern settlers well simply could not be constructed with ease on the prairies. The problem of finding materials also made the mortise structure far less attractive than it had been in the East. Furthermore, the boom town character of many of the Western mining and railroad construction settlements required rapid construction of temporary

structures and a scarcity of artisans, such as carpenters, demanded a new approach be found to dwelling construction. These conditions gave rise to a new type of structure that depended on pre-cut lumber and smaller and lighter framing members.

This new type of building became known as the "balloon frame" or "basket frame." Like the log cabin that was so symbolic of the advancing frontier east of the great prairies, the balloon frame was the first dwelling for the Western settlers. It shared with the log cabin two important characteristics. Both could be constructed quickly, and neither required the services of a skilled carpenter.

Although it is impossible to determine precisely when or where the "balloon frame" construction was first used, there is considerable evidence that it appeared in Chicago about 1833 when George W. Snow, a New Hampshire lumber dealer, constructed St. Marys Church. This style of building was so intimately associated with Chicago that for some years during the 1840s it was referred to as the "Chicago frame" technique of construction. Harry E. Pratt, a resident of Chicago in 1833, later described the new structures and the conditions that led to their development as follows:

> . . .nearly all of the buildings put up that year were, what was aptly described as balloon frames. That is, 2" x 6" joists for sills, studs 2" x 4" toed into the sills by nails, a strip of inch board for plate and if one story, strips of inch boards for the joists . . . . It required little mechanical skill to build one. It was not uncommon to see one rise in a single day and constitute the next day a snug home for a young and enterprising couple . . . . [72]

Pratt also described the conditions that existed in Chicago at the time. The town was a bustling boom town sorely in need of buildings but woefully short of materials and skilled labor.

> The town was full of strangers and more coming daily. All was activity and enterprise, and preparations for building everywhere. No mills had yet been started in the pine forests of Lake Michigan. The timber brought in from across the lake was mostly white wood. Some was brought up from the Wabash by teams . . . . However, the country was so wet much of the time, the roads were so bad, that it was difficult and expensive to move lumber from them [sawmills on the Wabash] to Chicago.[73]

From Chicago, the new style of buildings spread very rapidly. In 1835, Solon Robinson wrote in The American Agriculturist that "it [the house] is particularly intended for the new settler, and is to be built on a balloon frame which has not a single tenon or mortise in the frame . . . all the uprights are held together by nails . . . and just as good and far cheaper than ordinary frames." Others, including G. E. Woodward, in his book, Woodward's Country Homes, and Horace Greeley, one of the authors of the Great Industries of America, noted the "balloon frame" and attributed to it some significance. Greeley commented:

> The method of construction with wood known as balloon framing is the most important contribution to our domestic architecture . . . . The heavy beams, the laborious framing, and the use of mortise and tenons have all been replaced . . . so that a single man, and a boy can put up a house, such as formerly, for its raising, required the combined force of a village. There is hardly better evidence of the American spirit . . . than the introduction of this new style of building, and it has really been the most efficient cause of the rapidity with which, in modern times, our villages and towns spring into existence.[74]

The essential ingredients in the balloon frame were the nail and the pre-cut timber. As already noted, the development of the cut nail machine assured the capability of supplying large numbers of nails at reasonable cost by the 1830s. In 1833 when Snow built his Chicago "balloon frame," for example, nails already sold at an average of five

cents per pound and the price was rapidly declining. The cut nail machine, along with new milling equipment that made pre-dimension lumber readily available, coincided with the need of the Western environment to provide a new type of building. The new building, in turn, stimulated demand for nails and prompted additional growth in the nail industry.[75]

Greeley's view that the balloon frame was evidence of the American spirit was indeed accurate, for it rested squarely upon the nail industry, and the numerous innovations that produced it were largely products of the American environment. Greeley and other writers pointed consistently to the labor saving characteristic of the balloon frame which came primarily as a result of the replacement of the mortise and tenon with the nail. As significant as the saving in time was the replacement of the skilled mechanic with the unskilled workman in the construction industry. Estimates vary on the amount of savings. In 1869 one writer said that the balloon frame could be constructed for "forty percent less money than the mortise and tenon frame."[76]

The two American innovations, the balloon frame and the cut nail, not only relied upon each other but also may be seen as a direct outgrowth of the physical environment and the economy where labor was at a premium. Both stand as monuments of sorts to the American ideal of efficiency and mass production. The cutter and the automatic header speeded up the rate of production of nails, reduced the amount of labor required by the industry, and introduced efficiencies in materials use through savings on slitting and through the standardization of the product.

Likewise the balloon framed house could be constructed faster than previously used housing types, at less cost, and with less labor.

At the same time that Snow was constructing St. Marys Church in Chicago, David Agnew, a Pittsburgh iron master, was looking at Wheeling, Virginia, as a possible site for the manufacture of nails. Attracted by a sizeable supply of coal that could be used to fuel furnaces and steam engines, Agnew constructed a moderate size puddling, rolling and nail factory that was to be the foundation for several nail mills that would become the largest single group of nail manufacturers in the country in the decades after the Civil War. Between 1833 and 1900 Wheeling mills produced an estimated 50,000,000 kegs of nails, most of which were used in the American West. By 1890, it could be fairly said that there were few communities between the Ohio and the Rockies that did not have nails made in Wheeling, West Virginia, holding at least some of the dwellings together.[77]

The birth of the nail industry in Wheeling coincides closely not only with the development of the balloon frame house but also with the perfection of the automatic nail header. The Wheeling manufacturers developed after the major innovations in the industry were complete. Alfred B. Chandler, author of The Invisible Hand observed that "modern business enterprise rose as the volume of business activities reached a level that made coordination by management more efficient and more profitable than market coordination," and that "such an increase in volume of activity came with new technology and expanding markets." The Wheeling nail industry had the benefits of new technology and an expanding market. The remainder of this study will examine the industry,

its major location, and its organization, management, growth patterns, and general development over the course of the seven decades that remained in the nineteenth century.[78]

FOOTNOTES

CHAPTER I

[1]Henry C. Mercer, Ancient Carpenters' Tools (Doylestown, Pa.: The Bucks County Historical Society, 1929), pp. 238-244; Kenneth M. Wilson, "Nailers' Anvils at Old Sturbridge Village," The Chronicle of The Early American Industries Association, June, 1960, p. 1; "Nail Headers," The Chronicle of the Early American Industries Association, Nov., 1965, p. 36.

[2]James M. Swank, History of the Manufacture of Iron in All Ages and Particularly in the United States from Colonial Times to 1891 (Philadelphia: American Iron and Steel Association, 1892), pp. 48-49.

[3]Susan M. Kingsburg (ed.), The Records of the Virginia Company of London Co., (4 vols., Washington: U.S. Government Printing Office, 1936), IV, p. 227; C. A. Weslager, The Log Cabin in America (New Brunswick, N.J.: Rutgers University Press, 1969), p. 119.

[4]Lee H. Nelson, "A Nail Chronology," Technical Leaflet #48, (Nashville, Tenn.: The American Association for State and Local History, 1968), p. 3.

[5]Lawrence S. Cooke, "Nail Rod and Some of Its By-Products," The Chronicle of the Early American Industries Association, March, 1961, pp. 6-7. The prevalence of artifacts made from nail rod can be seen by examining almost any museum collection that contains examples of early American metal.

[6]Abridgments of the Debates of Congress from 1789 to 1856, (New York: D. Appleton & Co., 1857), I, p. 38.

[7]Ibid.

[8]Charles J. Hoadly, The Public Records of the Colony of Connecticut from May 1717 to October 1725 (Hartford: Lockwood & Brainard, 1872), p. 39; J. Leander Bishop, A History of American Manufactures from 1608 to 1860, (3 vols., Philadelphia: Edward Young & Company, 1864), I, pp. 623-624, 491.

[9]Ibid., pp. 484, 503, 519.

[10]Robert A. East, Business Enterprise in the American Revolutionary Era (New York: Columbia University Press, 1938), p. 19; Florence S. March Crofut, Guide to the History and Historic Sites of Connecticut, (2 vols., New Haven: Yale University Press,

1937), I, pp. 188, 189, 279, 420, 443; John Little, "Accounts of Smiths' and Nailers' Work Received from January 19, 1778 - October 1, 1779," MS, Library, The American Philosophical Society, Philadelphia.

[11]Victor S. Clark, History of Manufactures in the United States, 3 vols., (New York: Peter Smith, 1949), I, p. 222; Tench Coxe, A Statement of the Arts and Manufactures of the United States of America for the Year 1810 (Philadelphia: A. Cornman, 1814), p. 11; Francis A. Walker, The Statistics of the Wealth and Industry of the United States Compiled from the Original Returns of the Ninth Census (Washington: Government Printing Office, 1872), p. 617; Bishop, Manufactures, III, pp. 532, 582, 584, 710, 798.

[12]Committee on Historical Statistics of the Social Science Research Council, The Statistical History of the United States from Colonial Times to the Present (Stamford, Conn.: Fairfield Publishers, Inc., 1965), p. 765; Bishop, Manufactures, I, pp. 499, 500, 523, 629; Abridgments of the Debates of Congress from 1789 to 1856, I, p. 38; Bishop, Manufactures, II, p. 35; B. F. French, History of the Rise and Progress of the Iron Trade of the United States from 1621 to 1857 (New York: Wiley & Halsted, 1858), p. 13.

[13]Committee, Historical Statistics, p. 124; Thomas Senior Berry, Western Prices Before 1861 (Harvard: Cambridge University Press, 1943), p. 248; Gen. John Johnston, "Account Book of Gen. John Johnston, Indian Agent, Ft. Wayne, Indiana, 1802-1811," p. 9, MS copy, Library of the Ohio Historical Society, Columbus; John Little, "Accounts of Smiths' and Nailers' Work Received," entry for January 5 and January 8, 1778.

[14]Bishop, Manufactures, II, p. 34; Swank, History, pp. 49, 188; Coxe, Arts and Manufactures, p. xxxi; Francis B. C. Bradlee, "The Salem Iron Factory," Historical Collections of the Essex Institute, April, 1918, p. 103; Albert S. Bolles, Industrial History of the United States (Norwich, Conn.: The Henry Bill Publishing Co., 1881), p. 218.

[15]Susan Buggey, "Supplying Building Materials to the British Army in the Colonies: An Illustrated Document," The Association for Preservation Technology Bulletin, VIII (1976), pp. 94-118; Nelson, "Chronology," pp. 6-7.

[16]Buggey, "Supplying Building Materials," pp. 94-118. This article is largely a reprint of the Royal Engineers Catalogue, and contains one of the best graphic descriptions of wrought nails found during this study; Mercer, "Dating Old Houses," Old Time New England, April 1924, p. 171.

[17]There are no reliable data on production rates for wrought nails. John Little's "Account Book" does give numbers of nails produced for several nailers. John Wilson, February 14, 1778 - 6725 - 10d; John Wilson, June 6, 1778 - 1200 - 10d; Edward Reamer, January 22, 1778 - 2565 - 10d; John Blackburn, February 14, 1778 - 8761 - 10d. From these

and other accounts in Bishop, it is clear that any production over 6,000 (10d) per day was excellent. On February 14, 1778, when John Wilson produced 6725 nails, he had at the end of the day produced 134 pounds, or about one and one-third kegs of nails.

[18]Bishop, Manufactures, I, p. 388; H. J. Habakkuk, American and British Technology in Nineteenth Century (Cambridge: The University Press, 1962), pp. 17-28, 172.

[19]Bishop, Manufactures, I, pp. 498, 571. The number of patents for nail machines was arrived at by counting the listings of patents granted between 1790 and 1836. See Commissioner of Patents, A List of Patents Granted by the United States from April 10, 1790 to December 31, 1836 (Washington: Government Printing Office, 1872), pp. 7-690.

[20]Horace Greeley, et al, Great Industries of the United States (Hartford: Wm. Burr, Hyde & Co., 1872), p. 1072. At least a few innovators attempted to produce cast nails (Nelson, "Chronology," p. 6). They were too brittle and would not stand up to the carpenter's hammer. Occasionally a sample of a cast nail will show up in an old structure or in the collections of museums. During the course of this study approximately 4,000 nail samples were studied plus numerous photographs of nails. The sample ranged from nails taken from a fortification (Ft. Laurens) constructed in 1778 to modern cut nails taken directly from a currently operating cutting machine at the LaBelle Nail Works. No samples of machine wrought nails were found.

[21]Mercer, "Dating Old Houses," pp. 172-175; Nelson, "Chronology," pp. 3-10. This description is also based upon examination of nail machines at the LaBelle Nail Works of the Wheeling-Pittsburgh Steel Corporation. The machines, which are in operation, date to the late nineteenth century. In addition, the company has wooden foundry patterns for machines that date from the 1850s.

[22]Bradlee, "The Salem Iron Factory," pp. 110-111.

[23]The term "cut nail" was derived from the description of the process of cutting nail plate. Just when the term was used is difficult to determine. Nathan Reed used the term in 1798 in Bradlee, "The Salem Iron Factory," p. 111. The term "cutting nails" also appears in the U.S. Patent Records as early as 1794 in Commissioner of Patents, A List of Patents, p. 7.

[24]For a general discussion of state encouragement of manufacturing and transportation, see Alfred D. Chandler, et al, The Changing Economic Order (New York: Harcourt, Brace & World, Inc., 1968), pp. 148-165.

[25]Bishop, Manufactures, I, pp. 498-499; Abridgments of the Debates of Congress from 1789 to 1856, I, p. 38; Greeley, Great Industries of the United States, p. 1073.

[26]Bishop, Manufacturers, I, p. 619.

[27]Ibid., p. 519.

[28]Abridgments of the Debates of Congress, I, p. 38; Bishop, Manufactures, II, p. 485; F. W. Taussig, The Tariff History of the United States (New York: G. P. Putnam & Sons, 1923), p. 51; French, History of the Rise and Progress of the Iron Trade, pp. 15-18; Walter Lowrie and Matthew St. Clair Clarke (eds.), Documents, Legislative and Executive, of the Congress of the United States from the First Session of the First Congress to the Third Session of the Thirteenth Congress, Inclusive (9 vols., Washington: Gates & Seaton), VIII, pp. 854-855; Hunt's Merchant Magazine, XLIV (1861), p. 496.

[29]Abridgments of the Debates of Congress, p. 38.

[30]Coxe, Arts and Manufactures, p. xxxi.

[31]Ibid., p. 11.

[32]Bradlee, "The Salem Iron Factory," pp. 103-104, 110.

[33]Nelson, "Chronology," pp. 4-9.

[34]Bradlee, "The Salem Iron Factory," pp. 99, 109-114; Commissioner of Patents, A List of Patents, pp. 11-13, 22.

[35]Mercer, "Dating Old Houses," p. 174; Digest of Accounts of Manufacturing Establishments in the United States in 1823 (Washington: Gates & Seaton, 1823), pp. 2-31.

[36]Mercer, "Dating Old Houses," pp. 173-175; Nelson, "Chronology," pp. 3-11.

[37]Committee, Historical Statistics, p. 124.

[38]Bradlee, "The Salem Iron Factory," pp. 110, 111, 113; Swank, History, pp. 448-449; Commissioner of Patents, A List of Patents, pp. 270, 377, 646; Commissioner of Patents, Report for 1856 (Washington: Cornelius Wendell, 1857), I, p. 222.

[39]Bishop, Manufactures, II, p. 634. "Clenching" is a term used to describe a nail that was driven through two boards.

[40]Ibid. For a discussion of Burden, see Paul J. Uselding, "Henry Burden and the Question of Anglo-American Technological Transfer in the Nineteenth Century," The Journal of Economic History, Vol. XXX, pp. 312-337.

[41]Bradlee, "The Salem Iron Factory," p. 111.

[42]F. H. Kindl, The Rolling Mill Industry (Cleveland: Penton Publishing Co., 1913), p. 41; Peter Priess, "Wire Nails in North America," The Association for Preservation Technology Bulletin, V, No. 4 (1973), pp. 89-90.

[43]Bishop, Manufactures, II, p. 634.

[44]Committee, Historical Statistics, pp. 7, 123-124.

[45]Coxe, Arts and Manufactures, p. 11; French, History of the Rise and Progress of the Iron Trade, pp. 15, 18, 20, 23, 25, 71; Digest, 1823, pp. 2-31.

[46]Coxe, Arts and Manufactures, p. [11]; The Statistics of the Wealth and Industry of the United States, III, p. 406; Bishop, Manufactures, III, p. 486; Douglass C. North, Growth and Welfare in the American Past (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1966), p. 31. Figures on productivity are based on prices for the year.

[47]Coxe, Arts and Manufactures, p. [11]; The Statistics of the Wealth and Industry of the United States, III, p. 406.

[48]Digest, 1823, pp. 2-31; Bishop, Manufactures, III, p. 486; Coxe, Arts & Manufactures, p. [11].

[49]The Statistics of the Wealth and Industry of the United States, III, pp. 396, 400, 406.

[50]Ibid., p. 396; Statistics of the American and Foreign Iron Trades for 1899 (Philadelphia: The American Iron and Steel Association, 1900), pp. 56-57; Twelfth Census of the United States Taken in the Year 1900, VII, pt. 1 (Washington: Government Printing Office, 1902), p. 9.

[51]The Iron Age, April 2, 1885; The Wheeling Intelligencer, March 7, 1874; April 26, 1875; and May 10, 1875.

[52]Committee, Historical Statistics, pp. 123-124. Figures cited are computed based on data contained in The Iron Age, April 6, 1876; The Statistics of the Wealth and Industry of the United States, p. 396; Henry Dickerson Scott, Iron & Steel in Wheeling (Toledo, Ohio: Caslon Co., 1929), p. 40.

[53]Habakkuk, American and British Technology, p. 17.

[54]Eugene S. Ferguson (ed.), "Early Engineering Reminiscences (1815-1840) of George Escol Sellers," United States National Museum Bulletin, CCXXXVIII (1965), 125-126; Scientific American Supplement, I (1876), pp. 89-90.

[55]Ferguson, "Early Engineering Reminiscences," p. 126. Also see Hunt's Merchant Magazine, November, 1851, p. 578; Bishop, Manufactures, II, pp. 153-154.

[56]Swank, History, pp. 448-449. The scarcity of skilled nailers to operate the growing number of machines tends to support Paul Uselding's argument that labor scarcity was at least partially a result of technological change. See Lewis D. Cain and Paul J. Uselding (ed.), Enterprise and Economic Change (Kent, Ohio: The Kent State University Press, 1973), p. 77. I have no interest in getting into the controversy between Habakkuk and Uselding except to note that the nail industry may in fact prove that both theories are correct. It seems that initially labor scarcity as reflected through high labor costs did prompt the development of the cut nail machine and related innovations. In turn, however, these machines created a need for specialization and, in fact, there resulted a shortage of nailers and feeders.

[57]Robert L. Plummer, Sixty-Five Years of Iron and Steel in Wheeling: Reminiscences of Alexander Glass, n.p., n.d., p. 13. This printed volume is in the library of the West Virginia Historical Society at Charleston, West Virginia; James E. Reeves, M.D., The Physical and Medical Topography of the City of Wheeling (Wheeling: Wheeling Daily Register, 1872), p. 23.

[58]Swank, History, p. 449.

[59]Bradlee, "The Salem Iron Factory," p. 110.

[60]Charles I. Pettingell, "Powow River Industries," The Essex Institute Historical Collections, LXXXII (1946), 322; Bishop, Manufactures, II, pp. 124-125; Swank, History, pp. 448-449.

[61]Swank, History, p. 449; J. F. Everhart, History of Muskingum County, Ohio (Columbus, Ohio: A. A. Graham, 1882), p. 88.

[62]Coxe, Arts and Manufactures, p. [11]; Pettingell, "Powow River Industries," p. 321; John F. Kasson, Civilizing the Machine, Technology and Republican Values in America 1776-1900 (New York: Grossman Publishers, 1976), p. 24; Everhart, History of Muskingum County, Ohio, p. 88.

[63]Bishop, Manufactures, I, p. 629; Coxe, Arts and Manufactures, p. xxxi.

[64]Ibid.; Digest, 1823, pp. 7, 10, 14, 15, 28.

[65]Bishop, Manufactures, II, pp. 153-154.

[66]Ibid., I, p. 629; Crofut, Guide to the History, Vol. I, pp. 188, 189, 279, 420, 433; Bishop, Manufactures, Ii, pp. 125, 126, 131; Ronald L. Michael, "Cut Nail Manufacture: Southwestern Pennsylvania," Association for Preservation Technology Bulletin, VI, No. 2, 1974, p. 99.

[67]Bishop, Manufactures, II, pp. 111, 125, 126, 634; Pettingell, "Powow River Industries," p. 321; Bishop, Manufactures, III, p. 478.

[68]Committee, Historical Statistics, pp. 123-124; "The Minutes of the Meetings of the Board of Directors and Stockholders of the LaBelle Iron Works (Bailey, Woodward & Company) from January 28, 1868 to September 20, 1873," p. 23, MS, records of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[69]The Iron Age, September 22, 1881; Committee, Historical Statistics, p. 7.

[70]Weslager, Log Cabin in America, p. 225.

[71]"Bills for Repairs on House," Worthington Papers, MS in the collections of the Ohio Historical Society, Columbus.

[72]Harry E. Pratt, "Chicago in 1833 and 1834," Journal of the Illinois State Historical Society, XXVIII (1935), 10-11; Mable McIlvaine (ed.), Reminiscences of Chicago during the Forties and Fifties (Chicago: The Lakeside Press, 1913), pp. 6-7; Sigfried Giedion, Space, Time and Architecture, The Growth of a New Tradition (Cambridge: Harvard University Press, 1949), pp. 281-289.

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[74]Herbert Anthony Kellar (ed.), Solon Robinson: Pioneer and Agriculturist, Selected Writings, (3 vols., Indianapolis: Indiana Historical Bureau, 1936), I, pp. 553-558; Greeley, Great Industries of the United States, p. 41.

[75]"Manufactures of the United States," DeBow's Review, XVII (1854), 632-635; Committee, Historical Statistics, pp. 122-123.

[76]Walker Field, "A Reexamination into the Invention of the Balloon Frame," Journal of the American Society of Architectural Historians, II (1942), 7-8.

[77]Scott, Iron and Steel, pp. 7-8.

[78]Alfred D. Chandler, Jr., The Visible Hand: The Managerial Revolution in American Business (Cambridge, Mass.: The Belknap Press, 1977), p. 8.

CHAPTER II

FOUNDING THE NAIL INDUSTRY 1834 - 1860

> You have been pleased to refer . . . to my connection with the iron interest of Wheeling. It would be vanity in me to appropriate to myself the honor, although I may have been the moving cause . . . in bringing about the grand results that have been achieved in the iron manufacturies of the city.
>
> E. W. Stevens
> The Wheeling Intelligencer
> April 9, 1856

When American settlement breached the Allegheny Mountains during the last quarter of the eighteenth century, the upper Ohio Valley was the first stop for the westward bound travelers. Protection provided by several military forts encouraged many of the earliest travelers to take advantage of the federal land policy and remain in the area between Pittsburgh and Ft. Henry. Once established, the settlers were in a position to profit from the continued western migration, first as provisioners for the parties traveling west and then, because of the relatively easy water transportation, as suppliers to the growing population in the lower Ohio and Mississippi Valleys. The profit to be reaped from commerce, the expense and difficulty of importing Eastern manufactured goods, and the availability of key natural resources provided the impetus for traders to become manufacturers as soon as capital, skill, and natural resources were available.

The residents of Wheeling, Virginia, like their contemporaries in several other towns along the upper reaches of the Ohio River, were

quick to take advantage of the opportunity offered by their unique location. By 1820, Wheeling had become a minor commercial town located at the junction between a land route to the West and the Ohio River. As early as the third decade of the nineteenth century, the commercial interests in Wheeling were beginning to shift their attention from commerce to manufacturing. Within this context the manufacture of nails began and flourished, slowly at first, but more rapidly as the century progressed.

The upper Ohio Valley felt the influence of two larger urban centers, Pittsburgh and Cincinnati, which played an important role in the economic and cultural life of the entire region. Because of its close proximity to Pittsburgh, Wheeling was always influenced by the economic life of the "Iron City." Cincinnati, a down-river town, exerted less direct influence, and yet because the market for nails made in Wheeling lay to the south and west, and because Cincinnati was a major distribution center, that city, too, was of substantial importance. Much of the information on western nail prices, for example, has been drawn from the quotations on the Cincinnati market.[1]

Although the success of the Wheeling nail industry was rooted in broad economic factors, such as favorable markets, location, natural resources, and excellent transportation facilities, purely local conditions and specific individuals played a significant part in its establishment and growth. As has been found in the histories of other nineteenth century cities, personalities and local pride, expressed in urban boosterism, so typical of the Midwest during the early decades of the century, were of substantial importance. Local, and a few industrial,

historians who have given attention to the nail industry have in fact tended to place much emphasis on the role of a handful of individuals who established the first mills. Some writers have portrayed the founders as visionaries, while others, including some of the participants, have viewed these men as simple mechanics looking for a place and circumstances in which to practice their trade. The inescapable conclusion is that as a group, the founders were neither visionaries nor simple craftsmen. They were speculators whose motives were not unlike the land speculators or town promoters of the era.

The period between 1830 and 1865 was a time of transition. Isaac Lippincott in his classic (1914) Economic History of the Ohio Valley took the 1830s as a transition date that divided the "pioneer period," during which commerce was the major non-agricultural activity, from the "mill period" in which manufacturing evolved. This interpretation seems to be essentially correct if somewhat overstated. Richard Wade, author of The Urban Frontier, the best of the scholarly works on the early history of the Ohio Valley, was perhaps more accurate, if less precise, in his assessment of the period. Western towns, he said, were "cradled in commerce but while very young showed remarkable manufacturing promise." It was in these three decades that the infant towns of the upper Ohio began to leave the cradle, although, to follow Wade's figure of speech, they never ventured far from its nurture.[2]

Manufacturing first grew up in and around Pittsburgh. The early factory products (iron, glass, and ceramics) answered the needs created by the local provisioning trade. Settlers moving west in the 1790s and the first decades of the nineteenth century typically abandoned their

land vehicles south and east of Pittsburgh and took first to the Allegheny and then the Ohio River for the final leg of their journey. Pittsburgh and the neighboring settlements were handy places to stock up on needed supplies and to replace tools which were too bulky for the land journey or which were destroyed during the trip over the mountains. As early as 1789 Pittsburgh newspapers advertised the products of such diverse manufacturing trades as cabinet making, upholstering, locksmithing, sickle and scythe making. In addition to the supply trade stimulated as settlers moved west, the military campaigns launched against the Indians from Pittsburgh and Cincinnati in the 1790s also stimulated the provisioning trade. A decade and a half later the military expeditions of the War of 1812 had a similar impact.[3]

As the new settlers became customers for the products of the towns and cities of the upper Ohio Valley, the growing market and the availability of natural resources (coal, iron, sand and clay) stimulated manufacturers to undertake a wide variety of enterprises at an early date, just as in Pittsburgh. Iron manufacturing began in the upper Ohio Valley as early as 1798 and spread throughout western Pennsylvania and eastern Ohio during the early decades of the nineteenth century. In addition, the manufacture of glass, textiles, and ceramics, to name only the most prominent, grew up not only in the Pittsburgh area but in other towns along the Ohio River such as Steubenville, East Liverpool, and Wheeling. In 1818 and 1819, two English travelers, Thomas Hume and Timothy Flint, took note of the manufacturing in the upper Ohio Valley when they journeyed separately through the region. Hume commented on a "glass works" at Wellsburg, then known as Charlestown, and a woolen

manufactory, a cotton mill, a paper mill, an iron foundry, and "tan-yards" at Steubenville. Flint, in addition to commenting on the works mentioned by Hume, described an iron furnace, a fulling mill, and a carding mill near the mouth of the Beaver Creek, and two earthenware manufacturers in Steubenville. Flint also took note of "a considerable number of artisans" and the fact that the machines in the several establishments of the region were "wrought [powered] by steam."[4]

Another natural characteristic of the region that influenced the growth of manufacturing was the poor quality of the land. After the immediate influx of settlers who took up valley space, the availability of prime agricultural land was limited. Particularly after better agricultural regions farther to the west opened up in the 1840s and 1850s, labor could be more profitably employed in commercial and manufacturing activities. For example, in rural counties such as Monroe County, Ohio, population actually began to decline after 1850. By contrast, there was a noticeable influx of rural workers into the potteries at East Liverpool towards the end of this period.[5]

The single most important restraint on the development of manufacturing was the lack of capital and a related shortage of currency. Throughout the early decades of the century Eastern investment was noticeably limited even in the more developed cities such as Pittsburgh, Cincinnati, and Lexington. All through the Ohio Valley businessmen were left to their own devices to raise the money needed for equipping factories, constructing buildings, and procuring other facilities needed for production.[6]

The capital that did accumulate locally was almost always generated locally, and from one of two sources. The profits from commerce, specifically the provisioning trade, have already been noted. Earlier writers, such as Wade and Lippincott, have given great weight to the importance of this source of capital concluding that trade was of importance as a stimulus for manufacturing. Its importance as a source of capital, however, which is a different matter, has been much overstated. While there can be little question that men such as Colonel James O'Hara and John McClung, two Pittsburgh manufacturers, used profits from commercial ventures to begin manufacturing enterprises, the source for much of the early manufacturing capital was land speculation.[7]

Steubenville, Ohio, provides an example of a direct link between land and manufacturing enterprises. The early history of this place has received little notice even though travelers visiting the region during the early years of the nineteenth century consistently noted the industrial character of the town. During the second decade of the nineteenth century, Steubenville and the towns in the immediate vicinity were second only to Pittsburgh in manufacturing. Steubenville was the location of the United States Land Office between 1800 and 1821. As a consequence, currency was present in a greater proportion than in other cities, since land was one of the few things that could not be purchased through barter. And, in fact, one individual, Bezaleel Wells, a land speculator who had amassed large holdings in the old Seven Range land survey area, was responsible for the founding of the textile industry that flourished in and around Steubenville after 1810.[8]

A similar, but less obvious, situation existed at Wheeling. Archibald Woods, an ex-military man who had settled in Wheeling in the late eighteenth century, accumulated a sizeable fortune from Ohio land sales. Woods, in concert with his brother and Johnathan Paull, purchased much of the land that now comprises Monroe and southern Belmont counties and in 1813 founded the town of Woodsfield, selling off the surrounding lands. The money Woods realized from this venture eventually went into the organization of the Bank of Northwest Virginia at Wheeling. During the 1830s and 1840s this institution, being one of only two banks in Wheeling, provided resources for the expanded nail industry and a share of the $1,000,000 proportion of Wheeling's subscription to the Baltimore and Ohio Railroad.[9]

As a region, then, the upper Ohio Valley had advantages of location in relationship to markets, the availability of good transportation, a good supply of natural resources, and if not a liberal, at least an adequate, source of capital. Early efforts to develop manufacturing that were successful, largely in the Pittsburgh area, soon spread, and by the 1830s manufacturing was beginning to become an important part of life in the Ohio Valley. Moreover, over the course of the nineteenth century, manufacturing continued to develop, and as the region evolved it became one of the country's largest iron and steel, chemical, and coal producing areas.

Wheeling, described in 1821 as a "miserable Virginia country town, which can never be more than 200 yards wide" by one of its detractors, was located approximately seventy miles south of Pittsburgh on the east side of the Ohio River. The town had grown up in the general vicinity

of Fort Henry, a military outpost, first established prior to the American Revolution by the colony of Virginia to counter the claims that Pennsylvania had made to the panhandle region as well as to control the Indian population of the area. After the Revolution, Fort Henry, like Fort Pitt, was a stop for people--settlers, speculators, and others--traveling south along the Ohio River. Perhaps the most notable residents of the area during the pioneer era were the Zane family. Although Betty Zane, the frolicsome young heroine of later novels, has received most of the notice, it was her father, Ebenezer Zane, who left the largest imprint on Wheeling. In 1796, he set out to cut a trail west and south across Ohio to Maysville, Kentucky. This trail, and later the National Road and the Baltimore and Ohio Railroad, made Wheeling an important crossroads town. An English traveler by the name of Cummings, who visited Wheeling in 1808, commented that Wheeling was important "on account of its situation where the great post roads from Philadelphia, Baltimore, and the northern parts of Virginia unite and cross the river, on the route through the states of Ohio and Kentucky to Tennessee and New Orleans . . . ." Ten years later Flint, a traveler already mentioned, made essentially the same observations. And the editor of the Western Herald noted in 1816 in verse:

> Wheeling has secured her roads,
> Come wagoneers, come hither and bring your loads.
> Immigrants, come hither and build a town,
> And make Wheeling a place of renown.[10]

In addition to the favorable location along land routes, Wheeling also had a fortunate location on the Ohio River. Located further south than Pittsburgh, dry weather less frequently affected river navigation at Wheeling, and the port was therefore more accessible. This was an

important consideration as early as the first decade of the nineteenth century when Wheeling was chosen as the western terminus of the National Road. With the rise of steam navigation on the western rivers after 1820, Wheeling's location was even more critical. With the availability of cheap, regular upriver navigation, a new dimension was added to the economic activity of the upper Ohio Valley. For the first time, raw materials from the lower Ohio Valley and elsewhere along the Mississippi River system could be imported, freeing merchants and manufacturers from exclusive reliance upon upriver sources. Since a major iron manufacturing center, the Hanging Rock region of Ohio and Kentucky, lay to the south of Wheeling, the availability of upstream transportation and the dry season port were of critical importance to the establishment of ironworking establishments in Wheeling.[11]

All of these factors led Wheeling to develop a vigorous, mixed economy during the early decades of the nineteenth century. Because of its roads and river location, the city did a substantial business in transshipping. Goods arriving by the National Road from the east were transferred to river craft for shipment down river. In addition, Wheeling was a stopping point for easterly bound goods arriving by land along the National Road or by boat from down river. Wheeling businessmen also engaged in some raw material processing. At an early date coal was mined along the river banks for use in steamboat boilers, and at least one large sawmill, operated by the Hubbard family, supplied lumber for export and for local boat yards. In the days before steam power, flatboats, keelboats, and even a few ocean going schooners were constructed in Wheeling boat yards. After steamboats came into use,

Wheeling boat builders constructed steamboats along with other craft. As early as 1819 Hume observed construction of a stern wheeler in Wheeling "to go, they say, 1,800 miles up the Missouri River." The steamboat construction stimulated other manufacturing. By the late 1820s at least one boiler works and a foundry were located in the city. In addition to the boat builders these establishments probably provided castings and equipment for the early agricultural implement manufacturers who had located west of Wheeling in Ohio.[12]

Wheeling merits more attention than historians have given it heretofore. To date, for example, a comprehensive history of the town has not been written. While this study is not intended as a history of Wheeling, mention of some of the more important local events must be made. One of the enticing characteristics of Wheeling was the liveliness of the community. The constant competition with Pittsburgh colored almost every enterprise undertaken by the Wheeling business community. During the first two decades of the nineteenth century when Wheeling's population never exceeded 1,200 persons, a serious rivalry between the two towns seemed almost ridiculous. After Pittsburgh's fortunes were tarnished by the economic collapse brought on by the panic of 1818, Wheeling's prospects brightened. When Wheeling was selected over Pittsburgh and Steubenville as the western terminus for the National Road, local optimism rose and continued throughout the first half of the century. While the competitive spirit was embodied in many events ranging from boat racing to dog fights, the most significant manifestations were the Wheeling bridge case and the Baltimore and Ohio Railroad.[13]

In 1848 several businessmen in Wheeling, in concert with the city government, decided to construct a bridge across the main channel of the Ohio River to Wheeling Island where connections could be made with an existing bridge over the back channel of the river and thereby to the Ohio shore. Pittsburgh raised objections because the height of the bridge obstructed the passage of steamboats with high stacks. A lengthy court fight ended with a Supreme Court order that the bridge should be removed, but Wheeling interests took their case to Congress and successfully thwarted the court order by having the bridge declared a mail route.[14]

At the same time that the bridge controversy was under way, two railroads intimately connected with the cities of Pittsburgh and Wheeling were racing each other to become the first rail connection with the Ohio River. The Pennsylvania Railroad managed to nose out the Baltimore and Ohio in 1852. It was during the race westward that the city of Wheeling became so interested in beating the Pennsylvania Railroad that its businessmen subscribed almost a million dollars in Baltimore and Ohio stock, even going so far as to pick up part of the obligation originally subscribed by the state of Virginia.[15]

Just as local boosterism became entwined with the bridge and the railroad, so too the nail industry became inextricably involved with Wheeling's community pride. In the 1850s, Wheeling slowly crept up on Pittsburgh, the major western nail producer, and by the beginning of the postwar era was within striking distance. In 1874 The Wheeling Intelligencer finally declared victory. "Wheeling now justly claims

to be the greatest nail manufacturing city in the United States," wrote the editor of the Intelligencer. Pittsburgh conceded defeat a year later when The Iron Age, published in Pittsburgh, compared the two towns. "It has been supposed that Pittsburgh could compete with any other point in the country," the editor wrote, "but it transpires that Wheeling is now doing the leading nail business . . . ." Several writers, such as Daniel J. Boorstin and Richard Wade, have taken note of the importance of boosterism and "urban imperialism" pointing out that they were frequently bound up in the ambitions of businessmen and newspaper editors like those associated with Wheeling and Pittsburgh nail industries. The most that can be concluded here is that a sharp rivalry between Wheeling and Pittsburgh prevailed throughout the nineteenth century and frequently surfaced when the nail men met to discuss the affairs of their business.[16]

It was in this economic and social context that the commercial manufacturing of nails west of the Allegheny Mountains began during the last decade of the eithteenth century. The first factories were in Brownsville, Mercer, and Washington, Pennsylvania. But in the first years of the nineteenth century, Pittsburgh became the nailmaking center of the West. In 1807, Pittsburgh had four nail mills producing annually about forty tons of cut and wrought nails. By 1810, the production of the Pittsburgh mills had risen to over 2,000 tons. Two decades later, in 1831, the city's mills were turning out 2,096 tons or about 42,000 kegs of nails per year. When Wheeling entered the nail business in 1834, then, Pittsburgh was the unquestioned leader in the West. Even as late as the mid-1830s, Eastern nails, principally from Boston, were marketed throughout the Ohio Valley at a price generally one to two

cents higher per pound than the two major Pittsburgh brands--Juniata and Pittsburgh Common.[17]

Pittsburgh was not the only Western town to produce nails during the early decades of the nineteenth century, of course. Zanesville, Cincinnati, and even Wheeling had small nail manufacturers from a very early date. These small shops were geared primarily to produce for a local market and only infrequently engaged in the export of nails. Until Wheeling's later entry into the national market, the Pittsburgh mills were the only ones to seize upon the possibilities for broad marketing that the Ohio River Valley transportation system offered. By mid-century, eight Pittsburgh manufacturing establishments were producing in the range of 20,000 or more kegs of nails per year each and two factories, the Juniata Works and the Lyng-Painter & Company Works, were each turning out more than 50,000 kegs per year.[18]

The first Wheeling nail mill was a direct product of the Pittsburgh manufacturing community. In 1832 (or 1834, depending upon which source is used), two Pittsburgh iron manufacturers--Peter Schoenberger and David Agnew--came to Wheeling seeking a location for a puddling works. Both Schoenberger and Agnew were experienced iron manufacturers and both would play an important role in the American iron manufacturing community in the decades to come. Peter Schoenberger was most noted as an entrepreneur in the Pittsburgh iron community and as the first of the Western ironmasters to use the rotary squeezer at his Juniata Works near Pittsburgh. David Agnew, who had been the manager of Schoenberger's Juniata Works, had the distinction of being, in conjunction with his

brother, the first Eastern iron manufacturer to use Lake Superior ore, at the Sharon Iron Works in Sharon, Pennsylvania, in 1853.[19]

At least a part of Schoenberger's interest in Wheeling resulted from his friendship with Thomas Sweeney, a local foundry owner. Sweeney, as an old man, commented upon the founding of Schoenberger's works. "In about 1834," Sweeney told a newspaper reporter, "I was instrumental in getting Dr. Schoenberger, of Pittsburgh, a warm friend of mine, to buy property and build a rolling mill on the site of the present Top Mill." While Sweeney's friendship may have been important, Schoenberger almost certainly knew of advantages offered by the Wheeling area. The availability of the large and cheap supply of coal suited for use as a fuel in puddling and in the operation of steam equipment had been known for many years. Comments by travelers in the first and second decades of the century and later articles in both Hunt's Merchant Magazine and DeBow's Review made reference to Wheeling's coal supply. The writer of the latter source noted during the 1840s that coal was cheaper in Wheeling than in any other Western city. Locating mills in close proximity to fuel supply was not an uncommon practice. Puddling operations were in fact frequently located nearer to fuel sources than to iron supplies because fuel was more expensive to ship than pig iron.[20]

Sweeney in his comments about the Schoenberger mill confirmed that Wheeling's access to deep river transportation during the dry season played an important part in Schoenberger's consideration of Wheeling as a location for his mill. Scott and other writers have maintained that Schoenberger intended to ship pig iron from Western Pennsylvania to Wheeling. The lack of transportation during dry seasons

would have prevented such shipments, and since this was widely known it is unlikely that Schoenberger ever attempted to use Pennsylvania pig iron. Actually, Schoenberger and the others who located mills in Wheeling during the pre-war era were looking downstream to the Hanging Rock region of Ohio for their supply of pig iron. Published reports of steamboat cargoes and their origin show that a considerable portion of the iron used in the Wheeling puddling mills in fact came from the Hanging Rock region and later in the century from the Iron Mountain and Pilot Knob region of Missouri.[21]

In addition to the value of deep water navigation for pig iron shipment, Wheeling's position offered advantages for the marketing of the finished product. The river provided access to growing Western and Southern markets. Furthermore, the National Road provided a good land transportation route for shipping products such as nails to the interior of Ohio and Indiana after the western section of the road was completed in 1833. Although there is no solid evidence to support the claim, the opening of the Ohio canal system may have been another factor that led Schoenberger to consider Wheeling. With canal ports south on the Ohio at Marietta and Portsmouth open by 1834, and at the mouth of the Little Beaver to the north, Wheeling manufacturers had direct water transportation to Cleveland and to the Great Lakes.[22]

The importance of Wheeling's position along transportation routes was intensified in the late 1840s when the Baltimore and Ohio Railroad did finally choose the city as its western terminus. The arrival of the railroad in 1852 coincided with the organization of several new nail firms and with the construction of new mills in close proximity to the

railroad lines. While there is scant evidence from the pre-war era of heavy reliance upon rail transportation for the transportation of raw materials or finished products, the business community in general and the nail mills specifically saw the railroad as a positive factor. The nail makers, initially at least, were more interested in the market for spikes which the railroad offered than in its possibilities for transportation. This view of rail transportation changed in the late 1850s when the Baltimore and Ohio pushed westward to Cincinnati and when the nail mills added blast furnaces. By 1865 the railroads were becoming important as transporters of both raw materials and finished goods.[23]

Along with fuel and transportation, the presence of capital to finance the mill operations made Wheeling, as has been noted, an attractive spot. There can be little question that the Schoenberger mill was financed by Schoenberger, with perhaps some additional money invested by Agnew. After 1845, however, capital generated locally financed the bulk of the expansion that took place in the area. Between 1845 and 1870 there was a perceptible flow of money from commerce and real estate to manufacturing enterprises in and around Wheeling. Old land speculators such as Noah Zane, Archibald Wood, and Thomas Wood, early merchants like Daniel List and Thomas Paul, and prominent attorneys such as Gibson Lamb formed the Bank of Northwest Virginia, an establishment that, as previously noted, played an important role in the development of nail factories and Wheeling in general.[24]

A second bank that had a more direct association with the nail industry was the Merchants and Mechanics Bank of Wheeling, founded in 1834. Like the Bank of Northwest Virginia, the Merchants and Mechanics

Bank was formed by old mercantile families, such as the family of the Quaker merchant Israel Updergraff. The close relationship that existed between this bank and the nail industry continued from the founding of the bank. For example, David Agnew, manager of Top Mill, was a founder, director and major stockholder in the Merchants and Mechanics Bank. After the Civil War, J. N. Vance, President of the Riverside Mill, also served as president of the bank, and two other prominent "nail men," Samuel Laughlin of the Benwood Company, and L. S. Delplain of the Wheeling Iron and Nail Company, served as vice presidents.[25]

In addition to the money made available through the two banks mentioned above, money flowed directly from commercial or land enterprises to the nail industry. In 1852, for example, J. C. Acheson sold his interest in a stage line and invested the proceeds in the Benwood Mill. A. Wilson Kelley liquidated his considerable land holdings in the 1850s and invested his money in the Belmont Mill. And merchants such as Crispin Oglebay, L. S. Delplain, and Samuel Laughlin had begun to invest money accumulated through their merchandising establishments in the nail industry in the late 1840s and early 1850s.[26]

Although it would be inappropriate to regard them as reasons for the establishment of the nail industry at Wheeling, two factors--tariff policy and general economic expansion--must be taken note of. Both Henry Scott, author of Iron and Steel in Wheeling, and Earl May, author of Principio to Wheeling, a history of the Crescent Iron Works, claimed that during the three decades before the Civil War the fluctuations in tariff rates had an impact on nailmaking in the Ohio Valley. Both authors relied heavily upon The Wheeling Intelligencer for

information, and their conclusions about tariff policies appear to have come directly from a series of articles that appeared in this newspaper in 1874. Scott and May both concluded that industrial fortunes rose and fell with the tariff. Such a conclusion, while having some basis in fact, deserves much scrutiny, for the evidence does not permit so simple and direct a conclusion.[27]

It is of central importance to note that the American cut nail manufacturers had little foreign competition. The cut nail was developed and continued to be an American implement throughout the century. Except for specialty nails, few nails were imported. During the sixteen years between 1828 and 1844, for example, the average yearly import of nails was only twenty-four tons, or less than 500 kegs, and the single largest yearly import (in 1830-1831) was only 101 tons. Imports remained relatively high in the two following years, fifty-six and ninety-five tons respectively, but thereafter declined dramatically. This pattern would suggest that tariffs were of marginal importance, since the heaviest imports came while the "Tariff of Abomination" was in force. Especially for Western nail manufacturers, therefore, the tariff was of little consequence. The first mill in Wheeling was established during the era of the compromise tariff, and the Pittsburgh manufacturers prospered, if production is used as a measure, after the "Compromise Tariff" of 1833.[28]

If tariff policy did have an impact, it appears to have been that it widened the price range between Eastern and Western nails. High tariffs on imported iron and nail plate disproportionately affected Eastern manufacturers who relied heavily upon imported Swedish and

Russian iron. Although determining the precise impact of the tariff is difficult, it is possible to note that in the 1820s and 1830s, Eastern nails were consistently more expensive than Western nails. In the 1820s nail prices were generally quoted by both manufacturer and size; however, in the early 1830s the former designation was dropped and prices were listed only by size. This is perhaps unfortunate since the continued distinction by manufacturer as well as size would have permitted comparisons of prices between those manufacturers who relied on imported iron and those who used domestic iron. The most that can be said is that it seems reasonable to assume that the high tariffs on imported iron in 1828 and the corresponding high levels of tariff during the 1830s certainly did not improve Eastern prices in relationship to those of Western manufacturers.[29]

During the period between 1839 and 1855 Eastern manufacturers' production declined in general and the number of nails shipped West greatly diminished. Figures contained in Hunt's Merchant Magazine, for example, showed that the value of products of Massachusetts' nailers declined by almost three-quarters between 1839 and 1855. A part of this decline can be attributed directly to the lower prices per unit of output. But even when a 33 percent decrease in price is taken into account, the net decline in production was something more than 40 percent. Hunt's magazine also provides evidence that shipment from Eastern nailers to the West declined during the 1840s. Between 1846 and 1849, for example, the number of kegs shipped West from Philadelphia declined from about 184,000 kegs to just slightly more than 70,000 kegs, a reduction of 50 percent in the space of four years. This period of declining Eastern nail production and shipping coincides closely with an expansion in the production of both

the Pittsburgh and the Wheeling nail manufacturers noted previously.[30]

While the price differential (some of which resulted from tariffs on iron) between Eastern and Western nail manufacturers was a significant factor in the disappearance of the Eastern nail from the West, the general growth that was taking place in the Midwest and in those Southern states bordering the Mississippi appears to have been largely responsible for the rapid growth of Western manufacturing. During the twenty years after 1830, the East North Central states (Ohio, Indiana, Illinois, Michigan, and Wisconsin) had a population increase of more than 3,000,000 persons and was by far the most rapidly growing area of the country. The East South Central section (Kentucky, Tennessee, Alabama, and Mississippi) had a population increase of 1,500,000 persons and was the second fastest developing region in the nation. Based on average household size of 5.55 persons in 1850, a minimum of 827,000 residential structures would have had to have been constructed in these regions to accommodate the increased population. In addition to the residential construction needs, an indeterminate number of business structures, churches, schools, other buildings, an an expanding railroad and canal system created a demand for nails. The supposition that population growth and the resulting economic activity stimulated commercial activity in the upper Ohio Valley is supported by transportation statistics. Between 1831 and 1835, for example, the number of craft passing through the canal at Louisville increased from 826 per year to 1,611, and tonnage increased from 76,323 tons to 200,143 tons. Furthermore, estimates made by Timothy Pitkin placed the surplus of exports over imports of the Ohio Valley in 1834 at $18 to $20 million and the exports of Wheeling at a surplus of just over a million dollars.[31]

Transportation, fuel supply, markets and the other elements noted in the preceding pages therefore all contributed to a generally favorable environment for the launching of the nail manufacturing industry in Wheeling. While it is doubtful that Schoenberger or Agnew carefully weighed the importance of many or all of these conditions, information from later sources suggests that the more obvious ones--fuel and transportation--were considered as important by both men. But even with these advantages, Wheeling did not enjoy immediate success as a site for nail manufacturing. For more than a decade Agnew and Schoenberger's mill continued to be the sole manufacturer of nails in the Wheeling area.[32]

By latter day standards, Schoenberger's mill was a small enterprise. Insofar as can be determined, no contemporary descriptions of the mills have survived. An article in The Wheeling Intelligencer in 1874 suggested it was "designed for the general manufacture of bar, sheet iron and nails in accordance with the usual customs of the day." Fragmentary bits of information from other sources suggest that the mill had six puddling furnaces, a steam powered tilt hammer, a rolling mill, and either twelve or fourteen nail machines. Maximum capacity of a mill of this size would have been about 20,000 kegs per year.[33]

Between 1834 and 1840 the mill was operated by Schoenberger and Agnew, with Agnew as the operating partner. All accounts suggest that the mill was a prosperous one. Agnew quickly settled into the community. He helped found and became the president of the Merchants and Mechanics Bank. He participated in local politics. During the 1830s he was also part owner of at least one blast furnace in the Hanging Rock region

of Ohio. While the firm of Schoenberger and Agnew weathered the panic of 1837, Agnew's other business enterprises, probably the furnace mentioned above, drove him into bankruptcy sometime around 1840. Schoenberger purchased Agnew's interest and leased the mill to Greisener and Tallant, two workmen who had been associated with the mill during Agnew's tenure as manager.[34]

Even less is known about the operations of the Schoenberger mill after Greisener and Tallant took over than during the Agnew and Schoenberger days. The newspapers reported that the partnership, "with but limited resources at command barely sustained themselves, but made no money." The poor showing of the works between 1840 and 1845 was frequently blamed on tariff reductions; it was, however, more likely associated with a general decline in the price of nails after 1840 and with a lack of technical skill of the two partners.[35]

The struggling partners of the Schoenberger mill, commonly referred to as Top Mill after 1840, finally succumbed to bankruptcy in the spring of 1845, and a firm formed by E. W. Stevens, who like Agnew was an experienced iron master from Western Pennsylvania, took over the mill. Stevens' experience and his capital, reported to have been about $75,000, revived the faltering mill. Immediately upon his assuming control of the works, he set about expanding and improving the rolling mill and the nail mill. One of his decisions was to employ Edward and George Norton, two nailers from Pittsburgh, to take charge of the nail works at the Top Mill. With the arrival of Stevens and the two Nortons, the triumvirate that was to establish Wheeling as a nailmaking center had been assembled. Over the course of the following

decade and a half, these three men, along with two other Norton brothers, established more than a dozen firms and built five mills.[36]

These three men took pride in the title of practical mechanic. Even in their lifetimes they were regarded as the founders of the industry. They not only built, reorganized, and sold mills but recruited and trained nailers and tapped local sources of capital as expertly as any trained broker. Moreover, they expanded their business activities over the entire upper Ohio Valley, speculating in various phases of the iron business in Ohio, Kentucky, and Missouri. They also embarked upon a publicity campaign to convince the Western market that Wheeling nails were the best nails manufactured in the West. A writer using the pseudonym of "An Old Mill Employee" commented in 1874 that the success of Top Mill and others with which Stevens was associated could be attributed to "the unprecedented popularity of what was known as the Stevens nail."[37]

Stevens and the Norton brothers operated the Top Mill for a bit more than two years. In 1847, Stevens was embarrassed financially by the loss of $100,000 in an iron mining venture in New Jersey and was forced to bring Edward P. Schoenberger, the son of Peter Schoenberger, and two other anonymous partners into the firm that operated Top Mill. Shortly after this change, Edward Norton left Top Mill and along with Stevens, who retained his interest in Top Mill, and three other nailers, John Hunter, William Fleming, and Robert Morrison, organized Hunter, Morrison & Company. The newly organized firm undertook the construction of the Virginia Mill, Wheeling's second nail factory, and the first to limit production solely to nails. A report in DeBow's Review in April,

Fig. 14. George W. Norton, a brother and frequent business associate of Edward Norton. George, Edward, and Fred Norton were three of the first nailers to arrive at Top Mill when E. W. Stevens expanded the nail factory in 1844. The three brothers were responsible for organizing three mills between 1847 and 1855. (Scott, p. 9)

1848, contained reference to Top Mill and noted that a second "establishment of the same kind is progressing." By August, a writer in Hunt's Merchant Magazine in a brief article mentioned the Virginia Mill, noting that "only in part filled with machinery [it] is turning off about 1,000 kegs of very superior nails per week."[38]

Designed by Edward Norton and Thomas E. Lewis, an English millwright who had settled in Pittsburgh, Virginia Mill was considerably larger than Top Mill. About two years after it opened, forty machines were operating, making the factory comparable with any of the Pittsburgh mills in operation at the time. Like Top Mill, the particulars of its construction are not available, and since the mill was demolished in 1852 to make way for the Baltimore and Ohio Railroad terminal, there is little written or graphic evidence to depict the physical appearance of the mill.[39]

Edward Norton's stay with Hunter, Morrison & Company was a short one. By 1849 Norton had withdrawn to form a new firm. The old company reorganized under the name of Hunter, Fleming & Company, and Edward Norton organized Norton, Bailey & Company. The new firm included, besides Edward Norton, who invested about $8,000, his brother, F. D. Norton, and eight other nailers who had been employed either at the Top Mill or the Virginia Mill. The partners raised $40,000 amongst themselves for the construction of a new mill that they named the Belmont Mill. While the Belmont Mill was smaller than the Virginia Mill (having only eighteen machines), the new mill did introduce to the Wheeling nail manufacturers two important innovations--the Burden rotary squeezer and the bullhead roller. The squeezers completely replaced

the old tilt hammers that were used at Top and Virginia Mills and greatly improved the quality of the nail plate. The bullhead rollers permitted the production of a narrower nail plate and eliminated the need for cutting the nail plate from larger sheets. Furthermore, the squeezer and roller had the combined effect of producing nail plate that could be cut so that the direction of the grain of the metal ran the length of the nail. Thus the Belmont nails were the first made in Wheeling suitable for use as door battens and other uses that previously required hand wrought nails.

Like Hunter, Fleming & Company, the firm that built the Virginia Mill, Norton, Bailey & Company was a shortlived one. In November, 1851, William Bailey and six of the partners withdrew from the Belmont Mill selling their interest to Edward Norton, Henry Moore, James C. Acheson, and F. D. Norton. Moore, a wealthy farmer, had taken a small share in the old firm sometime after its founding in 1849. When Bailey and the others withdrew, Moore purchased about one-half of the interest ($36,000). J. C. Acheson, who had been a part owner of a stage firm operating along the old National Road, took about $10,000 worth of the interest sold by Bailey and the withdrawing partners. The two Norton brothers purchased the remainder ($21,000) of the withdrawing partner's interest.[40]

Bailey and the nailers who left the Belmont Mill formed a new partnership known as Bailey, Woodward & Company that was to become one of the most stable firms in the Wheeling nail industry. The new firm purchased four acres of land south of Wheeling and by the fall of 1852 had planned and constructed a new mill. Christened the LaBelle Mill, the new facility had eight boiling furnaces, two heating furnaces,

a muck mill, a skelp mill, and twenty-five nail machines. While the LaBelle Mill incorporated both the squeezer and the bullhead rollers that had been introduced at the Belmont Mill, there is no evidence that the LaBelle Mill contained any other important innovations.[41]

Bailey, Woodward & Company was different in one significant aspect from its predecessors. When the new partnership was formed, those men who signed it agreed that if any member of the firm wished to sell his interest, it had to be offered to the remaining partner who had the least interest in the firm. If that partner refused or could not purchase the departing interest, it was then offered to the next partner and so on. Only after each partner had declined could the interest be sold to someone outside the firm. A restriction of this sort hints that the members of the new firm were concerned with stability and that Bailey and his partners were aware of some of the more unfortunate effects of partners' leaving mills to establish new ones.[42]

After Norton and Bailey left Top Mill, the firm that Stevens helped put together to operate the mill struggled and then failed. A completely new firm, Johnson, Sweeney & Company, organized and took over operations of Top Mill in 1849, changing its name to the Missouri Iron Works, but they managed to run the mill with only "varying success," as a reporter in The Wheeling Intelligencer phrased it. Operations at the Virginia Mill followed much the same pattern. When Norton, Bailey, and the others withdrew, the firm operated "but with tolerable success" until 1852, when the Baltimore and Ohio Railroad purchased the mill site. At that point the company reorganized, and John Gill, a local banker, became the major owner. In 1853, Gill moved the equipment from the old

Virginia Mill south of Wheeling and began work on a new mill located on the McMechen Farm. This new mill, known locally as the Benwood Iron Works, began operation in late 1853. However, according to accounts in The Wheeling Intelligencer, "misunderstandings and constant dissatisfaction prevailed resulting in the frequent changes of administration, under none of which much success was achieved."[43]

Norton and his colleagues appear to have engaged in a bit of a game. They organized a firm, constructed a factory, showed a profit, and then sold their interest to local businessmen, who found it difficult to continue operations because those who knew the business withdrew to form a competing company. Edward Norton, who was widely hailed as a practical nailer of the first order, also had a talent for business affairs that seemed to escape the attention of his contemporaries. In addition to participating in the design of three nail mills, he served as the "business partner" in several firms where he had the responsibility for making contracts, making purchases, and selling the products of the establishments; and he generally "attended to the finances." Furthermore, Edward's brother George went into the shipping business as a captain of an Ohio River steamboat. Since a well-defined marketing system had not yet appeared, George probably played a crucial role as a salesman for his brother's product. Edward appears to have also made certain that his most recent mill was superior in one way or another to the one that he had just abandoned. Virginia Mill was larger than Top Mill, and at the Belmont Mill the rotary squeezer and bullhead rollers were introduced.

Norton's success shows clearly in the figures of the various sales and resales. When he came to Wheeling in 1845 he was not, insofar as can be determined, an investor at Top Mill. When Norton, Bailey & Company organized in 1849, Edward Norton invested $8,000; two years later, when the firm reorganized, he purchased an additional $17,000 worth of the withdrawing partners' stock, bringing his total holdings to $25,000. By 1868, when Norton left Wheeling, his holdings were in excess of $100,000 at the Wheeling mills, plus an undetermined amount at the two mills in Ironton, Ohio.[44]

A new element was introduced into the nail industry with the organization of Bailey, Woodward & Company. The firm purchased enough excess land around the new LaBelle Mill site to build houses for the partners and hired workmen, thus bringing into existence the region's first company town. For this firm, and the Benwood Company that followed suit the next year, the company town was a result of a decision to locate the mill outside of the city of Wheeling. The decision to move out of Wheeling was apparently prompted by two concerns. First, space was at a premium in old Wheeling, a town that was sandwiched between the Ohio River and a mountain. Second, moving south of the city placed the firms closer to the Baltimore and Ohio Railroad that ran south for several miles along the Ohio River to the Bellaire bridge where it crossed the Ohio River. Initially the company towns were simply accommodations for workmen, including the partners. By the late 1860s, these settlements began to assume some of the characteristic features that have been historically associated with mill towns. Script came to replace part of the workmen's wages, rules to regulate saloons and even

promoting of certain religious denominations appeared in the 1870s and 1880s. And in the late 1870s and 1880s, rents were used as a tool for breaking strikes.[45]

One interesting, and it might be said possibly unique, feature of the company towns in Wheeling was the role they played in attracting merchants to the industry. Crispin Oglebay, a substantial grocery and drygood merchant, who had become one of the more prominent "iron men," first entered the nail business through his contracts to operate the Benwood company store. Another merchant, L. S. Delaplain, also appears to have first gained an interest in the industry through the operation of a company store.[46]

The new settlements, one of which became the city of Benwood, West Virginia, seemed to have given additional permanence to the mills. The LaBelle Mill remained the property of Bailey, Woodward & Company until it was incorporated as the LaBelle Iron Company in 1875. The new corporation, made up largely of the old partners and their descendants, continued to operate the mill and maintain an interest in the company town until 1921, when it became a part of the Wheeling Steel Corporation. After several upheavals in the 1850s, the Benwood Iron Works settled into a similar pattern and like the LaBelle eventually became a part of the Wheeling Steel Corporation.

During the time (1847-1853) when Norton and his associates at Wheeling were building new mills, the economics of nail marketing changed rapidly. The partners found that the price of nails was declining. Between 1847 and 1852, for example, nail prices dropped steadily from $4.50 per keg to $3.13 per keg. At the same time demand,

at least in the West, was growing. At Cincinnati nail imports increased from 57,000 kegs per year in 1846 to 84,000 kegs per year in 1851, for example. Pittsburgh factories, like those at Wheeling, were expanding to meet the increased demand, increasing production between 1846 and 1850 from about 86,000 kegs per year to more than 269,000 kegs per year.[47]

That the price of nails fell during a time when demand was high raises several questions. If traditional market forces were at work, the opposite trend would have been expected. Although it is impossible to assert with certainty, three conditions may account for the falling prices in the face of increasing demand. First, transportation costs were falling. Both North and Taylor have noted the decline in freight costs over the first half of the century and specifically during the 1850s for river craft. Transportation costs were also being reduced by canals. Two canals, the Ohio and Erie and the Hocking crossed the Hanging Rock region, and since much of the pig metal that arrived at Wheeling originated in this area, these two canals contributed to the declining costs of transportation. With the cost of water transportation declining, the price of nails shipped to areas along the Ohio River would have reflected at least a portion of the savings. In addition, the cheaper transportation costs provided by canals reduced the price of nails in inland regions. Furthermore, the impact of railroads was being felt. The completion of the Baltimore and Ohio Railroad to Wheeling in 1852 had already been noted. Four years later the road was completed on to Cincinnati, a major market area for Wheeling nails. In addition to the Baltimore and Ohio, other railroads, particularly the Southern lines out of Cincinnati, may have been important as shippers of nails

to the Southern states. Exports of manufactured iron products from Cincinnati increased dramatically (1400%) between 1846 and 1853. Since Cincinnati did not have a nail industry, a portion of the increased imports noted above were being transshipped to the Southern states by rail.[48]

The decline in the cost of pig iron during the 1846-1852 period also accounts for a portion of the price decline. T. S. Berry, in his study of Cincinnati prices, noted that between 1846 and 1852 prices for pig iron receded from $31.50 per ton to $24.50 per ton, or about twenty-two percent. French observed the same trend in the East in his history of the iron trade. This decrease alone would have accounted for a substantial portion of the decline in nail prices.[49]

A final consideration in nail prices must be the technology that was being applied to the craft and the organization of the production units. As noted in Chapter I, productivity increased particularly in the West after 1850. While a more detailed analysis of this increase will be made below, it should be noted that prices were beginning to reflect decreases in production costs during the early 1850s.

Beginning in 1853 nail prices increased both nationally and in the West. The increase of about $1.75 per keg in 1853 was related to a corresponding increase in the cost of pig iron. On February 26, 1853, The Wheeling Intelligencer carried a notice that the Wheeling nail manufacturers were raising the price of nails 25 cents a keg as a "consequence of heavy increases in pig metal." Manufacturers throughout the West also came under pressure to increase wages in late 1853. Wheeling manufacturers acceded to employee demands for wage increases

for boiling and puddling in late December. The increase in the price of pig metal continued in 1854 and 1855; nail prices, however, began to slide downwardly as production capacity and demand became more closely matched and as the impact of the panic of 1857 was felt by the industry. This trend continued until 1861 when wartime demand sent the prices shooting upward once more.[50]

During the 1850s increased costs from materials and labor largely offset gains in efficiency and in transportation costs. Prices fluctuated from $3.13 per keg in 1852 to $4.76 per keg in 1854, but at the end of the decade prices were 15 cents per keg higher than in 1850. The experience of the 1850s showed clearly that costs, and prices, were in good part at the mercy of the iron market. If this central fact of life for the nail industry was lost on men who directed the firm in the 1850s, the high costs and difficulty in procuring iron during the Civil War emphatically pointed it out during the 1860s. Beginning in the mid-50s and for the two decades thereafter, one of the major objectives of the Wheeling nail firms was to counter these fluctuations in price and supply in the pig iron market.

The early 1850s, when declines in cost were outnumbering declines in price, was a time of considerable activity in the Wheeling mills. It was during this period that the LaBelle, the Belmont, the Virginia, and the Benwood Mills were planned or built, and when Top Mill was expanded. After 1853, when prices rose, accompanied by even higher costs, the impetus to organize new mills slackened. During the remainder of the 1850s, however, two factories, indirectly related to nail manufacture at first, were established, and the older ones began to

expand and move cautiously towards operating on a larger scale. In both the new mills and all but one of the older mills, the constant shifting of owners that had characterized the preceding years continued on an even more grandiose scale.

The railroad fever that seized the Ohio Valley in the 1850s was responsible for one of the largest ventures undertaken by the Wheeling iron manufacturing community. Taken by the potential for financial success that a rail mill, located at the western terminus of the Baltimore and Ohio Railroad, could have, E. W. Stevens, who had been the organizer of the nail factory at the Top Mill in 1840, and a sizeable investor in the Virginia Mill, set about organizing a rail factory. In company with John Gill and George Hardman, local bankers, and with the backing of Edward Norton, Stevens began the task of raising money for the new mill. The plans called for purchasing 9,000 acres of coal lands, a blast furnace, and the construction of a mill that was to have fifteen double puddling furnaces, three trains of muck rolls, two squeezers, and a variety of other equipment.[51]

Stevens, Gill, and Hardman raised enough capital locally to construct the mill during the winter of 1853 and spring of 1854. Shortly after completion of the mill, named the Crescent Mill because it paralleled the curvature of Wheeling Creek, Stevens, Gill and Hardman were joined by Chester Hubbard, an attorney, state representative, and heir to a sizeable sawmill fortune, and Henry Moore, and the firm was incorporated with an authorized stock of one million dollars. The three original partners subscribed about $300,000, mostly in the form of the mill that they had recently completed, and the new incorporators,

Hubbard and Moore, put up $200,000, largely in lands and other securities. To raise the remainder of the money needed to purchase the blast furnace and about 9,000 acres of additional land in Marshall County, West Virginia, the firm turned to John B. Gardner of Boston and Joseph Whitaker of Philadelphia. Whitaker eventually purchased a sizeable block of stock but no other outside investors were enticed by the rosy predictions of prosperity the organizers promised. A brochure published by the Crescent Manufacturing Company informed potential investors that the hills surrounding the Crescent Mill were layered with deposits of fire clay, sandstone, soapstone, coal, cement lime, and limestone. The minerals were to be mined until the hills were flattened and the lots were to be sold as real estate at $2,000 each.[52]

The company failed during the panic of 1857, only a few months after Stevens had sold his stock and left Wheeling for Kentucky, where a few years later he would once again team up with Edward Norton and go into the nail business at Ashland, Kentucky, and Ironton, Ohio. After the collapse of the Crescent Manufacturing Company, Chester Hubbard and the other partners reorganized it and operated the Crescent Mill until 1865, when the property was sold. The Whitaker family, already a noted iron family from Principio, Maryland, then purchased the majority of the holdings and operated the mill until it merged with the Laughlin Nail Company later in the century to form the Whitaker Glessner Corporation. The Crescent Mill was the only one of the Wheeling mills that never manufactured nails. Throughout its history the mill manufactured rails, sheet iron, and, in the 1880s, structural and architectural iron. The mill, and a closely associated enterprise,

the Wheeling Corrugating Company, also produced large quantities of corrugated roofing, metal tubs, and similar materials in the 1880s and 1890s.[53]

The Crescent Manufacturing Company did introduce Wheeling to the national financial community. The campaign to raise capital stock for the corporation drew attention, and during the 1850s and 1860s two Easterners invested heavily in Wheeling firms. In addition to Whitaker, W. L. Hearn, a New Yorker, invested in a small wire mill and converted it into the fifth Wheeling nail factory.[54]

The organizers of the Crescent Manufacturing Company were the first men in Wheeling to attempt to build a vertically integrated organization. Although the venture was criticized by the iron men of the 1870s as a speculative scheme, Stevens and his fellows attempted to collect under single ownership a mill, a blast furnace, and coal lands and other mineral holdings needed to operate an iron mill.[55]

Finally, the Crescent Manufacturing Company was the first of the Wheeling mills to incorporate. From the very beginning of the industry the firms that operated the mills were partnerships or were owned by single individuals. Capital was raised from partners, usually skilled workmen, or local businessmen. As already noted, these partnerships were volatile, subject to disintegration when the partners decided to separate. When a partner, such as Stevens, suffered financial embarrassment, as he did in 1847, the entire partnership was affected. Finally, the partnerships were distinctly limited in the amount of capital they could raise. After the Civil War the entire nail manufacturing community would learn that the partnership arrangement could not raise the

capital needed for expansion and would emulate the corporate organization pattern of the Crescent.[56]

The last mill to be organized during the pre-war period was the Eagle Wire Mill, founded by Eliphalet C. Dewey, a Cadiz, Ohio, native. Precisely when the mill was formed is unknown. Scott claims the mill dates from 1852, but in 1849 a visitor to Wheeling reported in Hunt's Merchant Magazine that a new mill in Wheeling was manufacturing cables for the suspension bridge that was under construction. If this reference was to the Eagle Mill, it dates from earlier than has been generally thought. The wire mill operated until sometime in 1855 when Dewey was financially embarrassed. After the mill stood idle for three years, Chauncey Dewey, the father of the organizer, operated the mill for a time before it was destroyed by fire. After the fire, Orville Dewey, a brother of the founder, reorganized the firm and began manufacturing railroad spikes and wagon axles. The firm of Dewey, Vance and Company struggled through the Civil War, continuing to be the smallest of the group of Wheeling manufacturers. In 1867 William Hearn, "a retired capitalist from New York City," joined the firm, putting up enough money to construct a new mill. From that time until the firm joined the National Tube Corporation in 1898, it, along with the LaBelle and Benwood Mill, enjoyed a reputation for being one of the more solid and prestigious firms in the city. While the LaBelle was known for its solid management and conservative technology, the Riverside Mill operated by Dewey, Vance and Company gained a reputation for engineering advances and technological sophistication. It was the first firm to build a Wheeling blast furnace, the first to employ an engineer, and

the only firm regularly to seek patents on innovations that it developed.[57]

Between 1856, when Orville Dewey reorganized the Eagle Wire Mill, and 1869, no new factories were built in the Wheeling area. Change in ownership continued as before, with firms rising and disappearing as the fortunes of individual partners rose and fell. A review of the history of the Virginia Mill, organized by Norton and Stevens in 1847 and abandoned by them in 1849, illustrates the path that ownership typically took. Immediately after Norton left the firm it was reorganized under the title of Fleming, Hunter and Company. After the Baltimore and Ohio Railroad Company purchased the Virginia Mill site in 1852, the firm that operated it was reorganized under the title of Gill, Fleming and Company and rebuilt at Benwood, south of Wheeling. With the financial setbacks suffered by Gill in the Crescent Manufacturing Company, the partnership was expanded to include A. Wilson Kelley, a farmer turned manufacturer. Eventually J. J. Holloway, a banker from Bellaire, Ohio, was admitted to the partnership. In 1857, Kelley purchased the interest of Holloway and Gill and operated the mill until 1864, when the courts ordered it sold to satisfy debts. At this point Edward Norton once again became associated with the mill, financing it in concert with several local businessmen and organizing a firm under the title of Norton, Mendenhall and Company.[58]

The instability of the firms and the top management of the mills was one of the features of the business environment during the early years frequently noted by later observers. The second generation "nail men," those who replaced Norton, Stevens, Gill and Moore, were

particularly critical of their predecessors. The periodic "swarming" of an earlier day appeared unthinkable to the corporate men who exercised control over the mills in the 1870s and 1880s. Actually, the frequent change of ownership, when viewed in perspective, had a salutary effect on the industry. The familiar pattern of "organize and sell" attracted capital to industrial ventures not only in Wheeling but in other towns in the Ohio Valley, and not only in the metal trades but also in glass and ceramics. Furthermore, the organize-and-sell pattern provided a method for bringing capital and skill together. Because of the technical nature of the nail industry, laymen could not easily plan, organize and put into operation a production unit. Once organized and staffed, however, a layman did have a reasonable chance of succeeding.[59]

In the case of the nail industry, the pattern of organization that produced a succession of mills was the foundation for the leadership that the Wheeling firms exercised after the Civil War. The expertise of Norton and, to a lesser degree, Stevens and Bailey assured the technical soundness of the industry. As observed above, each of the Wheeling mills was equipped comparably with those of their competitors at Pittsburgh and by 1860 were on the average larger.[60]

As unstable as ownerships appeared, there was an attempt, moderately successful, to structure related businesses--besides iron production--that would assure the success of nail manufacturing. Most notably, there were several attempts to organize packet lines in Wheeling during the 1850s. Previous reference has been made to E. W. Norton's brother, George, as a steamboat captain and to the relationship he bore to several nail enterprises. Other lines, such as the Sunfish Line and the

Union line also appeared, and among the organizers and owners were J. C. Acheson and Thomas Sweeney, men who had interest in two of the city's nail mills. While it cannot be demonstrated beyond question that a firm causal relationship existed between shipping and nail manufacturing, there can be little doubt that nailmakers profited from the home-owned transportation.[61]

Several local businesses had begun to service the machinery demands of the nail mills by the eve of the Civil War. The Sweeney Foundry, L. Spence Foundry, and the Center Foundry turned out nail machines, boilers, and other equipment needed by the factories, for example. Foundry patterns currently in the possession of the Wheeling-Pittsburgh Steel Company's LaBelle Works dates from the pre-war period with a few having stamped dates as early as 1860.[62]

The overpowering presence of Edward Norton, the organizer and salesman, and the men he enticed and led into enterprise after enterprise, tended to obscure another group of individuals who were less entrepreneurally oriented. These men, skilled mechanics and craftsmen, attracted to Wheeling by Norton personally and by the rapid growth of the mills after 1850, served as stabilizing elements for the mills and the industry in the ever-changing ownership and management milieu. Two such men were John Altmeyer and his son, Jacob, who emigrated to Wheeling from Pittsburgh in 1850. These two men worked as nailers at the Top Mill and Belmont Mill during the 1850s and by the 1860s and 1870s served as mill managers. Others such as Henry Babcock and David Spaulding had been nailers in Massachusetts before they came to Wheeling in 1854. Like the Altmeyers, these two men, skilled mechanics when they

arrived, quickly moved into what would be later called middle management.[63]

These four men, and several dozen like them, were a stabilizing force that kept mills operating while Norton and his colleagues' speculated. Long after Norton and Stevens had left Wheeling, the names of the nailers and puddlers who arrived in the 1850s remained associated with the industry. They provided the technical skills to keep the mills operating, taught the crafts to the new workmen, and exercised a general leadership role at the mill level. One of the more famous of this group was Nicodemus Reister, a German who learned the nailers trade as one of the original apprentices at Top Mill, at the age of fourteen. By the early 1860s he had become manager of the Belmont Nail Mill. In this position he was so popular with the workmen and so respected by the ownership of the Belmont that the new blast furnace engine in 1872 was formally christened "Old Nick" in his honor.[64]

Although most of these men owned stock in the companies for which they worked, only a few, most notably David Spaulding, ever rose above the level of mill manager. In fact, most placed more allegiance to their craft than to the particular company at which they were employed. Jacob Altmeyer and a younger brother, as well as Reister, for example, lost their positions in 1886 when they refused to teach their crafts to the new nailers.[65]

Men like Jacob Altmeyer and Reister were young men when they arrived at Wheeling in the 1850s. Throughout the 1860s, 1870s, and into the 1880s, they bridged the gap between the owners and top level managers on the one hand, and, on the other hand, the men on the nail line and

at the furnace hearth. Their stature at the mills was further reinforced by their standing in the community. Reister, for example, served on city council, was a director of the Peoples National Bank, and was a stockholder in the Wheeling Electric Railroad Company in the 1880s. All enjoyed, in addition to the respect of workmen and owner alike, a standard of wealth that made them the envy of other classes of workmen. Henry Scott, who was just entering the factories as Reister and Altmeyer were in their prime, referred to them as the plutocrats of the laboring force.[66]

In several ways the growth of the industry at Wheeling paralleled the development of the nail industry in Pittsburgh. Technologically, Wheeling was even with Pittsburgh by the mid-1850s and maintained parity until the great strike of 1886. Likewise the organizational forms, partnerships and close relationships with banks, were also similar to those which developed in Pittsburgh.[67]

Wheeling diverged from the Pittsburgh firms, however, in two important areas. First, in the 1850s Wheeling manufacturers individually and collectively became more specialized, concentrating their full attention, except for the Crescent Mill, on nail production, while Pittsburgh manufacturers tended to diversify, producing nails as only one of many products. This specialization in Wheeling intensified throughout the 1860s and into the 1870s and led the producers there to view themselves as nail manufacturers rather than iron masters. Indeed, it was not until the late 1870s that the Wheeling newspapers began to refer to the Wheeling manufacturers as iron makers instead of "nail men" or nailers.

The second divergence was that nailmaking in Wheeling developed much more rapidly than in Pittsburgh. If the arrival of Stevens and the Norton brothers in 1845 is taken as the beginning of the industry, all of the mills were constructed within a ten-year period and, except for the Eagle Wire Mill, which later became the Riverside Nail Works, they grew out of the efforts of Norton and Stevens, or men like Bailey who were associated with Norton. After a decade during which new production units were added, the nail manufacturers abruptly changed direction and began an internal expansion of existing facilities. The Belmont Mill, which had eighteen machines when it went into operation in 1849, had more than quadrupled its size (eighty machines) by 1860; the Benwood grew from forty-five to sixty-five machines; and the LaBelle increased in size from twenty-five to eighty-three machines. But, the expansion went beyond just adding machines. Two firms, the LaBelle and the Belmont, added blast furnaces in 1855 and 1857 respectively. In both instances, the Wheeling mills were in advance of competitors in Pittsburgh who did not add furnaces until 1859. In both cities the pre-war furnaces were regarded as experimental. It would take the Civil War market to prove their worth and the profits of that war to provide the capital for this movement to continue.[68]

In April, 1853, the editor of The Wheeling Intelligencer walked through the town and recorded his impressions of what he saw for his readers. Referring to the "lower part of center Wheeling," the editor reported "a cluster of manufacturies and busy mechanics, enough by themselves to fill a small town," and he concluded, "This part of her town is bound to shine." The miserable "country town that could never

be more than 200 yards wide" had begun to shed its commercial heritage and was moving firmly towards manufacturing. Combining favorable location, liberal fuel supplies, and a healthy portion of local capital with imported skills and a growing market, the town was to become the nail manufacturing center of the West in the late 1860s and remain so until 1886.[69]

FOOTNOTES

CHAPTER II

[1]Richard C. Wade, The Urban Frontier: Pioneer Life in Early Pittsburgh, Cincinnati, Lexington, Louisville, and St. Louis (Chicago: University of Chicago Press, 1964), pp. 323-327; Thomas S. Berry, Western Prices Before 1861 (Cambridge, Mass.: Harvard University Press, 1943), pp. 272-274.

[2]Isaac Lippincott, A History of Manufacturers in the Ohio Valley to the Year 1860 (New York: The Knickerbocker Press, 1914), pp. 129-197; Wade, Urban Frontier, p. 43.

[3]Ibid., pp. 46-48; Louis C. Hunter, "Influence of the Market upon Technique in the Iron Industry of Western Pennsylvania up to 1860," Journal of Economic and Business History, I (1928-1929), 245; Lippincott, History of Manufacturers, p. 52; Victor S. Clark, History of Manufactures in the United States (3 vols., New York: Peter Smith, 1949), I, p. 339; Beverley W. Bond, Jr., The Foundations of Ohio (Columbus; The Ohio State Archaeological and Historical Society, 1941), pp. 319, 343.

[4]Wade, Urban Frontier, p. 44; Reuben Gold Thwaites (ed.), Early Western Travels, 1748-1846 (31 vols., Cleveland, Ohio: A. H. Clark Co., 1907), XI, 79; X, 34.

[5]Annual Report of the Secretary of State to the Governor of the State of Ohio for the year 1872 (Columbus, Ohio: Nevins & Myers, State Printers, 1873), p. 361; Tucker Sutherland, Ohio Almanac (Lorain, Ohio: The Lorain Journal Co., 1967), pp. 124, 128.

[6]Douglass C. North, Growth and Welfare in the American Past (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966), p. 83.

[7]Louis C. Hunter, "Financial Problems of the Early Pittsburgh Iron Manufacturers," Journal of Economic and Business History, II (1930), 521-523; Wade, Urban Frontier, pp. 43-44, 48.

[8]W. H. Hunter, "The Pathfinders of Jefferson County," The Ohio Archaeological and Historical Publication, VI (1898), 210, 238-245, 249; William T. Utter, The Frontier State (Columbus, Ohio: Ohio State Archaeological and Historical Society, 1942), p. 129-130.

[9]Charles A. Wingerter, Greater Wheeling and Vicinity (Chicago: The Lewis Publishing Co., 1912), pp. 300-302.

[10]Wade, Urban Frontier, pp. 324-325; Bond, The Foundations of Ohio, pp. 187, 388-390; Thwaites, Early Western Travels, X, pp. 112-113; Thwaites, Early Western Travels, IX, p. 105.

[11]Wade, Urban Frontier, p. 325; The Wheeling Intelligencer, February 29, 1884.

[12]Henry Dickerson Scott, Iron & Steel in Wheeling (Toledo, Ohio: Caslon Co., 1929), p. 7. Henry D. Scott wrote this volume in the late 1920s while president of Wheeling Steel. At the time he had been associated with the Wheeling nail, and later steel, firms for almost fifty years. While he clearly has some biases, the volume contains many useful observations and information that is not available elsewhere. Scott's comments and his observations are treated as a primary source in the period after 1870. Prior to that date his comments must be taken as secondary. He did have access to certain business records of the pre-war factories that seem to have disappeared, and internal evidence suggests that he relied heavily upon The Wheeling Intelligencer; Thwaites, Early Western Travels, X, p. 78; H. Morgan to Dana Hubbard, letter September 18, 1835, Hubbard Family Papers, West Virginia University Archives.

[13]Wade, Urban Frontier, pp. 322-326.

[14]Scott, Iron & Steel, p. 17; George R. Taylor, The Transportation Revolution 1815-1860 (New York: Harper Torchbooks, 1968), p. 98.

[15]Ibid., Scott, Iron & Steel, p. 16.

[16]The Wheeling Intelligencer, March 7, 1874; The Iron Age, April 15, 1875, p. 11; Daniel J. Boorstin, The Americans: The National Experience (New York: Random House, 1966), pp. 115-133, 161-168.

[17]James M. Swank, History of the Manufacture of Iron in All Ages and Particularly in the United States from Colonial Times to 1891 (Philadelphia: American Iron and Steel Association, 1892), p. 216; Clark, History of Manufactures, I, pp. 340, 546; Berry, Western Prices, p. 262.

[18]Ibid., p. 253; Ronald L. Michael, "Cut Nail Manufacture: Southwestern Pennsylvania," Bulletin of the Association for Preservation Technology, VI, 1974, No. 2, pp. 102-104.

[19]Scott, Iron & Steel, p. 7.

[20]The Wheeling Intelligencer, February 29, 1884; "Coal and Iron Trades of the Ohio Valley," The Merchant's Magazine, May (1847), p. 454; J. D. B. DeBow (ed.), DeBow's Commercial Review of the South and West,

August, 1855, p. 207; Peter Temin, Iron and Steel in Nineteenth Century America; An Economic Inquiry (Cambridge, Mass.: MIT Press, 1964), p. 92.

[21]The Wheeling Intelligencer, February 29, 1884; Scott, Iron & Steel, p. 7; The Wheeling Intelligencer, April 23, 1853.

[22]The Merchant's Magazine, February (1841), p. 199. This publication suggests that in 1839 and 1840 the Ohio Canal was transporting large quantities of nails. Wheeling was located about midway between two canal ports that provided access to the Great Lakes shipping routes.

[23]The Wheeling Intelligencer, April 23, 1853, provides some indication of the general attitude and view of the railroad and manufacturing in general. The nail manufacturers appeared to look to water transportation in the 1850s primarily because the raw material came from the west and the market for the nails lay to the west and south. Not until after the Civil War was the rail network sufficiently well developed to begin to supplement water transportation.

[24]Scott, Iron & Steel, pp. 19, 38; History of the Upper Ohio Valley (2 vols., Madison, Wisc.: Brant & Fuller, 1890), I, p. 347.

[25]Scott, Iron & Steel, p. 13; Earl Chapin May, Principio to Wheeling 1715-1945 (New York: Harper Bros., 1945), p. 104; The Wheeling Intelligencer, February 2, 1874.

[26]B. F. French, History of the Rise and Progress of the Iron Trade of the United States from 1621 to 1857 (New York: Wiley and Halsted, 1858), pp. 27-30; Michael, "Cut Nail Manufacture," pp. 102-104.

[27]Berry, Western Prices, pp. 272-274.

[28]"Iron Trade of Philadelphia with the Interior," The Merchant's Magazine and Commercial Review, XVIII (1848), p. 311; "Iron Trade of Pennsylvania in 1848 and 1849," The Merchant's Magazine and Commercial Review, XXII (1850), p. 582; "Produce and Manufacture of Massachusetts," The Merchant's Magazine and Commercial Review, I (1839), p. 274.

[29]Social Science Research Council, The Statistical History of the United States from Colonial Times to the Present (Stamford: Conn.: Fairfield Publishers, 1965), p. 13; Lippincott, History of Manufacturers, pp. 142-143.

[30]The Wheeling Intelligencer, February 29, 1884.

[31]Ibid., February 2, 1874; Scott, Iron & Steel, p. 8.

[32]The Wheeling Intelligencer, February 2, 1874.

[33]Ibid.; Scott, Iron & Steel, p.

[34]Ibid., p. 14; The Wheeling Intelligencer, April 9, 1856.

[35]Ibid., February 5, 1874.

[36]Ibid., February 2, 1874 and February 5, 1874.

[37]J. D. B. Debow (ed.), "Commerce and Prosperity of Western Cities," DeBow's Commercial Review of the South and West, V, April (1848), p. 376; "Iron Works at Wheeling, Virginia," The Merchant's Magazine and Commercial Review, XIX (1848), 230.

[38]The Wheeling Intelligencer, February 5, 1874; Scott, Iron & Steel, p. 15.

[39]The Wheeling Intelligencer, February 7, 1874; Scott, Iron & Steel, pp. 15-17.

[40]The Wheeling Intelligencer, February 7, 1874; Scott, Iron & Steel, p. 19.

[41]The Wheeling Intelligencer, February 18, 1874; Scott, Iron & Steel, p. 18; The Steubenville Daily Herald, July 27, 1885.

[42]The Wheeling Intelligencer, February 18, 1874; Scott, Iron & Steel, p. 18.

[43]The Wheeling Intelligencer, February 2, 5 and 20, 1874.

[44]Scott, Iron & Steel, p. 16; Oliver I. Taylor, Directory of Wheeling (Wheeling: The Daily Gazette, 1851), p. 69.

[45]The Wheeling Intelligencer, February 5 and 18, 1874; The Benwood Iron Works, "Minutes of Stockholders and Directors Meetings from June 29, 1864 - January 21, 1880," pp. 132, 361, MS in records of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[46]The Benwood Iron Works, "Records," p. 13.

[47]Council, Statistical History, p. 124; French, History of the Rise and Progress of the Iron Trade, p. 173; "The Iron Trade of Europe and the United States," The Merchant's Magazine and Commercial Review, XVI (1847), 589; Michael, "Cut Nail Manufacture," pp. 102-104.

[48]Taylor, The Transportation Revolution, pp. 135-138; Frances P. Weisenburger, The Passing of the Frontier: 1825-1850 (Columbus, Ohio: Ohio State Archaeological and Historical Society, 1941), pp. 97-99, 104-105, 112-113; Berry, Western Prices, p. 257; French, History of the Rise and Progress of the Iron Trade, p. 173.

[49]Thomas S. Berry, "Wholesale Commodity Prices in the Ohio Valley, 1816-1860," The Review of Economic Statistics, XVII (1935), 32; French, History of the Rise and Progress of the Iron Trade, pp. 146-148.

[50]Council, Statistical History, p. 124; Berry, "Wholesale Commodity Prices," p. 32; The Wheeling Intelligencer, February 26, 1853, and December 29, 1853.

[51]Scott, Iron & Steel, pp. 20-23.

[52]Ibid.; The Wheeling Intelligencer, October 11, 1855; "Trustees Sale of Valuable Ironworks, Mineral Lands, and etc.," Broadside in collections of the West Virginia Historical Society, Charleston, West Virginia.

[53]Scott, Iron & Steel, pp. 20-23, 127, 170; Directory of the Iron and Steel Works of the United States (Philadelphia: The American Iron and Steel Association, 1901), p. 239; Directory of the Iron and Steel Works of the United States (Philadelphia: The American Iron and Steel Association, 1882), p. 131; The Wheeling Intelligencer, April 9, 1856.

[54]Ibid., February 25, 1874.

[55]Ibid., February 2, 1874.

[56]Scott, Iron & Steel, pp. 14, 16.

[57]Ibid., p. 24; The Wheeling Intelligencer, February 25, 1874.

[58]Ibid., February 7, 1874.

[59]This topic is discussed more fully in Chapter III.

[60]Size of the Wheeling mills in 1860 is taken from The Wheeling Intelligencer, February 5, 1874. Size of Pittsburgh mills is taken from Shael, "Cut Nail Manufacture," pp. 104-105.

Wheeling		Pittsburgh	
ood	40 machines	Juniata Works	84 machines
nt	80 machines	Graff, Bennett & Co.	30 machines
le	65 machines	Catherine Lorens	28 machines
Top Mill	40 machines	Hailman Ralinst Co.	40 machines
Eagle	48 machines	Lyng, Painter & Co.	82 machines
		Lloyd & Black	13 machines

[61]The Wheeling Intelligencer, February 11 and March 12, 1874.

[62]Ibid., April 23, 1853, and January 5, 1854.

[63]History of the Upper Ohio Valley (Madison, Wisc.: Brant and Fuller, 1890), pp. 214, 216, 229, 230.

[64]Ibid., pp. 414-415; The Wheeling Intelligencer, January 16, 1874. The Intelligencer reported, "The engine, we understand, is to be called 'Nick Reister,' in compliments, we suppose, to the efficient management of the Belmont."

[65]Benwood Iron Works, "Minute Books January 27, 1880 - August 4, 1892," pp. 186, 190; The Belmont Nail Company, "Minutes of the Stockholders and Directors Meetings July 11, 1879 - January 28, 1890," pp. 208, 214. Both manuscripts are in the records of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[66]History of the Upper Ohio Valley, p. 214; Scott, Iron & Steel, p. 13.

[67]Hunter, "Financial Problems of the Early Pittsburgh Iron Manufacturers," pp. 527-530.

[68]Data on the size of the mills was taken from a series of articles that appeared in The Wheeling Intelligencer on the following dates in 1874: January 10, February 2, February 5, February 18, February 20, February 25, and February 26.

[69]The Wheeling Intelligencer, April 23, 1853.

CHAPTER III

WHEELING: THE NAIL CITY 1860-1880

> Wheeling now justly claims to be the greatest nail manufacturing city in the United States and we propose to give enough figures to substantiate these claims . . . .
>
> The Wheeling Intelligencer
> March 7, 1874

In the history of the United States few events provided such a symbolic watershed as the Civil War. Historians in almost every field have seen the Civil War and the related events as a major dividing point in American history. What came after the great conflict was markedly different from that which had preceded it, be that something in politics, science, industrialization, or dozens of other areas of human endeavor. Some writers have been skeptical about the impact of the Civil War itself, pointing to other events as more important, while others have looked for broader causes of the changes that occurred in the second half of the nineteenth century. Particularly in the history of industrial development have recent scholars been hesitant to credit the Civil War with too much importance. A survey of the literature, however, shows that even for those writers, such as Glenn Porter and D. C North, who contend that the war had a limited influence, industrialization and the growth of big business accelerated after the war.[1]

While historians disagree on the role of the war in business development, most agree that in the decades that followed it the nature of business enterprise changed. Although some scholars have noted

intensified growth in some pre-Civil War business, particularly the railroads, "bigness," a descriptive term sufficient to communicate many of the changes that took place after the war, is most frequently used to describe business in the postwar era. More recently, writers have used the term "multi-unit" as a descriptive adjective to provide a more precise description of the postwar business community. No matter which adjective is used, the fact is that the scale of operations, number of units contained within single firms, and size of business units increased. Concurrently, the number of individual businesses decreased in many industries. Furthermore, improvements in transportation and the growth of the country provided larger and more diverse markets.

Developments in the Wheeling nail industry during the years after the Civil War illustrate rather well several of the forces that were afoot in the postwar business community. Specifically, this chapter will examine the move towards vertically integrated firms that controlled the flow of materials from mine to market, the impact that integration had upon ownership and management, the reaction of manufacturers to changing market conditions, and the change in business philosophy that emerged as the firms' operations and markets grew in size.[2]

Even a cursory comparison of the Wheeling nail firms of 1880 with those in 1865 indicated that pervasive change had taken place. While names of firms and a few individuals remained fixed, all else was transformed. Physical facilities were far larger. As a group, moreover, the Wheeling firms had risen from relative insignificance to a position of leadership in the industry. Finally, and most significantly, the owners and managers developed a new and far different

attitude towards the nature of the enterprises. This new attitude, perhaps described as a desire to control the manufacturing and marketing process, evolved directly out of the needs created by integration. Alfred Chandler, in his book The Visible Hand, recognized that the desire of professional managers to control the market was a major force shaping the development of business enterprise in the late nineteenth century. The research in this chapter confirms Chandler's major conclusion, the importance of the drive for market predictability, at least in the context of the nail industry. The transition from traditional to modern enterprise directed by professional managers was, however, more complex than is suggested by Chandler.[3]

By the eve of the Civil War the six nail factories in Wheeling already formed the city's largest manufacturing community. Even so, the size of operations were small compared to what they would be in the postwar era. In 1860 the mills had a combined total of 250 machines and employed about 500 workmen at peak periods. While precise figures on capital investment in the prewar factories are not available, none except the Crescent Works appears to have cost more than $70,000. During and immediately after the war the scale changed dramatically. At the end of 1873 the Wheeling firms employed 3,500 workmen, operated 625 nail machines, and had a capital investment in machines, factories, blast furnaces, and related equipment of more than $5,000,000. According to The Iron Age, Wheeling firms by 1875 formed the largest single group of nail manufacturers in the country and accounted for thirty-seven percent of the nation's nailmaking capacity.[4]

On February 2, 1874, The Wheeling Intelligencer published an article entitled "A New Era in the Manufacture of Iron in Wheeling." In this article and six others that followed during the course of the next few months, A. W. Campbell, editor of the Intelligencer, and another writer, probably Ben Fisher, one of the original nailers at Top Mill, evaluated the history of the nail industry and of each mill. Each article addressed and puzzled over a single question--what accounted for the success of the industry in Wheeling? "Tremendous energy," "cheap fuel," "supplies of raw materials," and the quality of the "Wheeling nail" appeared over and over as the reasons for the success of Wheeling's nail industry in each of these articles.[5]

Shortly after the Intelligencer articles ended, The Iron Age raised the same question. "It has been supposed," the editor noted, "that Pittsburgh could compete with any other point in the country . . . but it transpires that Wheeling is doing the leading nail business . . . ." The editor concluded that Wheeling's success resulted entirely from a "particular devotion to nails" and a freedom from "trade union influences."[6]

To a degree each of the conclusions arrived at by the writers of the articles that appeared in the Intelligencer and The Iron Age were correct. As noted in the preceding chapter, cheap fuel obtained from huge coal supplies in and around Wheeling, abundant raw materials from the Hanging Rock region, and a devotion to nailmaking were present, as were transportation facilities and accessible markets. Yet none of these factors could account entirely for the vigorous growth of the industry in the late 1860s and early 1870s.[7]

In fact, the initial reason for the growth came largely from the wartime economy. During the Civil War both the demand for nails and the price of nails showed a noticeable increase. Prices, for example, increased from $3.13 per keg in 1860 to $7.08 per keg in 1865, and the net profit for Wheeling firms ranged as high as $1.55 per keg. In addition to the brisk nail trade, the Wheeling mills also did a profitable business in the manufacture of armor plate. Just after the beginning of the Civil War, Edward Norton and James Acheson leased Top Mill, idle since 1858, and for two years they made naval armor plate for the Union river fleet.[8]

By the end of the war every mill in the area had recorded high profits. The LaBelle showed a profit of $164,780 in 1866, and although specific data is not available on the earnings of other mills, their dividend records show that they were "literally coining money" as a local newspaper story suggested.[9]

Although demand was good and profits were high, there was but a minor expansion of production facilities during the war. Two mills added large numbers of new machines--the Belmont, forty, and the Benwood, thirty-eight--during the war years. Two reasons account for the lack of expansion until after the war. First, the pig metal supply was erratic and, when available, very expensive. Only the firms, such as the Belmont and the Benwood, which had access to the Mendenhall furnace, and the LaBelle, which owned its own furnaces, had a regular supply of pig metal at a reasonable cost. Second, not everyone associated with the industry was interested in reinvesting the profits. Several individuals were content to take excess profits as dividends.

Other individuals, such as Edward Norton, continued the build-and-sell cycle that had existed before the war taking profits as capital gains. Norton, for example, bought into and sold out of at least two firms in the Wheeling area between 1861 and 1867, using the profits accumulated from the transactions to finance new factories in Ironton, Ohio.[10]

Two firms, the LaBelle Works and the Riverside Works, retained much of the wartime earnings as undivided profits. As late as 1874, the company records of the LaBelle showed $350,491 in undivided profits accumulated largely during the 1860-1866 period. By contrast, in the other firms--the Belmont, the Benwood, and the Wheeling Iron and Nail Company--the partners took sizeable dividends. The net result was that many of the profits that could have been reinvested were siphoned away, and, although several individuals became wealthy as a result of their association with nail works, those businesses emerged from the war with but limited resources.[11]

The actions of the partners in these latter firms were not unusual. As was observed in the preceding chapter, the industry from its very birth involved a speculative urge. That two firms did choose to establish a pattern of holding profits for reinvestment was in fact a significant departure from the past and was one that put them in an advantageous position after the wartime economy had cooled.

Towards the end of the 1860s profits declined. Earnings began to slump as the price of nails dropped by more than $2.60 a keg between 1865 and 1870. To compound the problem, pig iron prices held relatively high until after the panic of 1873. Caught between declining prices for the finished product and high cost for materials, the

Wheeling firms looked for ways to survive. Very quickly the manufacturers concluded that the market price for pig iron was excessive and that the solution to the dilemma they faced lay in circumventing the market as the determinor of price. In order to accomplish this they decided during the decade after the Civil War to construct blast furnaces and thereby internalize the production of pig metal. This decision was a critical one. Oliver Williamson has observed that a change in the assignment of a major "transaction," such as the one under consideration here, has ramifications that are far reaching and pervasive, particularly for the internal management hierarchy. To a considerable degree, this chapter will be devoted to an examination of the effects that this decision had on the management, structure, and operations of the Wheeling firms.[12]

By 1865 two firms--the LaBelle and the Belmont--had operating blast furnaces. The LaBelle had constructed two furnaces at Steubenville between 1862 and 1864. The firm that operated the Benwood also had leased the furnace that had been built by Cyrus Mendenhall at Martins Ferry, Ohio, in 1858. Mendenhall had operated his furnace independently until 1862, when the LaBelle had leased it. With the completion of its furnace at Steubenville the LaBelle lease lapsed and the Belmont first, and then the Benwood, took a lease on the Mendenhall furnace. Both the LaBelle and the Benwood had, as already noted, gained a stable supply of metal from their venture into the furnace business. The advantages were not ignored by other firms and by those individuals interested in the well being of the industry. The Wheeling Intelligencer, for example, frequently contained articles

about blast furnaces in the late 1860s and editorially commented in 1872 that "a large amount of money will be saved in freight and profit if pig metal can be manufactured in Wheeling."[13]

By 1870 most of the mills were committed to proceed with furnace construction. The Riverside was the first to begin construction, in 1871. During the next four years each of the mills built furnaces--the Wheeling Iron and Nail Works, 1872-1874, the Belmont Company, 1872-1875, the Bellaire Nail Company, 1872-1873, and the Benwood Company, a second one, in 1874. All of the new furnaces represented the state of the art for the time. Stacks ranged from 60 to 75 feet in height and bosh sizes varied from 15 to 18 feet. All were hot blast, utilizing either Player or Tate ovens, all had capacities of 50 to 70 tons per day, and all were fueled by coke.[14]

Three men designed and were associated closely with all of the Wheeling furnaces built after the Civil War. William Pollack, of Youngstown, Ohio, who designed and constructed the Riverside furnace, had a long association with Wheeling firms. During the 1870s and into the 1880s, he was employed by several firms as a troubleshooter, called upon to assist when problems arose with furnace operations. William Tate, a native of England and a resident of Pittsburgh who had gained fame as an inventor of the Tate hot blast oven, and William Bird of Pittsburgh, designed and built the other Wheeling furnaces. These included the furnaces at the Wheeling Iron and Nail Works, the furnace at the Bellaire Nail Works, the furnace at the Belmont Company, and the second furnace at the Benwood Company. The furnaces at each of these firms therefore bore striking resemblances to each other, and the

Wheeling Iron and Nail Company furnace and the Bellaire Nail Company furnace were exact duplicates of each other.[15]

Compared with other parts of the mills, the blast furnaces were expensive, costing nearly $200,000 in the 1868-1872 period. Owners of the mills where the partners had drained off much of the wartime income were forced to reorganize their operations, incorporate, and issue capital stocks and bonds to obtain the money. When this occurred, an entirely new group of men gained controlling interest in three of the nail firms. A number of the men who purchased large blocks of stock were well seasoned entrepreneurs when they moved into the board rooms of the companies. None were strangers to the nail industry, and many had been non-working partners or had invested in the industry during the 1850s. All were businessmen who had made money managing other enterprises. Crispin Oglebay, grocery merchant, and L. S. Delplain, a drygoods merchant, took control of the Benwood in 1868, replacing Edward and George Norton and C. M. Mendenhall. Chester D. Hubbard, politician and lumber merchant, Henry Hornbrook and G. K. Wheat, boatyard owners, and Alexander Laughlin, owner of a wholesale drug firm, took control of the Wheeling Iron and Nail Company, replacing the old Acheson, Bell and Company in 1869.[16]

The events that led to Hubbard, Hornbrook, Wheat and Laughlin's taking control of Top Mill illustrate the conditions that forced the old working partners from control. At the beginning of the Civil War, the firm headed by E. M. Norton and James Acheson operated Top Mill. With lucrative contracts for the manufacture of armor plate in hand, the mills should have been well situated. During the war the mill

was sold or reorganized three times and on each occasion one or more of the partners sold to remaining partners or outsiders who in turn took substantial profits from the mill to pay for the shares. After the war, the company simply did not have sufficient capital resources to purchase the needed blast furnace. A statement from the directors' meeting of May 4, 1869, shows the problem the firm faced. Moses B. Cox, a director, noted that "It was well known that all the profits in the iron business just now was [sic] in the blast furnace and it gave the mills who had furnaces such an advantage that they could go on making money while other mills . . . would be compelled to wind up before a great while." In June, 1869, therefore, the company dissolved and Hubbard, Wheat and Hornbrook purchased its assets for $200,000, formed the Wheeling Iron and Nail Company, and began raising money for a blast furnace.[17]

Several characteristics identified the new men. As noted, all had experience in businesses outside of the nail industry. Several were merchants who had experience in managing businesses in which success depended upon long term performances, buying low and selling high, and on the management of cash flow. It was just these skills that the nail industry required. The mills had to be put on a firm footing and the speculative nature of the business replaced with long term planning if the Wheeling manufacturers were to succeed. Furthermore, the industry needed an eye for financial detail. Because of the large quantities of nails produced, a fraction of a cent loss per keg or a few cents difference in the price paid for iron could mean the difference between a profit and a loss. With the technology of the industry well

established, business acumen came to play a more important role in shaping its history.[18]

A number of newcomers were also associated with banks. J. N. Vance, president of the Riverside Mill, William Bailey of the LaBelle Company, L. S. Delaplain of the Benwood, and A. W. Kelley of the Belmont, were on the board of directors of the Merchants Bank, for example. In addition, Henry Hornbrook and A. W. Campbell of the Benwood were directors of the First National Bank of Wheeling. Furthermore, several of the new men were directors of railroad companies, insurance firms, and glass companies. In short, they were in a position that permitted them to secure loans and to market stocks and bonds. This position, along with their personal wealth, helped in raising capital for the mills.[19]

By 1871 the new men were firmly in control of the industry. As a group they showed a strong interest in building their businesses. In addition to the blast furnaces, they added to the boiling departments, rolling mills, nail factories, and even such new units as keg and gas works. Between 1865 and 1874 the Benwood, for example, added eight boiling furnaces and thirty-six nail machines. During this period the total number of machines in the Wheeling area increased from about 240 to 625.[20]

As the new men came to control the firms, bringing with them new skills and new attitudes, the holdovers from the old working partners group were pushed aside. Edward Norton and his brothers liquidated their interest in the Belmont in 1868 after a disagreement (the nature of which is unknown) and moved to Ironton, Ohio to devote full time to two nail

works in that area. By the early 1870s The Wheeling Intelligencer actually criticized some of the departed heroes. Of Stevens, a writer for the Intelligencer said, "He listened to the wonderful tales of oily tongued Eastern speculators . . . and in a short time was relieved of a clean $100,000." As for Agnew, the writer commented that "A multitude of ill-advised enterprises engaged his attention and absorbed his capital." And John Gill's interest in "various schemes had wasted a major part of a handsome fortune," according to the Intelligencer.[21]

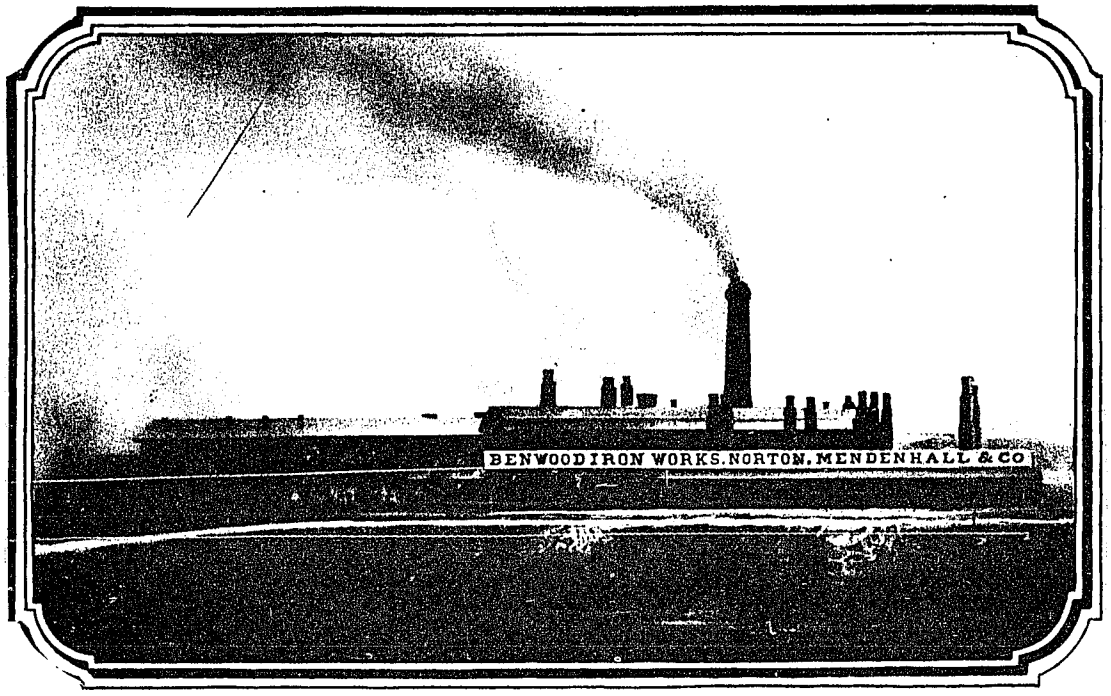


Fig. 15. Photograph of the Benwood Iron Works, ca. 1868. In this photograph the puddling mill is to the right in the area beneath the smoke stacks. The nail mill is to the left. (Scott, p. 35)

For the new owners acquiring the blast furnaces was the first order of business. The problems attendant on the construction of the blast furnaces were sizeable, particularly for men who had no experience as ironmasters. First, they had to familiarize themselves with the state of technology. The construction process usually began with the directors or a committee of the directors visiting furnaces, observing operations, and discussing their plans with the builders of furnaces that they had visited. The first stop was always Pittsburgh, followed by visits to the Mahoning Valley and Cleveland. The visits were followed by the selection of a builder and then negotiations for a price. William Tate, who constructed three of the furnaces, designed and supervised the construction in return for 25 cents per ton on each ton of metal produced during the first year of operation. Pollack, who designed the Riverside furnace, was paid a fixed sum. Even though individuals were hired to design and supervise the construction of the furnaces, procuring supplies for construction materials and finding subcontractors remained the job of the directors.[22]

From reports published in the Intelligencer it was apparent that the firms gave careful thought to a full range of considerations and carefully studied not only the furnace design but also that of auxiliary equipment. "Messrs. Dewey, Vance and Company of the Riverside Works," the Intelligencer reported, have, after careful examination and investigation of the cost of facilities for getting materials used in the manufacture of pig iron, compared with other localities, determined upon building a blast furnace." Three years after the Riverside furnace was complete, a reporter from the Intelligencer examined the operation

of several mills and noted that the design of auxiliary equipment at the furnace was one of the key elements in the financial success of the Riverside's operation. A system of overhead railroads and conveyors that allowed the moving of iron ore directly from freight cars to the furnace mouth, the reporter claimed, saved the company $8.00 per day in labor costs. It was in the context of decisions such as this that evidence of a new philosophy of operations, one that emphasized efficiency and long term growth, began to emerge.[23]

In addition to the problems associated with the decision to build blast furnaces, the boards were faced with the task of controlling, directing, and evaluating major construction projects while at the same time attending to the operations of manufacturing units. Oliver Williamson, in his book on markets and hierarchies, has observed that modern vertical integration inevitably entailed a change in organizational frameworks and generally led to a more complex hierarchy in which authority became centralized. Such was the case in the Wheeling nail firms. Before the blast furnace building era managing partner made most of the decisions about operations. During the furnace construction era, the old management structure that was composed of working partners of more or less equal standing who managed various units of the plants was abandoned. The boards of directors began to exert control over operations through alternative mechanisms. First, the boards began to organize into committees, which were charged with responsibility for studying specific issues and making operating decisions related to those issues. Second, the boards began to leave the supervision of daily operations of the plants and daily supervision of

production to the president and secretary, who exercised authority through a series of subordinate employees and collected information needed by the committees for decision making.[24]

In short, the management of the firms was becoming more structured, in large part due to the needs that rose directly out of blast furnace construction. Additional needs, resulting from operational problems, discussed later in this chapter, built upon the system of committees, and by the 1880s the managerial structure was beginning to take on the distinctly modern look frequently associated with the rise of professional managers.

The blast furnace construction era introduced the Wheeling nail manufacturers to other segments of the iron industry. The inspection trips that Wheeling directors made to Pittsburgh and Youngstown first brought these men into contact with their counterparts in these two cities. A subtle change in viewpoint began, and the nail men of Wheeling began increasingly to think of themselves as iron manufacturers who specialized in nailmaking. The change was first noticeable when firms adopted new names. The Belmont Nail Works, for example, became the Belmont Iron and Nail Works. A. W. Campbell, who was not only a major stockholder in the Benwood Company but also editor of the Intelligencer noted the change in the early 1870s when he commented that the manufacture of pig iron was "a legitimate outgrowth of our great nail business." By the end of the decade, Campbell commented, "Wheeling is widely known as an iron manufacturing point," and he described the Riverside Works as a manufacturer of "pig iron, bar iron, and all kinds of nails."[25]

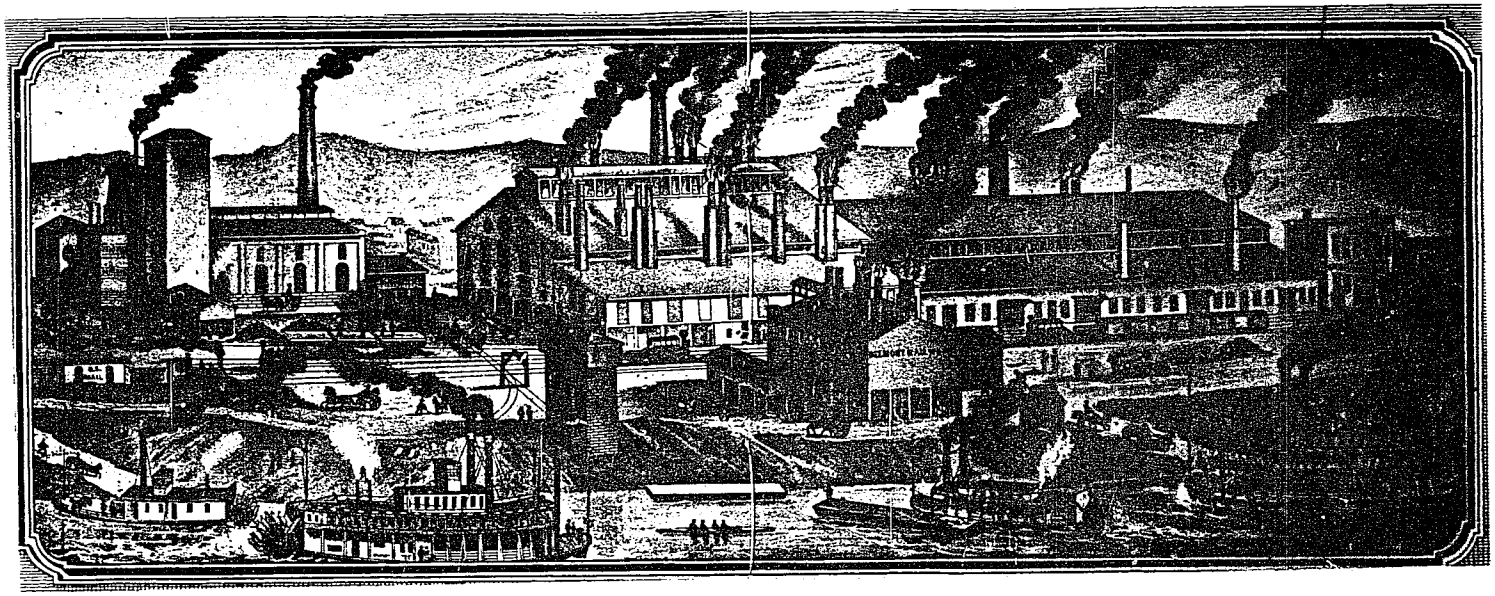


Fig. 16. The Belmont Nail Works 1877. This view of the Belmont Nail Works shows the various "departments" and their spacial relationship to each other. The buildings to the far left were the blast furnace and casting shed. The large building in the center of the drawing housed the puddling department and the large building to the right was the nail factory. Raw materials that arrived by rail and riverboat were off loaded near the blast furnace. Nails were loaded aboard trains or riverboats at the opposite end of the factory complex. During the 1870s, the Belmont Mill was thought by many to be the most primitive of the Wheeling mills. Comparison of this view with the drawing of Wheeling Iron and Nail's Top Mill on the following page shows several differences, the most notable being the loading systems. (Scott, pp. 10-11)

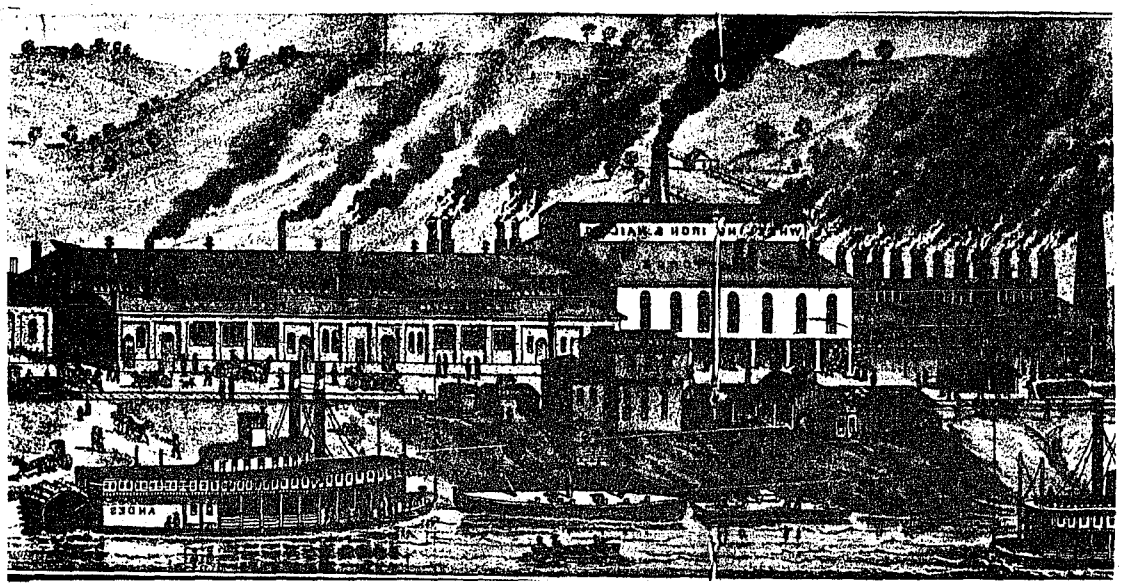


Fig. 17. Top Mill, ca. 1877. (Scott, p. 43)

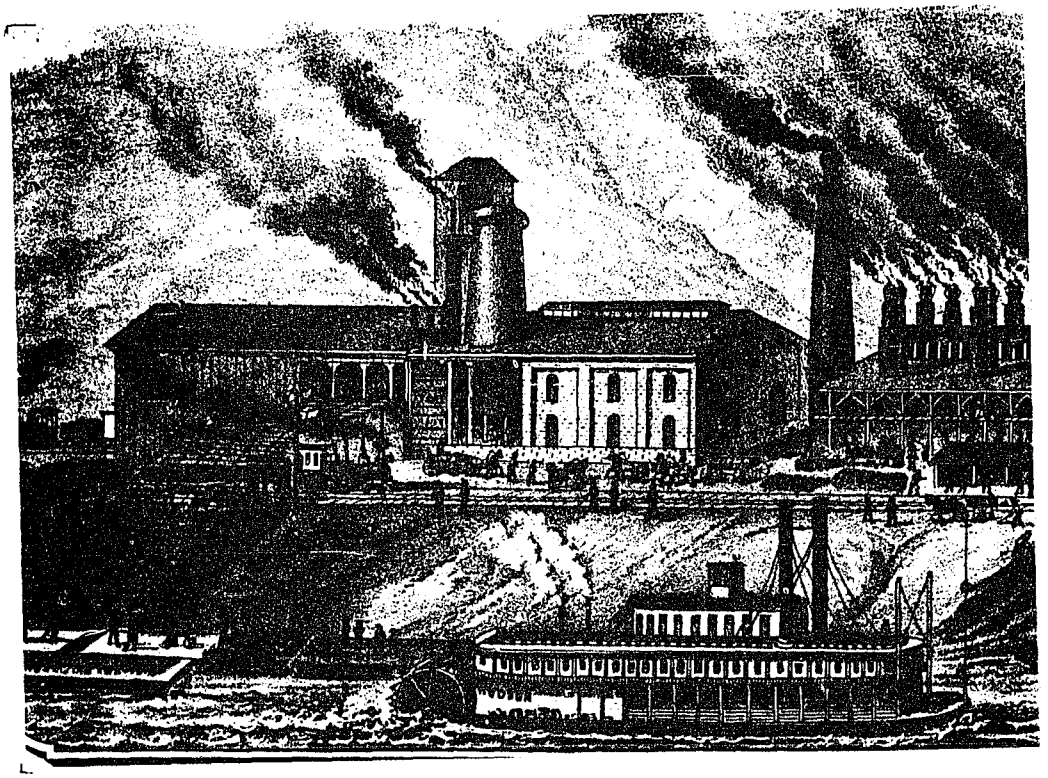
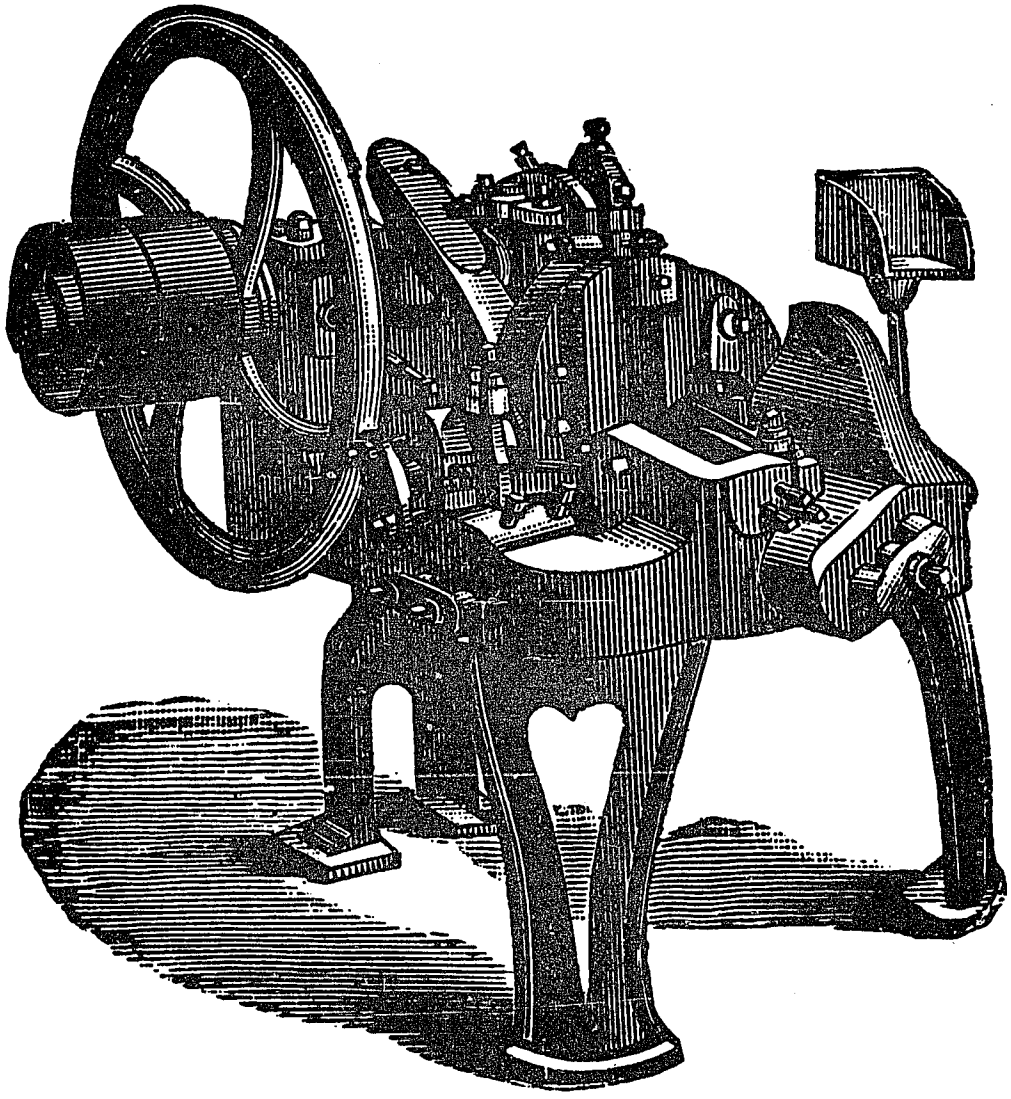


Fig. 18. Top Mill Furnace, ca. 1877. The elevated loading system shown here was copied from the Riverside Mill. (Scott, p. 42)



PITTSBURGH MFG. CO.,

Manufacturers of Nail and Spike Machines, Bolts Nuts, Washers Rivets, &c. Castings, Forgings and Blacksmith Work promptly attended to.

Office and Works: Railroad St., near 28th, Pittsburgh, Pa

Fig. 19. A typical nail cutting machine of the type used at Wheeling, ca. 1875. (Collections of the Wheeling-Pittsburgh Steel Corporation)

This change in self-image, almost unnoticed at the time, proved to be important to the development of the industry. When, in the mid-1880s the wire nails supplanted the cut nails, the firms easily shifted to other products such as tin plate that utilized existing facilities.

In the process of building blast furnaces the nail industry had a major impact on the business community of Wheeling. Except for the Riverside Mill, which relied heavily upon suppliers from the Youngstown area, a considerable amount of the equipment and most of the construction materials continued to come from the Wheeling area. Moorehead and Sons of Wheeling manufactured boilers; Cecil and Company Foundry of Wheeling, Spence Foundry, and the Center Foundry cast pipe, furnace plate, and other parts. In addition, the Spence Foundry of Martins Ferry manufactured engines for both the furnaces and the nail mills. Each of these companies had been associated with the riverboat construction industry prior to the blast furnace boom. Each became progressively more involved in the nail and iron industry during the 1870s and 1880s. These firms and several others in the area provided equipment for the industry during the rest of the century.[26]

In addition to the firms directly associated with the production of machinery and furnace parts, the furnace building era also provided a tremendous stimulus to the construction trades. Dozens of contractors provided lumber, bricks, and other construction materials needed for furnaces and auxiliary buildings and an undetermined, but certainly large, number of men was employed in building the structures. Between 1871 and 1875 the blast furnace construction projects pumped something over $2,000,000 into the Wheeling economy. That activity alone softened

the effects of the panic of 1873. "The financial panic, which threatened to swamp the entire country like a tidal wave," the editor of The Wheeling Intelligencer observed, "did not reach us even with the foam of its dashing." Prosperity resulting from the furnace and nail factory construction, along with the prestige that came from having the state capital moved to Wheeling in 1875, thrust the city and surrounding area into a very favorable position in the hard times that came in the middle part of the decade.[27]

By 1875 all of the furnaces were complete and in operation, and the effect on the community was noticeable. A visitor wrote, "There is a particular sordidness about these ironmaking towns . . . the air is constantly filled with 'blackies' . . . [that] descend upon one in greasy, filthy masses as if the contents of some plutonic featherbed had been shaken loose overhead . . . . The all-pervasive spirit of soot, must," the visitor speculated, "smirch even the immortal souls of the citizens." If anyone voiced concern about the pollution, it escaped notice of those in a position to record the complaint. Instead of complaining, many of the residents looked with amazement at what they saw and upon the prosperity that the transformation was bringing. "Every day," a writer for the Intelligencer reported, "hundreds of people to whom the manufacture of pig iron has heretofore been an unsolved mystery, gather at the works to witness the casting. They look with awe upon the fiery stream . . . this is to most of them something not only new but beyond comprehension," the reporter observed.[28]

As the preceding comments have suggested, the blast furnaces consumed much of the attention of the boards of directors and attracted

considerable interest from contemporary observers. To suggest that installation of the furnaces was the only innovation, however, would be to misinterpret completely the events of this era. Other, less dramatic changes (expansion of mills, substituting boiling for puddling, new keg factories, etc.) were taking place, and they were important because of the effects that they had. By the middle of the 1870s the Wheeling nail manufacturers had built manufacturing complexes that were well in advance of the rest of the industry. In 1876 the Wheeling mills averaged 96 machines per plant while the national average was 55.7. Furthermore, the Wheeling mills, as contemporary observers noted, were more efficient. Between 1870 and 1873, Wheeling manufacturers averaged 1,598 kegs of nails per machine each year. During the same time, Pennsylvania manufacturers averaged 1,329 kegs per machine and Massachusetts manufacturers only averaged 663 kegs per machine.[29]

Size and efficiency, therefore, allowed the Wheeling mills to undersell the market. In 1875, for example, the national average price for 10d common nails was $3.42 per keg. The Wheeling price for the same product was $2.85 per keg. Even at this price the companies were showing a considerable profit. The LaBelle, for example, showed a profit of 34.8 cents per keg.[30]

Glenn Porter has observed in his book, The Rise of Big Business 1860-1910, that the accumulation of different types of units in the single enterprises, such as occurred when Wheeling nail firms integrated, necessitated a change in the way businesses were run. While it is impossible to conclude that all the changes in Wheeling nail firms were caused

by the integration, many did appear concurrently.[31] Moreover, there was a constant meshing between the technology of the industry and the management technique structures that were applied to it.

As noted above, the capital requirements of the blast furnace construction brought new men, who were experienced entrepreneurs, to several firms. This change in turn prompted a restructuring of the basic organization. Between 1867 and 1876 all of the firms finished incorporating, replacing the old working partners with stockholders. While this change did not have an immediate effect upon daily operation, incorporation did alter the basic business environment in two ways. Incorporation alleviated the worst effects of the speculation that had gripped the industry earlier. Owners continued to sell their shares from time to time, but the corporations were spared the need for complete reorganization that the old working partnerships had gone through when a major shareholder had sold his interest.[32]

Additionally, the change to the corporate structure served to divide ownership from operations. Generations of scholars have recognized that this sundering was one of the major changes brought by the corporate form of organization. While this did eventually occur in Wheeling in the 1870s, ownership of corporate stock was concentrated in a few hands and the major owners sat on boards of directors and actually exercised a considerable degree of control over the operation and management of the factories.

The changes that did occur came gradually. The first occurred because the new owners did not have a working knowledge of the processes and equipment and had to rely upon others to provide data and explain

its significance. During the 1870s it was not uncommon to see entries in company minutes either noting that a workman had attended the board meeting to explain a particular technical detail or that the board had ordered the secretary to have some workmen attend the next meeting to explain a point that could not be comprehended without more information.[33]

Second, the new men who came to the board rooms did not know their employees and understand their capabilities or their interests in the same way the old working partners did. During the 1850s when the partners worked side by side with employees, the owners knew who was producing, who was the most skilled, and who was wasting materials. More importantly, the old working partners shared with their workmen basic attitudes towards labor, the nature of the industry, and the product. This relationship between management and workmen was best described by Stevens at his farewell party in 1856. Speaking to an assembly of nailers, puddlers, and other craftsmen, Stevens commented:

> I fully appreciate the feeling . . . coming as it does from those . . . who are best qualified to express an opinion of the management. Look around you and you see who are the owners and managers of the most successful establishments of this city. The answer will be the working men--mechanics. With true heart-felt pride I say it, being myself a mechanic.[34]

As management became more distant, a divergence of interests became increasingly apparent. The nailers' attention to quality conflicted with the directors' press for quantity, for example. And, inevitably, the board began to look upon employees as expendable elements. This latter point will be examined in more detail in the next chapter.

The management system that evolved in the 1870s in the Wheeling firms rose in response to problems that the integrated firm presented.

As the blast furnaces came on line, the manufacturers immediately had difficulty effectively controlling the new units. The problem was that the internalization of pig iron supply removed one of the major market controls of nail manufacturing. Manufacturers could no longer rely upon the market price of pig to set a significant portion of the cost of nail manufacturing. While circumventing the market price was a major objective of the firms in building blast furnaces, internal operations was not a total advantage, particularly for inexperienced operators. If operational costs of the furnaces were not competitive with those of independent furnaces from which competitors in Pittsburgh and other cities purchased metal, prices would be adversely affected. In order to avoid such a condition, the Wheeling firms had to devise some method of closely figuring production costs. In effect, they had to find a mechanism to replace the market as the determiner of cost for the basic material that went into nailmaking.[35]

For the Wheeling firms, the mechanism was cost accounting. While historians have taken note of the development of sophisticated accounting systems in the pre-Civil War railroads, there has been an assumption that industrial cost accounting, except for isolated instances, did not develop until very late in the nineteenth century. Michael Chatfield, who has studied and written extensively on the subject, concluded in his book, A History of Accounting Thought, that "until the twentieth century accounting data was not widely used as a direct aid to industrial decision making." Marc Jay Epstein, author of The Effect of Scientific Management on the Development of Standard Cost Systems, arrived at a similar conclusion. "The status of cost accounting in

1875," he wrote, " was that of an unsophisticated art." A. C. Littleton whose pioneering work, Accounting Evolution to 1900, dated the introduction of cost accounting in the last decade of the nineteenth century.[36]

In the examination of the history of cost accounting, many researchers, particularly those whose interests lie in accounting or the history of accounting, have relied heavily upon published accounting literature. Although literature published in Europe and the United States during the early and mid-nineteenth century contains elements of industrial cost accounting, it was not until 1875 when two Englishmen, Emil Garcke and J. M. Fells, published their book Factory Accounts, a work that suggested the integration of cost and financial accounts in a double entry system, that the first modern book appeared on the subject. Four years later G. P. Norton, another Englishman, published an article entitled "A Manufacturer's Trading Account," in the Accountant that addressed the subject of profitability in multi-unit enterprises. These two works, along with The Cost of Manufacturers and the Administration of Workshops Public and Private (1885) by Henry M. Metcalf, an American, are generally thought to have marked the beginning of cost accounting.[37]

A few studies have gone beyond the accounting literature and focused directly on the records and management decisions of individual firms. H. Thomas Johnson in his studies of the DuPont powder mills, and the Lyman Mills Corporation of Boston, Massachusetts, has addressed the subject. The latter study which focused on the period between 1850 and 1865 indicates that the firm was using a cost accounting system

by the mid-1850s and led the author to conclude that cost accounting systems "may have been used widely, long before historians had supposed." The development of cost accounting in the Wheeling firms tends to support this supposition.[38]

Although this study makes no effort to address the broad question of when cost accounting was generally introduced, it should be observed that the research on the subject suggests two points that may be salient in considering the question. First, cost accounting techniques were frequently regarded as industrial secrets and therefore not widely published. Second, cost accounting does not appear to have originated with accountants. Epstein notes, for example, that a significant portion of the nineteenth century material on cost accounting appeared to have come from engineers such as H. M. Lane ("A Method of Shop Accounting to Determine Shop Costs and Minimum Selling Price" and "A Method of Determining Selling Price") published in the Transactions of the American Society of Mechanical Engineers. At Wheeling engineers had no part in devising the system, for cost accounting appeared well before the professional engineers arrived. While the precise origin of cost accounting in Wheeling remains a mystery, it is clear from company records that one firm, namely the LaBelle, the first of the firms to operate blast furnaces, began the use of cost accounting sometime prior to 1866, and the practice spread to others very quickly.[39]

The LaBelle was also the first to institute a system of measuring and recording various classes of expenses. As early as 1867 the minute book of the directors' meetings contained reports that break production costs of each keg of nails down into several categories--

"pig metal" (showing separate costs in produced and purchased metal), "wages," "expenses" (overhead), "kegs," "coal," "iron ore," "taxes," "brick," "clay," and several other categories. During the early 1870s other firms followed the LaBelle's lead and instituted a similar system of recording costs. In 1872, for example, the directors of the Benwood Iron Works ordered the furnace clerk to provide a monthly statement of the "workings of the blast furnace," showing production, amount of stock used, and the purchase price of such stock.[40]

TABLE 1

THE EXPENSE OF MAKING A KEG OF NAILS FOR THE YEAR 1870
TAKEN FROM THE MINUTE BOOK OF THE
LABELLE NAIL WORKS

Expense	.266
Pig Metal	1.830
Oil and Tallow	.026
Iron Ore	.132
Steel and Iron	.024
Coal	.155
Wages	1.338
Brick and Clay	.042
Kegs	.200
Taxes	.053
Total Cost	4.066
Average Selling Price	4.251
Profit	.185

By the end of the decade every firm for which records have survived was keeping close cost records, some even more detailed than the LaBelle. In 1879, for example, directors of the Benwood Mill, recently reorganized after bankruptcy, began keeping separate books for the furnace and the nail mill. Pig metal, labor, kegs, and other costs were recorded for the nail factory and puddling operations. The books, however, had still other entries that showed the cost per ton for coke, ore, limestone, cinders, wages, expenses, and interest for the manufacture of pig iron.[41]

At base this system allowed the boards to exert control from a distance. They could measure the effectiveness of their operations without ever seeing a furnace, a nail machine, or a keg of nails. When broken into component parts, the accounting system had several characteristics that aided in management. First, the data was comparative and historical. The cost of a keg of nails in July of 1875 could be compared with the cost six months or two years earlier and the directors could immediately see how well present performance compared to past performance. Furthermore, the data provided opportunity for comparison with other firms. Although there is no evidence in minute books that such comparisons were made for the record, bookkeepers changed employers enough to assure that information was dispersed. Also, interlocking ownership patterns (the Laughlin family, for example, owned stock in three firms) probably also facilitated the exchange of production and cost information.[42]

The accounting system also had diagnostic capabilities. Production cost could be broken down into enough categories so that

the board could easily spot areas where costs were rising or falling. In some areas, such as ore costs, market factors were the prime reasons for the change and consequently lay beyond the control of board action. Other entries, however, served to identify internal problems. For example, an increase in the cost of labor per ton at the blast furnace could suggest poor management. In 1872, the Benwood directors spotted just such an increase, and after an investigation the founder resigned. A constant cost for pig metal accompanied by increasing per keg costs could suggest problems in the puddling, rolling, or nail mills. Scott recounted an instance in which directors noted such a disparity and sent orders to the mill managers to reduce the amount of waste metal being produced in each of these areas.[43]

The diagnostic capabilities of the accounting system were expanded at a very early date. Beginning in 1870 the LaBelle minute book carried an entry showing the number of kegs of nails obtained for each ton of metal produced. These figures show a steadily increasing yield from 1,870 pounds of nails per ton of metal in 1870 to 1,955 pounds of nails per ton in 1877. Later, the LaBelle maintained similar types of records for the amount of coal, iron ore, and coke used.[44]

Finally, cost accounting served as a planning tool. One of the difficult problems for managers of multi-unit enterprises was the matching of output capabilities of one unit with the input capabilities of the other. Since the structure of the Wheeling firms was basically linear--that is metal moved from blast furnace to puddling mill to rolling mill to nail mill--altering the capabilities of one had repercussions in all of the other units. As furnace technology

improved, and output increased, accompanying changes had to be made in nail factories. The pattern of increasing furnace production, largely achieved through "hard driving," followed by increased mill capability, is present throughout the decade. Between 1872 and 1879, for example, the Riverside furnace production rose from an average of 337 tons per month to more than 500 tons per month or by about forty percent. A corresponding increase then occurred in the size of the nail mills.[45]

In a rather general way, the cost accounting system established something tantamount to an operations philosophy. Basically, the directors came to the conclusion that lowering production costs was the key to success. At one level this philosophy translated into an emphasis on efficiency. Initially, efficiency was thought of simply as making the maximum use of materials. Very quickly, however, efficiency also became associated with plant organization. The previously cited example of the materials handling system at the Riverside furnace was one of the earliest examples of the emphasis upon organizational efficiency. Another example was the new Benwood Mill erected in 1877 to replace the old one that had been destroyed by fire. A visitor to the plant described the new factory as follows:

> The new Benwood has been built upon the latest and most improved plans for saving any waste expense, [sic] it has so arranged the building and heating furnaces with respect to the rolls, and the nail factory to the piling and shipping of nails, and the whole mill with respect to the receipt of ore and pig metal by river and rail, and the receipt and distribution of coal on an elevated railway, as to reduce distance, labor and expense to the lowest minimum, considerations which every man knows, are of the highest importance in these times.[46]

At another level, efficiency came to be related to the volume of production. Costs were measured in terms of the keg as output unit and included both operating and fixed expenses. Therefore, the fewer kegs sold the higher the fixed expenses and consequently the cost per keg. Thus, the manufacturers constantly pushed for more production in order to keep the fixed costs low. This strategy had a marked impact on marketing, which will be examined later, and on labor relations. In the latter area, the Wheeling firms did everything possible to avoid strikes. From the 1860s on, they based their wage scales on the ones prevalent for similar work in Pittsburgh, plus a small addition that came to be known as the "Wheeling Bonus." When industry-wide labor problems arose, the Wheeling mills promised to settle for what the Pittsburgh workers received plus the bonus, and except for a brief work stoppage in 1875, the Wheeling plants avoided any major labor disturbance during the 1870s. One mill, the Bellaire, even went so far as to make a separate pact with its employees that contained provisions for continued work even if the other Wheeling mills were on strike.[47]

Overemphasis of the impact of cost accounting would be difficult. It touched every area of the mill and was a significant factor in every decision. Without a thorough sampling of company records from other parts of the country, it would be inappropriate to generalize too much at this point. An examination of records of the Burden Nail Company of Troy, New York, a leading firm well respected in the industry, does suggest, however, that the cost accounting system devised in Wheeling was not a standard in the industry during the 1870s.[48]

Joseph Litterer pointed out in an article on scientific management during the late nineteenth century the importance of cost accounting as a tool for informing "higher management" of business activities throughout the organization. Wheeling exemplifies this use of cost accounting. There it served as an important bridge between directors, men largely unschooled in the technological aspect of nailmaking, and the men who actually ran the mills. This was a major interface between business and technology. It is also obvious that cost accounting was a tool devised by management and forced upon the mills. Scott relates that a mill manager who was taken to task for producing too much scrap "put his hands in his pockets, shrugged his shoulders, and replied, 'Well, you [the directors] get the scrap, don't you? The men don't carry it home with them!'" Obviously, the poor man did not get the point.[49]

Both the furnace construction and the accounting system had an influence on the way the board and management of the mill were structured. At the board level all of the mills were similar. The stockholders elected a board of directors each year. The number of people on the board varied from seven to fifteen, and occasionally the boards were expanded when new stock was issued. Typically, the boards had a president, a secretary, and a vice president, who acted as the executive officers and as chief operating officers of the company. The boards met frequently, sometimes as often as once a week, to take whatever actions were needed or to discuss the general nature of the business. The records of these weekly meetings, as well as the annual and semi-annual reports of the stockholders, contain the bulk of the

information now available on the mills.[50]

Generally the boards operated in one of two ways. At the LaBelle and the Bellaire firms, individual members of the board were supervisory employees. Both of these operations retained many operative craftsmen on their boards and frequently acted on advice or information from single individuals. At the other end of the scale, the Wheeling Iron and Nail Works and the Benwood Mill evolved a committee system. Initially the committees were structured to study or oversee certain aspects of furnace construction and operation, but by 1873 both firms had appointed an "operating committee." In addition, the Benwood had three standing committees--control, finance, and salaries--and several temporary committees to look into specific problems, such as furnace renovation. The type of organization seemed directly related to the degree of technical expertise of the board. The more technically competent the individual members, the less likely was the committee structure to evolve.[51]

All of the boards operated basically in the same way. The president of the board, as chief executive and operating officer, oversaw the day-to-day operations. He was the highest paid employee with an annual salary as much as $3,500 per year. Generally, strong presidents managed the mills during the 1870s. Samuel Laughlin at the Benwood, Dana Hubbard at the Wheeling Iron and Nail, and J. R. McCourtney at the Bellaire Mill all stand out as examples. All were men with extensive business experience, and at least two of the presidents--C. D. Hubbard and J. R. McCourtney--were prominent political figures in the area. These men rose to their respective positions largely

through their ability to raise money, and each was wealthy in his own right. And it was such figures who also had access to banks and insurance companies through seats on boards of directors of those institutions.[52]

Next to the presidents, the secretaries were the most influential. Like the president, they were paid employees. The role of the secretary became much more important as the mills moved beyond the capital expansion phase of the early 1870s. In fact, one of the most noticeable trends in board organization was the gradual but persistent increase in the power and responsibility of the secretary. This increase in power appears to have resulted from the secretary's role in collecting information and reporting data to the board and as a result of his position as the only individual in the firm who had frequent contact with all of the operating units within the organization. This role could be seen most clearly at the Benwood Mill. In 1872 the board of directors began ordering the secretary, Alexander Loring, to "cause" reports on various subjects to be made and financial records to be kept. In 1873, the secretary was "authorized" to order materials and equipment. By the end of the decade the secretary was taking charge of labor negotiations and representing the company at the Western Nail Association meetings. The predominance of the secretary was completed by 1880. On January 29 of that year the Benwood directors passed a resolution stating that "The president-elect shall be released from discharging the active duties incumbent upon him . . . in consideration whereof, he hereby agrees to release all claims for a salary . . . but shall preside at meetings of the board of directions and shall, as

president thereof, discharge those duties that are usually performed by a director." With this motion, the secretary formally became the chief operating officer and general manager and the active participation of the president in the day-to-day affairs of the mills came to an end.[53]

Second level management of the mills was in the hands of a group of men generally referred to as superintendents or managers. The system was similar at each mill. The management group consisted of a bookkeeper, a nail factory manager, a forge manager, a furnace manager, and a keg manager in the case of mills that had keg factories. In addition, clerks were employed at the mill and the furnace. Although seldom mentioned in the minutes, the companies also employed a coal bank boss. These unit managers employed skilled laborers--nailers, founders, puddlers, etc.--and a labor boss to supervise a wide variety of unskilled laborers. Some skilled workmen such as nailers had the responsibility of employing their own laborers and were free to contract with them at whatever wage they saw fit. By the mid-1870s wages had become standardized and both mill managers and the boards were beginning to influence pay scales for the inside contractors.[54]

The clerks and bookkeepers were in critical positions during the 1870s. As the boards of directors grappled with the problems of managing the rapidly-expanding mills they relied more and more upon statistical data from which to fashion decisions. The clerks in effect became the eyes and the ears, collecting information that was fed to the secretary and thence to the board of directors. As a result they were in a position to rise quickly to managerial levels.

In fact, the bookkeepers and clerks of the 1870s became the managers of the 1880s and the 1890s and formed the basis of a professional management group similar to the one that Chandler discusses in The Visible Hand. Cecil A. Robinson, for instance, who served as both secretary and president of the LaBelle Company, began his career as a bookkeeper for the Etna Company in 1875. Likewise, H. M. Priest, another president of the LaBelle, had served as an assistant bookkeeper in the LaBelle factory. And yet a third person, Clarence E. Irwin, who became secretary of the LaBelle in 1887, had begun his career as a mill clerk.[55]

During the fifteen years after the Civil War the nail market changed substantially. Prices fell rapidly during the immediate postwar period and continued to slide throughout the 1870s. In 1866, for example, nails sold at $6.97 per keg; by 1871 the price had declined to $4.52 per keg; and by 1879 the price was $2.69 per keg. The receding prices initially resulted from a cooling of wartime demand but later, after the panic of 1873, a slackening of construction, particularly in the railroad industry, drove prices further from the high levels of the 1860-1866 period.[56]

As prices fell, so too did production. Between 1870-1873, national production declined by almost 13 percent. While demand shrank nationally, the Western market held firm and actually expanded through 1875. This condition was reflected in the number of plants operating in various areas of the country. In 1860, for example, Massachusetts had forty nail factories. By 1876 the number had dwindled to eleven. During the same period the number of nail factories in New York declined from fifteen to three. Even the Pennsylvania manufacturers were

suffering. The number of firms remained fairly constant, but the output per firm declined during the early 1870s.[57]

Contemporary observations confirmed the statistics of the trade. The editor of The Iron Age suggested that while most nail manufacturers were having difficulties, the Wheeling firms were remarkably successful. In 1875 the editor commented, "Wheeling . . . is doing the larger share of the work, but she cannot hold this supremacy long, as there are other manufacturers and a great additional amount of manufacturing power, which will not lie idle long, and which will not consent that Wheeling should take the largest proportion of nails."[58]

As production had risen in Wheeling, the nail companies there had expanded their distribution system. By the mid-1870s, a host of agents and traveling salesmen were marketing Wheeling nails throughout the South and West. Benwood Company records reveal the most detail about the distribution system. The company developed two marketing structures. Between 1869 and 1872, it appointed agents in several cities--New Orleans, Chicago, Memphis, Nashville, Cincinnati, Pittsburgh, Nebraska City, Marshall (Wyoming), and Norfolk. The agents in larger cities maintained sizeable warehouses, while those in smaller areas ordered as demand required. The size of the agency's business can be gauged approximately from shipments. The St. Louis gent, Moore & Company, sold as many as 50,000 kegs of nails per year in the mid-1870s.[59]

In addition to the fixed agents, the companies also employed traveling salesmen. The number varied from time to time and from firm to firm and very little is known about their activities. In the late 1870s, men like J. A. Metcalf, traveling agent for the Belmont Company,

concentrated on the Far West looking for boom towns such as Denver.[60]

The marketing effort was not only a sizeable one, stretching over the better portion of a continent, but it was also a cooperative venture in which several firms worked closely with each other. During the 1860s, the firms established a reputation for high quality nails and had cooperated in several areas, including marketing, wages, and prices. By the early 1870s, market coordination was beginning to take an organized form. On February 20, 1872, for example, the president of the Benwood Nail Works reported that he had met with other nail manufacturers in the city and had agreed not to sell nails at a price lower than that which was received in the final week of February, 1872. Furthermore, the Wheeling firms had begun to appoint agents jointly in the early 1870s. Moorehead & Company in St. Louis, for example, served as an agent for both the Benwood and for the Wheeling Iron and Nail Company. Finally, the firms occasionally loaned nails to each other to meet short term needs.[61]

While there is no evidence to suggest that the Wheeling firms had established a formal organization for the coordination of marketing activities, they had by the early 1870s begun to work very closely in marketing matters. This close cooperation did not escape the attention of observers. By 1874, the editor of The Iron Age had begun to consider the Wheeling companies as a single marketing entity that had to be dealt with as a unit rather than on a firm by firm basis.[62]

In 1865, major nail manufacturers had organized the National Association, led by Pittsburgh and the Massachusetts manufacturers. While records of the Association are not extant, accounts of its

activity suggest its major purpose was to regulate prices. For reasons that are unclear, the Wheeling firms never took part in the association, even though in 1872 and 1873 the annual meetings were convened in Pittsburgh and every other major producer from both the East and West was represented. In fact, it was not until 1874 that the industry even took notice of the developments at Wheeling, and by that time Wheeling manufacturers were the largest producers in the country.[63]

The National Association disbanded in late 1874 or early 1875, a particularly bad time for most segments of the nail industry. During this time, as noted already, the production of Wheeling firms held steady and actually increased slightly. In April of 1875, for example, the New York Times reported that "For the past four months, they [Wheeling mills] have been running night and day. They have placed hundreds of thousands of kegs of nails all over the country at $3.00 per keg cash and in some instances less"--at a time when other manufacturers were attempting to market nails at $3.40 per keg.[64]

Not only were the Wheeling manufacturers undercutting the market on a day-to-day basis, but they had begun, by 1875, to take future orders at set prices, provide substantial discounts to large customers, and actually attempt to "cut Pittsburgh out of the market." With this in mind, the editor of The Iron Age surveyed the nail industry in April of 1875 and raised several questions.

> . . . Suppose all of the nail manufacturers in the country kept the people at work at the same price that Wheeling manufacturers are getting? How long would it take to more than surplus the market? If Wheeling is making so many nails--the Top Mill alone producing 1,000 kegs per day by running 106 cutters--is it not a question whether there are too many nail manufacturers in the country?[65]

Clearly some action had to be taken to thwart Wheeling manufacturers if the national industry was to escape losing out to them altogether. Just as clearly, however, the other manufacturers did not understand the forces at work in Wheeling. Instead of organizing production to meet the lower cost that Wheeling was establishing, the Western manufacturers outside of Wheeling organized to keep prices aritificially high, first by fixing prices at a predetermined level and then by curtailing production.[66]

In early 1876, led by Pittsburgh manufacturers, the Western nailers organized the Western Nail Association. The first hint that Wheeling nail men were considering joining the other Western manufacturers came on March 27, 1876, when the directors of the Wheeling Iron and Nail Company approved a resolution authorizing the president and secretary to "enter into a formal agreement with the nail manufacturers west of the Allegheny Mountains for the purpose of regulating the production of nails, [and] fixing the price and terms of sales under penalties . . . as may be deemed best in their judgment." A month later, on April 24, 1876, J. P. Gilchrist, the company's secretary, reported that "the organization of the Western Nail Association has been completed," and the Wheeling Iron and Nail Company had paid an assessment of $2,650 to the forfeiture fund. Gilchrist further informed the board of directors that "there was a prospect that the Eastern manufacturers would form an association similar to that of the Western manufacturers." No direct mention of the Association was made in the surviving minutes of the other factories except for the account book of the LaBelle Company in August, 1876, which contained

an entry under assets of the firm in the amount of $10,922, labeled "Western Nail Association." This entry was probably the company's contribution to the forfeiture fund.[67]

By the beginning of 1877, all of the Wheeling and Pittsburgh firms had joined the Association, and by the end of 1878 every major producer west of the Allegheny Mountains was a member. In January, 1879, the Association had twenty-nine members divided into four groups--Pittsburgh and the Mahoning Valley (12), Wheeling and the immediate vicinity (8), Indiana and Illinois (4), and Southeastern Ohio and Northern Kentucky (5). The Wheeling contingent represented the largest number of machines (783) followed by Pittsburgh and the Mahoning Valley (706) with 484 spread over the remainder of the territory. From the outset, the Wheeling manufacturers had the numbers to exert great influence over the Western Nail Association and could, by calling on the mills in Southern Ohio, which were closely aligned with Wheeling, control an absolute majority of the members.[68]

Since records of the Western Nail Association are not extant, much of the information about its activities must be gleaned from the minutes of the board meetings of its members, newspaper accounts, and information in The Iron Age. The latter is a particularly good source since the editor, J. D. Weeks, was also, until 1885, secretary of the Western Nail Association.[69]

As the resolution passed by the Wheeling Iron and Nail Company suggested, the objective of the association was to control the prices and production of its members. Other matters, such as wages and iron prices, remained the prerogative of the Western Iron Association,

an organization formed in 1871 that had members from all branches of the iron trade.[70]

When the representatives of the Western Nail Association met in March of 1876, they set about adopting policies to implement their previously stated objectives. The organization adopted a new price list--or card, as it was called. The price of 10d nails was set at $2.85 per keg, with other sizes, as was the custom, pegged to this price. Furthermore, the Western Nail Association established common terms for payment. Orders of 200 kegs or more could be discounted up to 10 percent and manufacturers were bound to require payment in sixty days with the provision that no more than 2 percent could be discounted for cash.[71]

Conditions of the agreement regulating the terms of sale specifically addressed the problem of jobbers and large customers. In addition to shopping for the best prices, the jobbers and large customers also bargained for liberal payment terms. Even among the Wheeling manufacturers, terms of sale varied dramatically. Given the business climate of the times, mills could, and in fact did, suffer heavy losses from dealers who purchased large quantities of nails on extended terms and failed before final payment. The Benwood, for example, had taken a considerable loss under these circumstances when Charles Mendenhall, a jobber in Cincinnati, failed in 1873.[72]

A forfeiture provision was also adopted to put force behind the Western Nail Association's policies. Any manufacturer violating the policies was subject to a fine of $100 per machine, and each manufacturer was required to place with the Western Nail Association a cash

deposit equal to $100 for each machine in its mill. Compliance with this provision was irregular. While the LaBelle complied, the Wheeling Iron and Nail Company never deposited more than a fourth of the amount that was required under this provision.[73]

This agreement had very little chance of succeeding as long as the demand for nails remained tight. Wheeling firms were notorious for, and, it might be added, quite successful in violating the price guidelines. In 1877, for example, the Wheeling Iron and Nail Company produced nails at an average cost of $2.59 and sold them for an average price of $2.73, twelve cents under the established price guidelines. The LaBelle records show production costs of $2.67 per keg and a similar undercutting of the Association's price. Enforcement was so difficult, however, that only one of the Wheeling firms, the LaBelle, appears to actually have paid any fine to the Western Nail Association during the 1870s.[74]

In an attempt to prevent undercutting of the price guidelines, the Association attempted to control production by forcing plant shutdowns for periods sufficiently long to bring supply into balance with demand. While this tactic was grudgingly supported by the Wheeling firms during the 1870s and early 1880s, it did cause problems. First, it was not easy for the integrated firm to close. Blast furnaces, for example, were far more difficult to discontinue and restart than a simple nail factory. Consequently, the Wheeling manufacturers, while closing nail works, continued producing metal throughout most of the shutdowns and used this stockpile to intensify production after operations commenced. Second, the cost accounting system had identified

rather effectively fixed costs of operations and had distributed those costs over the units produced. Pricing, therefore, was in part, at least, related to volume, and since down time affected volume, the Wheeling firms were opposed to extended shutdowns. In effect, the accounting system by the middle and late 1870s had come to be a significant factor in marketing as well as production decisions. Wheeling firms came to accept and live by the proposition that lower unit costs were a function of volume and that a favorable market position depended not on the selling price alone but rather the difference between selling price and production cost multiplied by volume. Given this view, improvements in profits could occur by manipulation of either of the three variables and did not depend alone on price.

What showed up in the relationship between the Wheeling firms and the Western Nail Association was a basic difference in management attitudes towards the market and towards the relationship between the market and production. Wheeling manufacturers, seeing cost, selling price, and volume as variables, began to press the Association to go beyond price matters and to take an active role in controlling other costs, such as labor prices.[75]

With Wheeling undercutting established prices and circumventing at least the spirit of shutdowns, the Western Nail Association attempted to place stricter controls on marketing. In 1878 the Western Nail Association proposed a pool for marketing all the nails produced by Association members. A board of six persons, two from Wheeling, two from Pittsburgh, and one each from the other two areas of the Association, would oversee the marketing of all nails so as to "remove all

possibility of underselling the prices established." This board was to appoint agents who would act for the Association rather than individual firms and was to supply them with nails from the member firms in proportion to the productive capacity of the mills. Furthermore, the board of control was to have the power to "fix the number of kegs and nails to be made by each mill in each month."[76]

Although the plan was published in The Iron Age, the pooling agreement was never put into effect. The boards of directors of two Wheeling firms discussed the pooling arrangement and both approved it with reservations. The Benwood directors wanted to insure that large purchasers would get a discount. There is, however, no indication in the surviving records of the other companies that the boards even discussed the plan.[77]

Furthermore, evidence suggests that by late 1878 the Wheeling manufacturers were becoming sufficiently uncomfortable with the Western Nail Association to break away from it. The point of contention was the Western Nail Association's refusal to deal with cost controls. In 1878 the price of nails had fallen to an all time low of $1.85 (10d) per keg. Even the Wheeling nail manufacturers were beginning to run very close margins. During the first six months of 1878 the Wheeling Iron and Nail Company showed manufacturing costs and selling price at $2.48 per keg and profit at zero. While the Western Nail Association continued to support price fixing and production reduction and blame uncooperative members for the problem, the Wheeling firms looked elsewhere and came to the conclusion that Eastern manufacturers were the villians. A statement contained in the minute book of the Benwood Iron Works speaks

to the opinion held by the Wheeling manufacturers. "We are being driven out of the markets in which we have heretofore sold our product . . . . We find upon comparison of wages we are compelled to pay 33 1/3 percent to 50 percent more for various classes of skilled workmen than is paid at competitors in the East," the statement read.[78]

Beginning in 1878 the Wheeling manufacturers pressed doubly hard for the Western Nail Association to take an active role in wage negotiation. In an uncharacteristic move, the Wheeling firms closed down to support Pittsburgh manufacturers in a dispute with puddlers in the summer of 1878. When the Pittsburgh manufacturers acceded to the demands of the workmen, the Wheeling nail men were outraged. The president of the Wheeling Iron and Nail Company reported to his fellow board members: "The failure of the manufacturers of Pittsburgh to hold out in their opposition to the demands of the boilers has undercut all actions on the part of the Wheeling mills."[79]

In early 1879 when prices began what was to be a four year rise, the Wheeling firms took a firm stand. In July, they resisted an increase approved by the Western Nail Association and for several months sold nails at twenty-five cents below the card rate. More importantly, the Wheeling manufacturers began considering the possibility of gaining control of the Western Nail Association and looking for methods to establish an even firmer grip on the industry. As in the early 1870s the manufacturers turned to the use that could be made of technology to provide the advantage. In order to control labor costs, they increased mechanization, and in order to lower the cost of materials, they began to use steel. The full impact of this decision will be discussed in the next chapter.[80]

During the fifteen years after the Civil War, Wheeling manufacturers were confronted with two problems. First, the firms, if they were to prosper, had to meet the challenge of simultaneously falling nail prices and high pig metal costs. Concluding that pig metal could be made in Wheeling as cheaply as elsewhere, and looking to the example afforded by the LaBelle Mill, the firms undertook the task of constructing blast furnaces. In arriving at this decision, the Wheeling manufacturers internalized a stage of the manufacturing process that theretofore had been separate and governed by the market. From the point of view of the manufacturers, the decision was an appropriate one since it allowed the management hierarchy to exert a considerable degree of control over the manufacturing process. Not only did the firms reap significant savings from the internal procurement of pig metal that improved their competitive position but they also realized benefits from a long range philosophy of operations that the new managers evolved. Unlike competitors who were at the mercy of fluctuating metal prices, the Wheeling firms by the late 1870s could more closely control costs and therefore nail prices, a situation that translated directly into a competitive advantage in the nail market.[81]

The decision to internalize the blast furnace operations was not without consequences, however. The second major problem faced by the firms in the 1870s--exerting internal control over the manufacturing process--was a direct outgrowth of the decision to integrate blast furnace operations with those of nail and rolling mills. During the 1870s the problem of internal control resolved itself into distinct but related needs. One of these needs was the coordination of the flow

of material through various processes in such a way as to insure that waste and inefficiency did not negate the gains realized from internalization of the blast furnaces. By the early 1870s there was evidence of a production control system that measured kegs of nails per ton of metal. Likewise, accounts of mill superintendents' berating workmen for producing excess waste suggests that management understood and attended to the problems of coordination. As the manufacturing enterprises grew in size and as the relatively inexperienced directors who took control of the mills in the immediate postwar period came to power, there existed a danger of what Joseph Litterer called "organizational uncoupling." Records of the firms show that the directors expended considerable energies attempting to understand and provide coordination for the multi-departmental organizations and thereby prevent uncoupling.[82]

In order to provide coordination and thwart the tendency towards disintegration, the board had to provide mechanisms that (1) facilitated the collection and transmission of information for use in decision making, and (2) allowed decisions to be transmitted to appropriate operational personnel. To ascertain the appropriate information, each of the firms devised a cost accounting system that relied upon a series of secretaries and bookkeepers to collect information and report it to the board of directors. The information was digested by board level committees that relayed decisions and directions to lower level personnel through the president and a series of mill superintendents.

By the mid 1870s all of these coordinating mechanisms were firmly enough fixed and sufficiently sophisticated to provide a powerful management tool. Secure in the belief that they could produce nails as

cheaply as any competitor and with an understanding of the relationship between unit price, overhead, and volume production, the firms, unlike their competitors, formulated an aggressive production policy that sought maximum unit output instead of high unit profit margins.

Moreover, by the late 1870s the coordinating mechanisms were being used as diagnostic and planning tools. The Wheeling firms not only spotted very quickly the discrepancy in labor costs in the East and West but also had the capability of identifying points where the substitution of mechanical processes for manual labor could correct the imbalance. As a result, Wheeling firms began searching for and evaluating substitutes for puddling and wrought iron in the late 1870s. During the first half of the 1880s, as will now become clear, this search was a major preoccupation of the nail manufacturers.

FOOTNOTES

CHAPTER III

[1]Glenn Porter, The Rise of Big Business 1860-1910 (Arlington Heights, Ill.: AHM Publishing Corp., 1973), pp. 27-31; Douglass C. North, Growth and Welfare in the American Past (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1966), p. 149.

[2]Vertical integration is the adding of production units that manufacture or process materials that are used by existing units. At Wheeling the nail factories built blast furnaces that produced pig iron, keg factories that made packaging for finished nails, and a variety of other operations that contributed materials or services.

[3]Alfred D. Chandler, Jr., The Visible Hand: The Managerial Revolution in American Business (Cambridge, Mass.: The Belknap Press, 1977), pp. 6-12.

[4]Figures on employment during the 1850s were taken from the Directory of the City of Wheeling and Ohio County (Wheeling, Va.: The Daily Gazette, 1851), p. 11. Additional figures on employment in the 1860s and early 1870s are contained in a series of articles in The Wheeling Intelligencer between February 2 and March 4, 1874. Also see The Wheeling Intelligencer, December 30, 1879 and April 30, 1875.

[5]The Wheeling Intelligencer, January 10, 1874; The Wheeling Iron and Nail Co., "Minutes of the Stockholders' and Directors' Meetings from July 15, 1869 to July 22, 1892," p. 30, MS in possession of the Wheeling Pittsburgh Steel Corporation, Wheeling, West Virginia.

[6]The Iron Age, April 15, 1875, p. 11.

[7]See Chapter II, pp.

[8]Committee on Historical Statistics of the Social Research Council, The Statistical History of the United States from Colonial Times to the Present (Stamford, Conn.: Fairfield Publishers, Inc., 1965), p. 123; Woodward, Bailey & Co., "Minutes of the Meetings of the Board of Directors and Stockholders of the LaBelle Iron Works from January 28, 1868-September 20, 1873," p. 1. It should be noted that the title of this volume is misleading. Entries begin on January 1, 1867 for the preceding year and continue through 1895. MS in possession of the Wheeling-Pittsburgh Steel Coporation, Wheeling, West Virginia; Henry D. Scott, Iron and Steel in Wheeling (Toledo, Ohio: The Caslon Co., 1929), p. 37.

[9]LaBelle, "Records," p. 1.

[10]Wheeling Iron and Nail, "Records," p. 30; The Wheeling Intelligencer, February 23, 1872, January 10, 1874, February 5, 1874, and March 17, 1874.

[11]LaBelle, "Records," p. 40; The Wheeling Intelligencer, February 5, 1874 and February 7, 1874.

[12]For example, see Wheeling Iron and Nail, "Records," p. 30; The Wheeling Intelligencer, February 23, 1872; Oliver E. Williamson, Markets and Hierarchies Analysis and Antitrust Implications (London: Collier MacMillan Publishers, 1975), pp. 9-11, 83-85.

[13]The Wheeling Intelligencer, January 10, 1874, February 23, 1872, and February 18, 1874.

[14]Ibid., January 10, 1874, February 23, 1872, and December 30, 1879; The American Iron and Steel Association, Directory of the Iron and Steel Association, 1882), pp. 52-53, 65-66.

[15]The Wheeling Intelligencer, January 10, 1874; Wheeling Iron and Nail, "Records," p. 33.

[16]History of the Upper Ohio Valley (2 vols., Madison, Wisc.: Bront and Fuller Co., 1890), I, pp. 330-332, 325, 471. This volume has no listed authors. It is primarily a collection of biographies of residents of the upper Ohio Valley. Also see Scott, Iron & Steel, pp. 40-52.

[17]Ibid., p. 47.

[18]While there is no solid evidence to show that the merchant background of the new owners was crucial, the knowledge of marketing, bookkeeping, and unit profit seems likely to have been transferred to manufacturing.

[19]The Wheeling Intelligencer, January 6, 1872, January 8, 1872, and January 31, 1872.

[20]The Benwood Iron Works, "Minutes of Stockholders' and Directors' Meetings from June 29, 1864 to January 21, 1880," pp. 61, 146, 180, MS in possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia; Wheeling Iron and Nail, "Records," p. 30; The Wheeling Intelligencer, February 5, 1874, and March 7, 1874.

[21]Ibid., January 31, 1874, and February 5, 1874.

[22]Benwood Iron Works, "Records," pp. 101, 102, 103; Wheeling Iron and Nail, "Records," p. 33.

[23]The Wheeling Intelligencer, February 23, 1872, and January 10, 1874.

[24]Williamson, Markets and Hierarchies, pp. 96-100.

[25]The Wheeling Intelligencer, January 10, 1874, and December 30, 1879.

[26]Benwood Iron Works, "Records," pp. 104, 166, 189; The Wheeling Intelligencer, January 10, 1874.

[27]Ibid., March 7, 1874, April 20, 1875, and May 25, 1875.

[28]Ibid., August 16, 1875, and September 10, 1875.

[29]The Iron Age, April 6, 1876, p. 15; The Wheeling Intelligencer, March 7, 1874; Bureau of Statistics of United States Treasury Department, Statistical Abstract of the United States, 1878 (Washington, D.C.: Government Printing Office, 1879), pp. 40-41; Francis A. Walker, The Statistics of the Wealth and Industry of the United States from the Original Returns of the Ninth Census (Washington, D.C.: Government Printing Office, 1872), pp. 446, 617.

[30]Committee, Historical Statistics, p. 123; LaBelle, "Records," p. 42.

[31]Porter, Rise of Big Business, p. 17.

[32]Benwood Iron Works, "Records," p. 50. This citation is to the records of the meeting at which Edward Norton withdrew from the Benwood. He had, prior to this meeting, been president of the firm. Others including Alexander Laughlin sold large blocks of stock, but in both cases the firm continued operating unaffected, a striking contrast to the prewar period.

[33]Benwood Iron Works, "Records," pp. 143, 176, 218.

[34]The Wheeling Intelligencer, April 9, 1856.

[35]Chandler, The Visible Hand, p. 11. The Wheeling firms fit the theory Chandler proposed almost perfectly. The first attempt to control or replace the market as the controlling factor was in determining the price of pig iron.

[36]Michael Chatfield, A History of Accounting Thought (Hinsdale, Ill.: The Dryden Press, 1974), p. 105; Marc Jay Epstein, The Effect of Scientific Management on the Development of the Standard Cost System (New York: Arno Press), p. 45; A. C. Littleton, Accounting Evolution to 1900 (New York: American Institute Publishing Company, 1933), p. 358; David Solomons, Studies in Cost Analysis (Homewood, Ill.: Richard D. Irwin, Inc., 1968), p. 17.

[37]Epstein, Effect of Scientific Management, pp. 15, 49, 50; H. Thomas Johnson, "Early Cost Accounting for Internal Management Control: Lyman Mills in the 1850s," Business History Review, Winter, 1972, p. 467; S. Paul Garner and Marilynn Hughes (eds.), Readings on Accounting Development (New York: Arno Press, 1978), pp. 523, 524.

[38]Johnson, "Early Cost Accounting," pp. 466-474; Garner & Hughes, Readings, pp. 209-217; H. Thomas Johnson, "Management in An Early Integrated Industrial: E. I. duPont de Nemours Power Company, 1903-1912," Business History Review, Summer, 1975, pp. 187-196.

[39]Epstein, Effect of Scientific Management, pp. 51-57. Perhaps it should be noted also that Taylor published in the ASME Transactions. Other works that generally relate to cost accounting include Richard P. Brief, "The Origin and Evolution of Nineteenth-Century Asset Accounting," Business History Review, Spring, 1966, pp. 1-24; David F. Hawkins, "The Development of Modern Financial Reporting Practices Among American Manufacturing Corporations," Business History Review, Spring/Summer, 1963, pp. 135-168; Michael Chatfield (ed.), Contemporary Studies in the Evolution of Accounting Thought (Belmont, Calif.: Dickenson Publishing Company, Inc., 1968), pp. 222-236; S. Paul Garner, Evolution of Cost Accounting to 1925 (The University of Alabama Press, 1976), pp. 27-91.

[40]LaBelle, "Records," pp. 1, 10, 22; Benwood Iron Works, "Records," p. 106; Wheeling Iron and Nail, "Records," p. 39.

[41]The Belmont Nail Company, "Minutes of the Stockholders' and Directors' Meetings of the Belmont Nail Company, July 11, 1879-January 28, 1890," p. 40, MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[42]At least twenty individuals held stock in more than one firm.

[43]Benwood Iron Works, "Records," pp. 106, 128, 129; Scott, Iron & Steel, p. 67.

[44]LaBelle, "Records," pp. 10, 36, 38, 50.

[45]The Wheeling Intelligencer, February 23, 1872, and December 3, 1879; Iron and Steel Association, Directory, 1882, pp. 52-53.

[46]Scott, Iron & Steel, p. 76.

[47]The Wheeling Intelligencer, April 26, 1875; Scott, Iron & Steel, p. 95.

[48]The Burden Iron Company, "The Burden Iron Company Papers 1860-1900," n.p., MS in the possession of the New York Historical Society.

[49]Benwood Iron Works, "Records," p. 162; Joseph A. Litterer, "Systematic Management: Design for Organizational Recoupling in American Manufacturing Firms," Business History Review, Spring/Summer, 1963, p. 380; Scott, Iron & Steel, p. 76.

[50]Benwood Iron Works, "Records," pp. 8, 18; Wheeling Iron and Nail, "Records," pp. 2, 8; Scott, Iron & Steel, pp. 47, 59, 82.

[51]Benwood Iron Works, "Records," pp. 117, 120; The Steubenville Daily Herald, July 27, 1885.

[52]Wheeling Iron and Nail, "Records," pp. 22, 56; Benwood Iron Works, "Records," pp. 56, 57, 97; Scott, Iron & Steel, p. 49.

[53]Benwood Iron Works, "Records," pp. 106, 169; The Benwood Iron Works, "Minute Book, January 27, 1880-August 4, 1892," p. 4, MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[54]Benwood Iron Works, "Records," p. 112; Wheeling Iron and Nail, "Records," p. 16; The Belmont Nail Company, "Records," p. 9; The Wheeling Intelligencer, April 26, 1875.

[55]History of the Upper Ohio Valley, I, pp. 309, 310, 417, 418, 490; Chandler, The Visible Hand, pp. 8-10, 421-423.

[56]Committee, Historical Statistics, pp. 124-125; The Iron Age, February 12, 1874, pp. 19-20.

[57]The Iron Age, February 12, 1874, p. 19; April 6, 1876, p. 15; Bureau of the Census, Manufacturers of the United States in 1860 Compiled from the Original Returns of the Eighth Census (Washington, D.C.: Government Printing Office, 1865), pp. CXCIV-CXCV.

[58]The Iron Age, April 15, 1875, p. 11

[59]Benwood Iron Works, "Records," pp. 77, 122, 140, 173.

[60]Wheeling Iron and Nail, "Records," p. 85; Benwood Iron Works, "Records," pp. 143, 148.

[61]Ibid., pp. 77, 164; Wheeling Iron and Nail, "Records," p. 52.

[62]The Iron Age, April 15, 1875, p. 11; June 29, 1876, p. 11.

[63]Ibid., January 16, 1873, p. 17; February 12, 1874, pp. 19-20; The Wheeling Intelligencer, March 7, 1874.

[64]Quoted in The Wheeling Intelligencer, April 28, 1875.

[65]The Iron Age, April 15, 1875, p. 11.

[66]Ibid., April 13, 1876, p. 16.

[67]Wheeling Iron and Nail, "Records," pp. 56-57; LaBelle, "Records," p. 46.

[68]The Iron Age, April 6, 1876, p. 15. For a general discussion of the conditions in the hardware trade see William H. Becker, "American Wholesale Hardware Trade Associations, 1870-1900," Business History Review, Summer, 1971, pp. 179-199.

[69]A thorough search was made for records of the Western Nail Association. Their loss is regrettable because they would be very valuable, particularly insofar as they may deal with the "forfeiture fund."

[70]Wheeling Iron and Nail, "Records," p. 49. The exact nature of the relationship between the Western Nail Association and the Western Iron Association is unclear. The two organizations were separate although Wheeling firms participated in both. At times the company records are unclear in reference to the two groups. From the mid 1870s, the Wheeling manufacturers pressed the Western Nail Association to take over the wage establishing functions and in the 1880s succeeded in their quest.

[71]The Iron Age, April 6, 1876, p. 15; December 28, 1878, p. 20; April 13, 1876, p. 15.

[72]Benwood Iron Works, "Records," pp. 152, 201.

[73]The Iron Age, April 13, 1876, p. 15; LaBelle, "Records," p. 46; Wheeling Iron and Nail, "Records," p. 57.

[74]LaBelle,"Records," pp. 46, 50; Wheeling Iron and Nail, "Records," p. 75.

[75]Benwood Iron Works, "Records," pp. 365, 379; Benwood Iron Works, "Minute Book," p. 11.

[76]The Iron Age, December 28, 1878, p. 20.

[77]Benwood Iron Works, "Records," p. 348; Wheeling Iron and Nail, "Records," p. 103.

[78]Ibid., pp. 87-99; Benwood Iron Works, "Records," p. 365.

[79]Ibid., pp. 108-109.

[80]The Wheeling Intelligencer, April 16, 1879, and December 29, 1879.

[81]Williamson, Markets and Hierarchies, pp. 25, 29, 35-39.

[82]Litterer, "Systematic Management," p. 380.

CHAPTER IV

THE STEEL NAIL: 1880-1886

> So far as Wheeling is concerned, it would have been better if the Englishman [Bessemer] had died before he discovered this process.
>
> The Wheeling Intelligencer
> October 23, 1884

Hindsight often suggests an inevitability that was not noticeable or even conceivable to participants. So it was with the Wheeling nailmakers. To later observers, events would seem to be leading to the climax that pitted the cut nail industry against the wire nail. Yet, clearly the participants--owners, workmen and interested citizenry--did not perceive that the events in which they were participating constituted a decisive change. By the time they came to the realization that the cut nail was being driven from the market place, the only course of action open to them was to place the blame and direct their energies elsewhere.

Labor organizations, new technologies, overproduction, rising and declining prices and profits, and new competition mingled together to create a complex crisis. Finally a traumatic clash between workers and management destroyed the cut nail industry. Basically, these events of the 1880s grew out of the overexpansion of the industry. After the panic of 1873 subsided in 1878, the flush times increased the profits of the nailmakers to the highest levels since the 1860s. Existing

factories expanded, and new ones entered the industry at an alarming rate between 1880 and 1884. When the market cooled, competition became fiercer, and the industry eventually saw profits threatened. Pooling arrangements were redrawn and manufacturers at Wheeling resumed the search for new ways to reduce costs and expand markets.

During the 1870s and early 1880s the nail manufacturing enterprises in Wheeling organized into several departments. The processing of materials began with the blast furnace. The iron master or furnace manager, as he was referred to in several firms, was the person in charge of the operations of the blast furnace. He was responsible for the total operation of the furnace and the casting house, that area of the furnace where the pigs were formed. Besides an assistant manager, a clerk and an assortment of skilled workers who serviced and operated the machinery, the furnace departments employed mostly unskilled workmen who loaded raw material into the furnace, worked in the casting house, and performed other labor as required. The firm records contained little information about the numbers, rates of pay, or method of calculating pay for furnace personnel aside from the furnace manager and clerk.[1]

The intermediate stage in the nail manufacturing process was found in the puddling (after 1870 the boiling) and rolling mills. Pig iron was transported from the blast furnace to the boiling departments where it was remelted in the presence of mill cinder and converted into wrought iron. Each nail manufacturer had a number of boiling furnaces and each furnace was operated by a "boiler" who, with the aid of several helpers, loaded, charged, and "worked" the boiling furnace until

the metal had attained the proper degree of refinement. At the appropriate time, the hot metal, which had a pasty consistency, was removed from the furnace and transported to the squeezer, a machine that forced excess slag from the metal and shaped the bloom, a long cylindrical piece of iron.[2]

From the boiling department the metal moved to the rolling mill where the blooms were reheated and passed between a succession of rollers to attain the desired thickness and width. Here several classes of workers labored. A "roller" supervised and directed the operation of each "train" (set) of rolls aided by "shove-unders" who fed the metal into the rollers, "drag-outs" who retrieved the plate when it emerged, and "cutters" who cut the plates of metal into proper width and length. Additionally, other workmen pickled the metal and ran it through a lime slurry that added a lubricant to the plate that facilitated cutting when automatic feeders were used.[3]

Once cut into proper lengths and widths, the plates were delivered to the nail mill where "helpers" distributed them to the feeders who forced the plates into the nail cutters. When machines were manually fed, each machine had a feeder assigned to it and a nailer who supervised a minimum of four machines. The nailer had responsibility for adjusting the machine, sharpening the blades, and overseeing the quality of the nails produced.[4]

In addition to the major departments noted above, each mill had a shipping and warehouse department that loaded the nails into kegs, transported the kegs to the shipping point, and maintained inventories. Although no two mills were precisely the same, several had separate

stables, repair shops, keg production shops, water works, and gas and coal houses that employed skilled and unskilled workmen.[5]

Each of the separate units had a superintendent or manager, although in some of the mills during some periods, service areas, such as the stables, were attached to one of the larger subdivisions of the plant. The mill superintendents were salaried employees whose rate of compensation the board of directors established. During the 1870s and until 1885, the superintendents were without exception nailers, boilers, or rollers who had risen to the managerial levels from the ranks. The skilled workers--boilers, rollers, nailers, etc.--also worked directly for the mill. Wages were pegged either to the market value of nails (nailers) or to an agreed upon rate per pound (boilers and rollers). The feeders, and certain classes of workmen in the boiling and rolling mills who worked directly for the boilers and rollers were inside contractors who were paid directly by the nailer, boiler or roller. Without exception the rates for these inside contractors were tied either to the prevailing price of nails or the negotiated piece work rate for boiling and rolling. Nailers and other skilled workmen seemed to have been paid by the hour or on a flat salary amount determined by the board of directors.[6]

This division of labor was rooted in tradition and existed relatively unchanged after the 1840s. Until the end of the 1870s both management and labor had an apparent respect for the privilege and economic position of the three basic crafts--nailers, boilers, and rollers. During the 1880s this condition changed as management sought to reshape the nail manufacturing process with the stated purpose of

eliminating one group of workmen--the boilers. Management's motives, and means of accomplishing this objective, provide an insight into their use of accounting data for decision making. Of particular interest here is the managers' perception of technology, in this instance the Bessemer converter, as a mechanism for cost reduction.

The year 1879 marked a turning point of sorts for the Wheeling nail industry. In an article appearing in The Wheeling Intelligencer, the editor claimed that the "nail interests are in serious circumstances just now. Nails are not only being made without profit," the editor continued, "but at a loss." Records of the mills show that the observations made by the editor were generally true. The Wheeling Iron and Nail Company reported a loss of $14,083 for the last six months of 1878, and the Belmont Company failed altogether. Only the LaBelle and the Riverside Mills managed to operate in the black, and those by the thinnest of margins.[7]

The hard times prompted the Wheeling nail manufacturers to question some assumptions about their ability to compete with Eastern manufacturers. They also intensified their efforts at controlling costs. In May, 1879, the Western Nail Association issued a request for a reduction in wages. "We ask," the printed request read, "the skilled operatives of our factories to consent to a reduction in wages to the prices paid in the Eastern mills . . . ." Concurrently, the manufacturers began to look for alternate sources of materials from which to manufacture nails, seeking, through substitution, to reduce the cost of puddling wrought iron. The LaBelle Company, along with the Bellefont Iron Works of Illinois, experimented with rerolling used

rails into nail plates. And all of the Wheeling manufacturers began to look seriously at using steel instead of wrought iron as the basic material for nails. By 1879 the managers had identified high wages as the key problem. Rerolling rails and using steel offered ways to dispense with the boilers, some of the highest paid employees in the plants.[8]

During late 1879, demand for nails increased, and manufacturers, at least temporarily, abandoned plans for steel plants and rail reprocessing mills. The same editor who earlier predicted doom now reported that "the consumption of nails, owing to the impetus given by the building of western cities, towns, mining camps and agricultural sections, has proven enormous, and prices, which were very low in the early part of the year, subsequently advanced very materially." With the new conditions, the plans for wage reduction were not only abandoned but skills were maintained and every scrap of metal to be found was turned into nails. Factories added machines and even ran competitions to determine which plant could produce the most nails in specified periods of time.[9]

Two basic conditions combined to inject new vitality into the nail industry. As the editorialist observed, construction picked up. Local sources laid the resurrection of the industry to Western construction. "New cities like Leadville, unknown a few years ago," a writer in The Wheeling Intelligencer reported, "have laid heavy requirements upon our jobbers, and these sales added to the sales to old customers, make the total an exceedingly liberal one." Statistics not available at the time show that the revival of construction was indeed

the cause, or at least one of the causes, for the revival of the nail industry. Indexes compiled by Riggleman and Newcomb show that the dollar value of construction almost doubled between 1878 and 1881. This increase, coupled with an upsurge in railroad construction, increased the demand for nails and other building materials dramatically.[10]

At the same time that new construction picked up, raw material prices began a downward slide. Ore costs, for example, dropped from $13.03 per ton in 1880 to $8.00 per ton in 1884. Coke prices showed an even more dramatic decline, dropping from $10.77 per ton in 1880 to $6.75 per ton in 1881 and as low as $4.57 per ton in 1884. As a result of these cost reductions in the manufacture of pig iron, the cost of making nails fell sharply. The Belmont Company records show that in the last six months of 1879 the metal cost in a keg of 10d nails was $1.28 per keg. For the corresponding period in 1883, metal costs were 92¢ for the same keg, a 28 percent decline.[11]

The growing market and the declining cost of metal set off a boom, the likes of which had not been seen since the late 1860s. During the first six months of 1880, the Belmont Company averaged $1.10 profit per keg of nails; in 1882, 63¢ profit per keg; and in 1883, 47¢ profit per keg. In 1880 and 1881, the six mills in the Wheeling district paid dividends totaling $712,000, leading a writer in the Bellaire Independent to proclaim that the industry had regained its full strength.[12]

The immense profitability of nails drew considerable attention from other metal producers to the industry, particularly with the

decline in the price of pig iron. By 1882, therefore, these conditions began to attract new competitors. The boom had continued long enough to convince the skeptics of the existence of a firm market, and enough capital had accumulated within the industry to finance new enterprises. J. D. Weeks, secretary of the Western Nail Association, saw the inevitability of new competition in October of 1883 and concluded that, "The satisfying condition of the nail trade cannot be permanently maintained." His prediction was of course correct. Between 1883 and 1885, the number of nail machines in operation in the United States increased from 3,995 to 5,695, or almost 43 percent. This dramatic increase in production capacity then had disastrous consequences. After 1883 production began greatly to outstrip demand, and vicious competition among the manufacturers forced prices down.[13]

Additional production capacity developed in three ways. The largest increase came from existing plants. Seven of the nine Wheeling factories added new machines, increasing Wheeling capacity by almost 20 percent. Other factories in the Western Nail Association territory followed suit, adding new machines and related equipment. Furthermore, the Western Nail Association stopped enforcing production quotas that had been in effect in the 1870s and thus threw the door open for uncontrolled expansion, particularly in the years between 1882 and 1884.[14]

Competition also arose from new factories along the fringes of the Western Nail Association territory. During the 1880-1885 period new factories in Omaha, Nebraska; Pueblo, Colorado; Oakland, California; Woodward, Alabama; and Chicago, Illinois, went into production. "The

recent mania for building new works," Weeks observed in 1884, was "placing great pressure on the nail market."

The new factories along the fringes of the association were joined by several new nail works constructed by established firms in other branches of the iron industry. Between 1880 and 1884, fifteen rolling mills throughout the country that had not previously operated nail mills added plants. The North Chicago Rolling Mill Company, for example, added a one hundred machine nail mill to its rolling mill in 1883. With profits so high, companies with rolling mills could add nail machines at minimal cost (about $30,000 could outfit a nail factory with between thirty and forty machines) and recoup the investment within a year's operation. By 1885 Weeks estimated that the productive capacity of the nation's nail works was nearly ten million kegs per year, while consumption, including exports, was no more than seven million kegs per year. In short, by 1885 capacity stood at least 30 percent above demand.[15]

Several of the new factories were actually financed by Wheeling capital. A factory in San Pedro, California, for example, was organized in Steubenville by workmen of the LaBelle Company. The Woodward, Alabama, works was the brainchild of S. H. Woodward, a major stockholder of the LaBelle Company and son of one of the founders.[16]

Additionally, the Western Nail Association and the Wheeling firms received severe competition from Eastern factories, particularly those located in eastern and central Pennsylvania. Between 1882 and 1884 manufacturers in eastern and central Pennsylvania added 318 new machines, increasing their productive capacity by about 25 percent.

For example, the Williamsport Iron and Nail Works added fifty-five machines to its rolling mill, and the Pottstown Iron Company expanded an existing nail factory by sixteen machines. In addition to the old firms, new ones, too, began to encroach on the territory that had traditionally been claimed by the Western nail makers.[17]

The revival of the nail making community in eastern and central Pennsylvania was partially a result of changes in transportation costs. Throughout the prewar period, transportation costs for both raw materials and finished products had given the Wheeling firms an advantage. This factor, along with the production efficiencies, had permitted all of the Western manufacturers to turn their backs on the East. After the Civil War the Eastern factories had adjusted their wages to a much lower level than those of the West (the distress of whose managers has already been mentioned) and were relatively successful in blocking unionization. By 1880 a difference of almost 30 percent continued to exist in many mill wage categories between Eastern and Western workers. Even with the higher wages, however, transportation stood as a barrier to Eastern firms. In the 1880s transportation, too, changed. Iron ore from Lake Superior could be shipped east by the lake route at far lower cost than previously, and railroad rebates and other practices familiar to students of American history made it possible to ship finished nails west at reasonable prices. One Pittsburgh manufacturer, for example, claimed that eastern Pennsylvania nail manufacturers could ship their products to Chicago at the same rates as producers in Pittsburgh.[18]

By 1882 the dividing line between the East and the West had become blurred. While demand was high, this change did not present a real

problem to Westerners. Furthermore, there was no real objection from the Wheeling manufacturers, who saw an advantage in breaking out of the old Western territorial confines and moving to the lucrative urban markets of the northeast. By 1881 Wheeling manufacturers had agents in Baltimore and New York City. One agent for the Belmont Company, for example, sold 10,000 kegs of nails to Fuller Brothers & Company of New York City in 1880.[19]

It was when the price slide began in 1883 that the Western manufacturers faced problems. In 1884 the Western manufacturers, particularly those in Wheeling, met stiff competition for the first time. Bereft of a substantial part of their Western and Southern markets by the new nail mills, and unprotected by transportation tariffs, they had to meet Eastern mills on a more or less equal footing. By the end of 1884 production costs in the two sections were very comparable--with Wheeling mills having cheaper supplies and an edge in efficiency and the Eastern mills having cheaper labor costs.

Wheeling firms not only found themselves facing stiff competition in pricing and marketing, but they also were being challenged for the best skilled labor in the market. Specific events sometimes provide a good summary of a broader phenomena. Such an event occurred on September 28, 1882, at the Baltimore and Ohio Railroad depot in Wheeling. The Wheeling factories were closed because of a strike. The Eastern, Southern, and Western factories that were not members of the Western Nail Association were running at full force and in need of workmen. On September 27, a "Mr. Timberlake" from chicago had set up an office to

recruit workmen for the new Chicago nail works. The Intelligencer reported the following scene:

> The office [Mr. Timberlake's] and the pavement in front presented an animated scene. About a hundred iron workers were there, all discussing the probable outcome of the manufacturers meeting that was in progress in the Riverside office. Every once in a while a delegation would go up the alley to Main Street and gaze at the windows of the office, but no news or consolation was to be obtained. About 1:00 o'clock someone cried out, "Well, boys, we better be getting to the depot," and the crowd began to move. At the B & O depot the scene was simply indescribable. The big waiting room and platforms were packed with nailers, feeders, boilers, helpers, and in fact, men from every department and every mill.
>
> At 2:00 o'clock, vice president Thomas [vice president of the Amalgamated Association of Iron & Steel Workers] was seen hurrying along South Main Street. His approach was eagerly awaited, and as he entered the main waiting room, the crowd poured pell-mell after him. He mounted a bench and said, "Gentlemen. The manufacturers have sent word to me asking for a conference at 7:00 p.m. which I have agreed to call. I advised you yesterday to stay until today. Today I do not want you to be influenced at all by what I say. If you have made up your minds to go--go!"
>
> As Mr. Thompson stepped down, the crowd yelled "Go" and with a hurrah started for the doors when the voice of Mr. Timberlake was heard. Standing on a trunk, he said,"The train starts in fifteen minutes. What I want now is for those of you who are going with me to hold up your hands and pledge yourselves to remain two weeks."[20]

Competitors thus not only sent nails to territories formerly exclusively held by the Western Nail Association but they even recruited workmen in the very shadow of the Wheeling mills.

Much of the manufacturers' planning from 1882 through 1886 was directed at improving the position of the Wheeling firms in the market-place. As in the preceding decade, the activities continued to be directed primarily at cost reduction and at market control. The Belmont Mill provides an instructive example. The Belmont was rather typical, not the best, the largest, or the oldest of the Wheeling firms. The

firm had been reorganized in 1878 (after bankruptcy) under the leadership of some of the outstanding men in the business. The reorganizers included Samuel Laughlin, formerly of the Benwood and the Laughlin Nail Company, J. M. Todd of the LaBelle Company, and A. W. Wilson of the Benwood Works. Records of the Belmont Company are complete enough to show with some accuracy what was happening to prices and costs during the first five years of the 1880s. The following table contains information taken from the minute books of the Belmont Company.

TABLE II

COST, SELLING PRICE, AND PROFITS AT THE BELMONT MILL

Year	Cost per Keg	Selling Price	Profit	Kegs Produced
1879*	2.79	3.30	.51	---
1880 (1st half)	3.31	4.42	1.11	78,442
1880 (2nd half)	2.75	2.97	.22	130,087
1881 (1st half)	2.62	2.97	.35	120,397
1881 (2nd half)	2.69	--	--	143,450
1882 (1st half)	2.80	3.43	.63	---
1882 (2nd half)	2.80	3.66	.86	75,940
1883 (1st half)	2.68	3.36	.68	134,317
1883 (2nd half)	--	--	--	---
1884 (1st half)	2.42	2.66	.24	126,386
1884 (2nd half)	2.38	2.31	-.07	95,897

*1879 statistics were for a full year.

Production costs held relatively steady, fluctuating by only 93¢ per keg between the high in 1880 and the low in 1884. Prices, on the other hand, varied greatly with a difference of $2.11 between the high year and the low year.[21]

Two major trends appeared in the cost of various items that went into nail making. The cost of iron dropped from 48 percent of the manufacturing cost in 1880 to 38 percent in 1884. At the same time the cost of labor increased from 35.6 percent to 42.6 percent of the manufacturing cost. This configuration of rising labor and declining material costs bore heavily upon the minds of the Wheeling manufacturers. With material costs going down for all manufacturers, and Eastern competitors having a labor cost advantage that offset the efficiency that Wheeling enjoyed, the Wheeling nail men mounted a determined effort to reduce labor costs. Although largely unnoticed at the time, production units outside of Wheeling had copied Wheeling's mode of integrated firms. It is also reasonable to assume that the cost accouning system had also been copied, since a number of the new production units were either funded by Wheeling investors or staffed by former employees of Wheeling firms. This new set of conditions, unlike any that the Wheeling manufacturers had previously faced, required a rethinking of market and production strategy.[22]

During the lean days of the 1870s the Western Nail Association had attempted to control both the production and marketing of nails. Just before the prices began to rise in 1879, the Association had proposed to move towards an even more centralized control aimed at copying the trust arrangements that the tack manufacturers had entered

into a decade earlier. Talk of placing all plants under the control of a central board that would decide on all phases of operation was abandoned, however, in light of the new-found prosperity and the disagreements within the Western Nail Association. With every producer "coining money" at each stroke of the nail machine, the need for such control vanished. In 1880, 1881, and 1882, the Western Nail Association's role in controlling the marketing of nails declined. The manufacturers met less frequently, and at least the published accounts of the meetings gave no indication that anything of significance occurred. Published reports of meetings of the Western Nail Association generally contained no more than a listing of those in attendance and comments on the general affairs of the trade. The only matters of substance discussed between 1880 and 1884 were an occasional increase in the price of nails or a determination of the date for the annual summer "shopping," or shut-down for repairs.[23]

Under the stimulus of changing market and labor conditions, the Association began to revive in 1883. At first the members of the Association resorted to their old tactic of price fixing. Even when it became clear that overproduction was the problem, the manufacturers tried to hold prices high. With the new Western mills in operation and the continued incursion of Eastern mills, this course of action failed. The Association then turned to another familiar ploy--controlling the rate of production. By extending the annual summer repair period in 1883 and 1884, the manufacturers cut their production by the equivalent of 1,000,000 kegs each year. This "lay off" was successful, at least to a limited extent. J. D. Weeks, editor of The Iron Age, reported,

"Since the Western manufacturers have been pressing a restricted policy, the price of nails has held much more steady." By 1884, however, neither the pricing nor the production control policies were effective. Mills outside the Association continued in the market, effectively defeating any plan and continuously pushing production higher and dropping prices lower.[24]

The manufacturers soon resurrected the two courses of action that had been contemplated in 1878 and early 1879. Among these two was a renewed concern for wage control and a fresh look at another source of material for nail making.

The Western Nail Association had never taken an active role in wage negotiations. Prior to the formation of the Amalgamated Association of Iron and Steel Workers in 1875, wages were negotiated by each factory, and Wheeling always followed the lead of Pittsburgh in setting pay for laborers and skilled craftsmen (except nailers). The immutable formula described above had held fast. Wheeling mills paid twenty-five cents more per ton for puddling and boiling than Pittsburgh mills. When wage disputes resulted in strikes, Wheeling men stayed on the job and waited for the Pittsburgh settlement which set their wages. Several observers, depending upon their perspective, commented upon this arrangement, alternately complaining of the effect that this arrangement had on Pittsburgh and lauding the stabilizing influence on the Wheeling factories. In non-wage matters, and in dealing with unskilled labor or related enterprises such as coal mining and keg manufacturing, each manufacturer dealt with his own workmen.[25]

After the Amalgamated Association of Iron and Steel Workers was formed in 1875, the Western Iron Producers Association became the manufacturers' bargaining agent. Made up of representatives of producers from all segments--furnaces, rolling mills, etc.--the WIPA was largely controlled by Pittsburgh iron manufacturers. Although Wheeling had representation, and the Western Nail Association took an active interest, the nail producers had no real influence. They accepted the prevailing rates--or card--as negotiated and implemented them in their mills.[26]

It was in 1879 that the Western Nail Association first showed its interest in determining wages and, largely at the request of the Wheeling firms, published a request asking workmen to accept the reduction in wages. The request claimed that the Eastern nail workers were being paid one-third less than those in Western mills. But, as noted above, with the upswing in 1879 and 1880 the Western Nail Association withdrew its request and, moreover, deferred to the Western Iron Producers in the contract negotiations of 1880.[27]

Negotiations in 1881 resulted in an increase in wages for boilers, puddlers, and their helpers. During the negotiations, Andrew Jarrett, vice president of the Amalgamated Association, promised the manufacturers that should a raise be forthcoming for boilers and puddlers, no adjustment would be sought the following year. The Wheeling manufacturers were not happy with this settlement and in fact were reported to be particularly bitter against signing the scale. When the puddlers and boilers asked for an increase the following year, the Wheeling firms broke ranks and for the first time negotiated directly with their workmen

on their own. To conduct the negotiations the manufacturers formed a local association made up entirely of the Wheeling members of the Western Nail Association plus George Whitaker, of the Crescent Mill. The local association did thwart the wage increases but was unable to eliminate the "Wheeling bonus" or to roll the wages back. In fact, before the negotiations were completed, the Wheeling firms had fallen to fighting among themselves, and Alexander Laughlin had pulled the Laughlin Nail Company out of the group. Primarily because mills in the rest of the Western Nail Association settled, went back to work, and threatened to attract Wheeling workmen, the manufacturers gave up in late September. Their attempt at negotiating locally showed them the impossibility of negotiating successfully at less than the regional level.[28]

After the 1882 strike, the Wheeling manufacturers acted more independently than ever before, asserting their presence in the Western Nail Association council more vocally and it may be said, more ruthlessly. Led by J. N. Vance, an engineer who was president of the Riverside Works, the Wheeling contingent began holding formal strategy meetings prior to monthly Western Nail Association meetings. By 1884, policy for the entire Western Nail Association was being made in the Wheeling district meetings, followed by perfunctory approval from the entire body.[29]

From the founding of the organization, the Western Nail Association had been associated closely with Pittsburgh. Weeks, The Iron Age editor, also served as its secretary and maintained an office for the Association in Pittsburgh. This arrangement had worked well during the

first few years. Although Pittsburgh was on the eastern edge of the Western Nail Association, it had the second largest group of mills and was accessible for the majority of the manufacturers. Furthermore, Pittsburgh was a supply point, and as one of the owners of an Illinois factory noted, it was therefore a logical meeting place since owners had to visit Pittsburgh frequently on buying trips.[30]

From the late 1870s on, when the Wheeling manufacturers openly disagreed on the course to be taken in wage negotiations and pressed consistently for lower prices than the Pittsburgh nail manufacturers, the Pittsburgh papers often accused the corporations in Wheeling of keeping prices low. In 1883 and again in 1885, the Wheeling firms triumphed after sharp debates and forced price readjustments over the objections of the Pittsburgh manufacturers. The friction between the two nail making centers finally led to an open break in March, 1885. The issue was pricing policy. In this instance, however, Wheeling representatives wanted higher rates. At the February 12, 1885, meeting, Wheeling manufacturers had pressed for a price of $2.25 per keg for 10d common nails while Pittsburgh and Mahoning Valley representatives preferred $2.15 per keg.[31]

On March 21, 1885, the Pittsburgh Commercial Gazette reported that, "An effort is being made to have the offices of the Western Nail Association moved from Pittsburgh in a very short time." The reporter interviewed several people, including Weeks, secretary of the Western Nail Association, and Ray F. Keating, president of Zug & Company, one of the larger nail manufacturers in Pittsburgh, and vice president of the Western Nail Association. Both men agreed that the

"report was absolutely without foundation." When the Western Nail Association met for its regular meeting on April 9, the delegates considered little business and adjourned to meet in Wheeling twelve days later. Plans laid by the Wheeling manufacturers came to fruition when the manufacturers reconvened. Headquarters of the Association were moved to Wheeling and Weeks was replaced by George Wise, an employee and stockholder of the Belmont Mill. In addition, Vance of the Riverside Mill was elected president. Furthermore, the Wheeling men formally changed the policy of the Western Nail Association so that "hereafter the Western Nail Association will . . . treat with these unions [nailers, rollers, heaters and feeders] and with other organizations whose branches of labor are employed in the bar, sheet and iron mills." Finally, the Association went on record favoring a price differential between iron and steel nails.[32]

Except for two minor concessions--leaving General Fitzhughes, a Pittsburgh manufacturer, as vice president and promising to move the meetings from city to city--the Wheeling manufacturers carried the day completely. During the following decade and a half, Wheeling manufacturers never lost control of the Western Nail Association. They set prices, rolled back wages, and generally took a hard line. Nevertheless, the Western Nail Association did not succeed. When the organization disbanded in 1898, the cut nail was all but an anachronism, having been largely supplanted by the wire nail.[33]

There was another element that had become involved in the internal struggle in which the Wheeling manufacturers gained the upper hand within the Western Nail Association. The Wheeling manufacturers had

Fig. 20. J. N. Vance was a member of Dewey, Vance and Company (The Riverside Mill). President of the Western Nail Association in 1885 and 1886, Vance had a large role in guiding the industry during the "Great Strike." (Scott. p. 44)

proposed in April of 1885 that the Western Nail Association approve a separate price scale for steel nails, giving them a price advantage over wrought iron nails. This was an obvious move to gain a significant market advantage for the Wheeling mills which had commenced the shift to steel as the basic material for nail making.[34]

The Wheeling nail manufacturers studied the possibility of making nails from Bessemer steel in the late 1870s, at about the same time the LaBelle and the Bellview (Illinois) Iron Works began to experiment with rerolling used rails. Both measures were studied because they would eliminate the need for puddling and boiling and thereby relieve the mills of the need to employ a substantial number of high paid employees. It was this motive alone that led to the introduction of steel. No one, either workman or manufacturer, ever made claims that the steel nail was superior or offered any advantage whatever over wrought iron nails. In fact, many claims were made to the contrary. Carpenters and manufacturers who resisted the switch claimed that the steel was too hard and brittle for nails. Writing of the Wheeling interest in steel nails in 1882, a reporter for The Iron Age implied that steel nails would not sell. "A great many attempts have been made to introduce the use of steel as a material for nails," the reporter wrote. He went on to say that all had failed "for various reasons."[35]

The early discussion of using steel nails was not followed by action. The reviving economy, the heavy capital expenditures needed for steel works, and previous failures probably discouraged manufacturers from making changes in the late 1870s or early 1880s. But even though the subject had been laid aside, it was not forgotten. The

matter came up again in 1880. On June 17, the board of directors of the Benwood Iron Works requested the secretary to gather information "in relation to the making of nails from Bessemer steel instead of iron" and to report on the comparative costs of manufacture. No records of the secretary's report could be found in the company's records but Scott, who was intimately involved with the industry at the time, claimed that steel plate was located, tests were run, and a few kegs of steel nails were actually produced. The events that followed indicated that the tests must have been favorable.[36]

By mid-1882, the Belmont Mill, the Benwood Iron Works, the Wheeling Iron and Nail Company, the Bellaire Nail Works, and the Riverside Mill, as well as writers in The Iron Age and The Wheeling Intelligencer, showed an interest in steel nails. During the fall of 1882, J. N. Vance, president of the Riverside Works, led an effort to erect a "union steel works" that would be jointly owned by the Wheeling area mills. A company, named the Wheeling Steel Company, was incorporated with an authorized capital stock of $1,000,000 to erect a Bessemer works. The corporation had a short life. On December 14, 1882, the stockholders of the Wheeling Iron and Nail Company refused to approve the board of directors' request to issue additional capital stock to raise the money for the Wheeling Iron and Nail Works' purchase of one-seventh of the stock in the new company. A month later the Benwood Iron Works also withdrew from the combination and its board was authorized to erect a separate steel works. Following these defections the proposed corporation was abandoned.[37]

Fig. 21. Advertisement for the Jefferson Iron Works of the LaBelle Company that appeared in The Iron Age, January 7, 1886. Note the heavy emphasis on steel nails.

The Wheeling Steel Works episode was notable for several reasons. First, the scheme was hatched during the six-week strike of 1882 during which the boilers demanded a sizeable increase in pay. Interest waned quickly after the strike ended without an increase in pay. This suggests, once again, that the manufacturers saw a direct relationship between the introduction of steel and the costs associated with boiling. Second, the "union steel mill" was the first effort at horizontal integration within the Wheeling nail community. The idea had, for a time at least, the blessing of the top management and the boards of directors of several firms. It was the stockholders who vetoed the idea. Probably the large representation of workmen, particularly puddlers and boilers, who owned small amounts of stock in three of the firms--the Wheeling Iron and Nail Company, the Bellaire Nail Works, and the Benwood--lobbied heavily against the proposal. These workmen definitely saw that steel would not be advantageous for them personally. In addition, some stockholders may have been frightened by an article that appeared in The Iron Age in which a writer asserted flatly that the cost of steel nails would prevent their widespread use. Since this article appeared when it did and in a publication edited by the secretary of the Western Nail Association who was closely allied with the Pittsburgh manufacturers, it must have been viewed by those in Wheeling who favored the steel works as an attempt to prevent manufacture of steel nails. Vance, who had led in the formation of the corporation to build a steel plant, later coordinated the Wheeling takeover of the Western Nail Association. After assuming the presidency of the Western Nail Association, Vance's first act as noted above was to replace Weeks.[38]

The failure of the "union nail works" had only a marginal effect on the resolve of the Wheeling mills to shift to steel. The Riverside and the Bellaire Nail Works began laying plans in early 1883 for their own steel plants and both firms had completed Bessemers by late spring of 1884. The Benwood Company proceeded at a slower pace and was eventually joined by the Wheeling Iron and Nail Works and the Belmont Company in the construction of a Bessemer works. The LaBelle built its own steel plant, using the Clapp-Griffins patent, in Steubenville, and the Laughlin Mill constructed a separate Bessemer at Mingo Junction in concert with the Junction Iron Company. By 1886 all of the Wheeling firms were in the steel business. Much as the profits of the Civil War era had permitted the firms to purchase blast furnaces, so the profits of the 1880-1882 era allowed them to add steel mills. Like the blast furnaces, the steel mills had far reaching implications for the industry. Steel mills began the process of horizontal integration that eventually ended in 1921 with the formation of the Wheeling Steel Corporation.[39]

More importantly for the purposes of this study, the steel mills did in fact achieve the projected impact. They lowered the cost of nail making dramatically. During 1884, the last full year the Belmont Company used wrought iron, labor costs averaged $1.01 per keg. Two years later after the switch to steel was complete, labor costs dropped to fifty-six cents per keg.[40]

By 1883, Wheeling was alive with rumors of impending changes. Profits from 1880, 1881, and 1882 filled the coffers of the various mills and, judging from the dividend records, the pockets of a large number of stockholders. Local and foreign investors were anxious and

the city fathers were ecstatic about the future. The papers spoke freely of plans to "boom the town" and regularly spread forth the praises of the social, economic, and political climate the city had to offer. The city was billed as "progressive," with notations frequently of the abundance of coal and natural gas and the excellent railroad and water connections the city offered. During 1883 and 1884, delegations of businessmen from other cities were regularly brought to Wheeling as a part of a campaign to attract new industry.[41]

All was not well, however. The nail industry, although profitable, was careening towards a disastrous showdown. A first skirmish between the owners and the workmen resulted in the six-weeks strike mentioned above and a settlement that maintained the status quo. It was the final showdown that came in 1885 and 1886 that put the boilers and nailers out of work. The "Great Nail Strike," as it was frequently called, resulted from a wage dispute between the Western Nail Association and the United Nailers. While this event was viewed by contemporary and later observers as the most significant in the industry's history, it was only the final chapter in a long, conspicuous struggle, the roots of which stretched back into the 1870s.[42]

Tracing the course of events that led to the great strike of 1885 necessitates recounting certain labor-management and internal labor relationships that began to evolve in the early 1870s. The decision to introduce steel and the methods selected to introduce it were influenced by management's perception of labor's strength; management's perception of its ability to manipulate various classes of workmen; and management's interpretation of conflicts among various classes of workmen.[43]

The Wheeling mills were built around two groups of workmen--the boilers who worked the wrought iron and the nailers who ran the nail machines. In the prewar period the owners of nail mills came largely from these two classes of workmen and even as late as the 1880s many continued to own stock and hold hopes of moving into the ranks of management. By the standards of the day, both groups continued to be well paid. Andrew Glass, who went to work in the nail factories in 1873 at age 14, noted in his reminiscences that in the 1877-1879 era he consistently earned between $12 and $20 a day after paying his helpers. Glass's claims are substantiated by others. The boilers were paid equally well.[44]

Although the boilers and nailers were the two most important tradesmen, they did not compose, by any means, the largest group of workmen. Wheeling firms probably never employed more than 350 nailers at any given time. The precise number of boilers is much more difficult to determine, but based on the number of furnaces, the Wheeling firms probably never exceeded 900 workers in this category. The largest number of workmen were semi-skilled (helpers, feeders, rollers, etc.) or laborers such as "drag-outs," "shove-unders," and the like. Throughout the history of the industry, the semi-skilled workmen who worked directly with skilled craftsmen were employed by the craftsmen, while the laborers and a few craftsmen (such as machinists and blacksmiths) who were disassociated from either the boiling or nail works, worked directly for the firm. The blast furnace operations generally departed from this system, but the "inside contracting" continued in the nail mills up until at least 1942.[45]

The skilled craftsmen were all piece work employees. Wages were established on the basis of prices of nails and rose or fell with the market rate at any particular time. In the mills only laborers, the managerial personnel, and a few craftsmen (i.e. blacksmiths, machinists, etc.) were paid a flat rate divorced from the price of nails. At the blast furnace everyone was paid at a flat rate, unrelated to the market price of nails.[46]

Generally, management either directly or (after 1874) through a third party negotiated a card rate for each class of workmen. For example, when 10d common nails sold for between $2.00 and $3.00 per keg, nailers were paid 21¢, boilers $5.75 a ton for wrought iron, and coal miners 3¢ a bushel. If prices rose to $5.00 per keg, nailers received 30¢ per keg, boilers $9.55 per ton, etc.. During negotiations central questions always turned out to be adjustments in the scale. Such adjustments could take many forms, ranging from actually changing the wage to limiting or expanding the range within which a particular amount was paid.[47]

Throughout the period from 1875 to 1885, the rate for nailing remained constant. The 21¢ scale, as it was called, held firmly with neither party showing much interest in change in the base rate. The boilers, on the other hand, constantly agitated for change. They demanded and received adjustments in prices and working hours in 1879 and in 1881, and asked but failed to get an adjustment in 1882 and 1884. The manufacturers showed a considerable concern for any pay adjustment for the boilers because several other classifications of workmen had wage rates directly tied to the boiling rate. For example, muck rollers

received one-eighth of the rate for boiling. Consequently, any change in boiling rates affected other classifications.[48]

The frequent demands for increases in the rate and the ripple effect that these increases had on other workmen, therefore, was a central feature in the desire of Wheeling manufacturers to shift to steel. Such a shift would rid the manufacturers of the toublesome boilers, and they made no secret of their desire. "A well known iron man" was quoted in The Wheeling Intelligencer as saying, "Steel nail makers are rolling out steel nails at less cost than they can produce muck bar. Now you want to know why," he continued. "Simply because we have to pay such a high price for puddling."[49]

The boilers presented a dramatic contrast with the nailers. During the ten year period between 1874 and 1884 the nailers were not responsible for a single major work stoppage. The only problems in the nail mills resulted from a constant conflict between nailers and feeders that began in 1872 when "bad blood" developed between the two groups of workmen. The differences centered around the issues of money and apprenticeships. In 1875 the feeders went on strike demanding that the nailers increase their rates from two-fifths to one-half of the money earned by the nail machine the feeder operated. The nailers retaliated by introducing automatic feeders and broke the strike. While the automatic feeder had been available from the very early days of the industry, it had been ineffective because it produced a large number of irregular nails. After the Civil War, several new feeders became available that reduced waste, but even as late as 1880 these machines were not used very widely. Improvements, particularly the perfection of

the "flip plate feeder" did make the machines usable in emergencies such as the feeders' strike and certainly served notice to everyone interested that a completely satisfactory machine was not far away.[50]

After the strike in 1875, most of the feeders returned to their old jobs working alongside automatic feeders that had been installed during the strike. In some cases the nailers who had purchased the machines actually removed them, preferring to have hand fed nails. Nonetheless, the automatic feeders were a threat to the feeders, who correctly blamed the nailers for their introduction. The bitterness that resulted may aptly be gauged from comments made by J. Elmer Bell, a feeder at the Benwood Mill. Speaking before the feeders' union in April of 1875, he said:

> Once more we are called upon and assembled here for the purpose of taking steps to remove from our necks the tyrannical yoke of oppression . . . that unprincipled men have placed us in . . . .
>
> Behold the nailer as he appears before the eyes of the world living in one of the finest residences of the city, of which he is owner and landlord; his wife and children clad in the finest garments the city can produce; and when you encounter him upon the highway you will quickly observe the air of independence he exhibits, which tends to show his superiority over the poor and almost despised feeder, whom he robs of his just dues . . . .[51]

The bad feeling between the feeders and nailers carried over into the organized labor movement when the Amalgamated Association was formed in 1875. For almost five years, the nailers exerted pressure to keep the feeders out of the union so as to retain a free hand in dealing with them on the wage and working condition questions.[52]

For a while the factory managers refused to become involved in the differences between the feeders and the nailers. In the early 1880s, this changed. The manufacturers offered to purchase the automatic

feeders from the nailers, who readily sold them. From this point forward the owners played a game using the nailers against the feeders and vice versa. When the feeders complained, threatened to strike, or demanded improvements in conditions, the owners simply added a few new automatic feeders and brought the men back into line. When the nailers spoke, as they did in 1883, of a scale adjustment, the manufacturers let it be known that they favored an increase in the feeders' pay or an adjustment downward in the scale when automatic feeders were employed. The threat worked effectively for the manufacturers and insured relatively smooth operations in the nail departments of the factories.[53]

Until 1884 the "union baiting" was limited to the nail departments. Then faced with stiff resistance to the introduction of steel nails from the boilers, the manufacturers turned to this old tactic to control the Amalgamated Association and reduce the resistance of the boilers. When and by whom the strategy was formulated is unknown.

When it became apparent that the Wheeling manufacturers were intent upon converting to steel nail plate, the boilers conceived a strategy that offered some hope of forestalling, if not blocking, the move. At the Wheeling district Amalgamated Association meeting in March of 1884, the boilers pushed a resolution asking the National Amalgamated Convention to demand an increase in nailing rates of 10 percent when steel nail plate was used. The rationale was that steel was harder, caused more breakages in machines (for which the nailer had to pay), and made the job of the feeder more difficult. The resolution passed with the support of the nailers, who brought it before the National Scale Convention. It was later written into the 1884 scale

agreement. Just how the manufacturers reacted to this provision is unknown. Since only the Wheeling manufacturers were converting to steel it would have been clearly in the interests of Pittsburgh, Mahoning Valley, and Ironton manufacturers to have this provision included. With no knowledge of the manufacturers' reaction, one can only speculate that the Wheeling representatives to the Western Iron Association were overruled on any objection they may have posed. If this were in fact what happened, it would have been another contributing factor in the Wheeling men's desire to take over the Western Nail Association and become the industry bargaining agent with the Amalgamated Association.[54]

The agreement appeared to have the desired results. As early as January, 1884, the nailers let it be known in an interview published in The Wheeling Intelligencer that they would ask for the increase. Even after the Bellaire Nail Works and the Riverside Works put Bessemer converters into operation in April and May of 1884, boilers were kept on the payroll. The LaBelle, through its secretary, announced that the company intended to continue making iron nails and even went so far as to install new gas boiling furnaces. The most widely held opinion was that the companies would continue to manufacture iron nails along with steel nails and that the loss of jobs among boilers would be minimal. To compensate for jobs that would be lost, a group of businessmen even went so far as to organize a bridge factory expressly to utilize the boilers thrown out of work by the steel nail.[55]

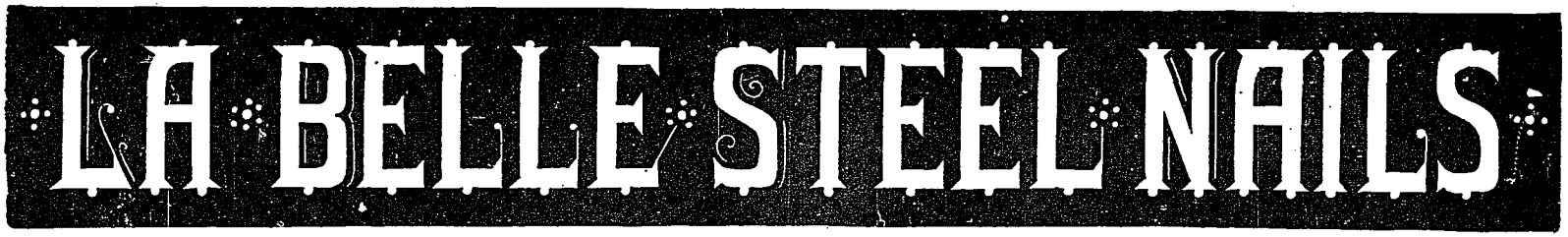
Just when the Amalgamated Association seemed to have hammered out a process for saving some of the jobs, the nail feeder controversy surfaced again. At the August 8, 1884, meeting of the Amalgamated

Association of Iron and Steel Workers, the feeders brought their complaints--a claim for wage increases--before the convention and found considerable sympathy. "In the opinion of many mill men," an anonymous delegate said, "the feeders are pretty near right in their demands for more wages." Before the convention ended, the nailers had begun to rethink their position on the steel nail question. "If steel could be made having a carbon content as low as .9 of a percent," reasoned one nailer, "the steel nail might be a success."[56]

Less than a day after the Amalgamated floor fight, the manufacturers struck with a vengeance. LaBelle, the company that had only three months earlier built new boiling furnaces, posted notices discharging all its boilers. In reporting the action, a Wheeling Intelligencer reporter commented:

> Such a notice without warning came with the force of a blow. . . .
>
> A feeling of uneasiness took possession of all the mill men. It was regarded as a break which would be followed by all the other mills in due time. Of course it could have only one meaning, that the use of iron for nail making was to be abandoned and steel is to be substituted.[57]

Every bit of evidence points to manipulation. There is no doubt that the Bellaire and Riverside owners struck a deal in which they promised not to back the feeders in return for which the nailers dropped the extra cost of cutting steel nails. The workmen in other departments of the mill regarded the actions of the nailers with suspicion and passed on rumors of a party at which the nailers and owners had met to hammer out their agreement. What is unknown is whether the manufacturers had any hand in encouraging the feeders to make their demands at the convention.[58]



OF EVERY VARIETY ARE MANUFACTURED BY THE

LA BELLE IRON WORKS.

OFFICE AND WORKS, - - - - WHEELING, W. VA.

Fig. 22. Advertisement for the LaBelle Iron Works. Note the emphasis on steel nails. (Collections of the Wheeling-Pittsburgh Steel Corporation)

When the nailers openly defied the Amalgamated Association and refused to demand the additional 10 percent for cutting steel nails, the boilers at the Belmont broke with the Amalgamated Association as a protest. This action forced the president of the Amalgamated Association to demand that nail locals ask for the additional percentage for cutting steel nails. After hearings on the matter, convened in Wheeling by the president and secretary of the Amalgamaged Association, preparations were made to expel Hershey Lodge (Bellaire Nail Works). Before the Amalgamated could act, the Hershey Lodge voluntarily gave up its charter and its president, John K. Weir, began laying the groundwork for a new union--United Nailers. In short order, the other lodges of the Amalgamated Association also surrendered their charters. During the early months of 1885 the nailers went about the task of organizing a new union and convincing the heaters and rollers to join them.[59]

By January, 1885, the Amalgamated forces in the Wheeling area were in disarray. As the approaching wage negotiations came nearer, the Amalgamated Association backed away from its insistence on retaining the boilers' jobs and on retaining wages at the 1884 level. Willingness to sacrifice the boilers and willingness to take a 10 percent cut in wages cost the Amalgamated Association even more members.[60]

The maneuvers of the manufacturers were far from ended. With the boilers in check, the manufacturers turned their attention to the nailers. As the 1885 scale talks opened, the nailers asked that wages be continued at their old levels (21¢ scale) and that the manufacturers pay for the cost of repairing broken machines. Meeting in Cincinnati on May 27, 1885, the manufacturers drew up a plan that called for the

reduction of nail rates from 21¢ to 17¢ per keg for 10d nails, plus an additional reduction of one-fourth when automatic feeders were employed, and for the nailers to continue paying for breakages. The nailers, except those at the Bellaire Mill, refused to sign the manufacturers' scale and called a strike on June 1.[61]

The manufacturers were steadfast in their claims that Eastern competition was destroying them. "We are at a disadvantage," one manufacturer said. "The difference in distance from our market does not compensate for the differences in the cost of production." In fact, as noted earlier, the margin of profit had been growing progressively slimmer since 1883. It was in 1884 and 1885, for example, that the Belmont began to lose money on each keg of nails manufactured.[62]

While the manufacturers looked to the ledger books to justify their actions, the nailers dismissed the strike in a half-humorous way. "It's a bluff," one nailer was quoted as saying in The Wheeling Intelligencer. Others claimed that the Western Nail Association's motive was to drive the Eastern nail makers from the market.[63]

Within two weeks after the strike commenced, the controversy between the nailers and the feeders revived. The immediate cause of the difficulty was apprenticeships. During 1884 and early 1885 the manufacturers had introduced more automatic feeders, and it was clear to many people that the days of the manual feeders were limited. Shortly before the strike began, the nailers had "decided to cut off all apprenticeships" of feeders. When the feeders learned of this they went before each lodge of nailers and asked for a reversal of the decision, demanding that 3 percent of the feeders in each of the mills

be taught the nailers' craft each year. Furthermore, the feeders appealed to the manufacturers for support in this matter and received assurances from the manufacturers that "if they [the feeders] would maintain their demands, the mill owners would do all they could to see the feeders had justice done in this matter."[64]

The manufacturers moved quickly to take advantage of this new controversy. On July 8, 1885, in a meeting of the Western Nail Association in Cincinnati, the delegates passed a resolution giving the nailers until July 11 to accept the "Cincinnati Scale." If the nailers refused, "the mills connected with the Western Nail Association will be opened and the machines given to nail feeders or any competent person or persons who will agree to cut nails at the price of said scale."[65]

Though the threat was meant to be serious, the nailers greeted it with a laugh and with the assumption that "no man who has not served a regular apprenticeship as a nailer can do a nailer's work." "Talk about circuses," one nailer said, "that would beat any three ring show Barnum ever dreamed of." As the date came, the nailers refused even the courtesy of a reply to the manufacturers. At their annual meeting on July 15, the nailers formally organized their new union, The United Nailers, Heaters and Rollers, drew up by-laws, and celebrated their new alliance. They reaffirmed their position on wages, demanding the 21¢ scale, reasserted their position that the manufacturers should pay for broken machines, and went on record favoring the fifty-hour work week.[66]

Shortly after the nailers adjourned, the feeders of the area met and agreed to accept the manufacturers' offer to take over machines.

On July 26, the first feeders began operating machines at the Benwood Mill. Over the course of the remainder of the summer, every mill began the process of training feeders to become nailers. By January, 1886, it was apparent that the feeders could indeed become skilled nailers. By that time approximately two-thirds of the machines in the Western Nail Association were in operation.[67]

The strike therefore had far-reaching ramifications for the industry. For once and for all, the contention that the nailers possessed irreplaceable talent was debunked. The feeders who took over the machines quickly picked up the critical skills of grinding (sharpening) the blades of the nail machines, the aspect of the nailers' job that had been assumed to be the part requiring the most experience and training. Many observers had suspected for a long time that the real secret of the nailers trade was that there was no secret at all. "Any man who has worked about a nail machine for a long time," one mill owner said at the beginning of the strike, "if he has average intelligence ought to soon give acceptable service as a nailer." This in fact proved to be a correct assumption.[68]

As the nail strike dragged on, the nailers were finally and completely separated from the management of the mills. This class of workmen, who had built the industry, was finally torn away from any role in determining its direction. Although this had in fact been the case for many years, the strike pointed out the realities that many had refused to recognize. Those nailers who had risen to management levels such as Jacob Altmaier of the Benwood and John Morrison of the Wheeling Iron and Nail Company were faced with a dilemma. While their boards

ordered them to teach their craft to new feeders, their sense of loyalty to their co-workmen demanded that they refrain from imparting their skills. Both men, and many more like then, resigned their positions and left Wheeling for mills in California and other states.[69]

The nailers at first held firm in the faith that the experiment would fail. Eventually they turned in desperation to violence. Several minor incidents of machine breakage began the escalation. This was followed by attacks on "scab" labor, particularly a few nailers who refused to leave the mills and those workmen imported to teach the feeders. Violence reached a climax in late September when about forty striking workmen attacked and laid siege to the Laughlin Nail Works at Martins Ferry. After a two hour gun battle, the attackers were driven away without doing any real damage.[70]

All efforts to disrupt the manufacturers failed. The manufacturers moved cautiously, bringing more and more machines on the line as men became available either from the internal training programs or from other factories outside of the Western Nail Association. In November the manufacturers, who were by this time satisfied that the new men were capable, responded to an overture to negotiate by declaring that "our obligation to these new nailers is such that we could not entertain any proposition that would endanger our obligations." Individually, the mill owners reinforced this attitude by running ads promising feeders "a chance to learn nailing" with the attached provision that "places are guaranteed to those who accept this offer."[71]

By the end of November, 1885, strikers and manufacturers settled into a stand-off, neither offering to compromise. Each month the

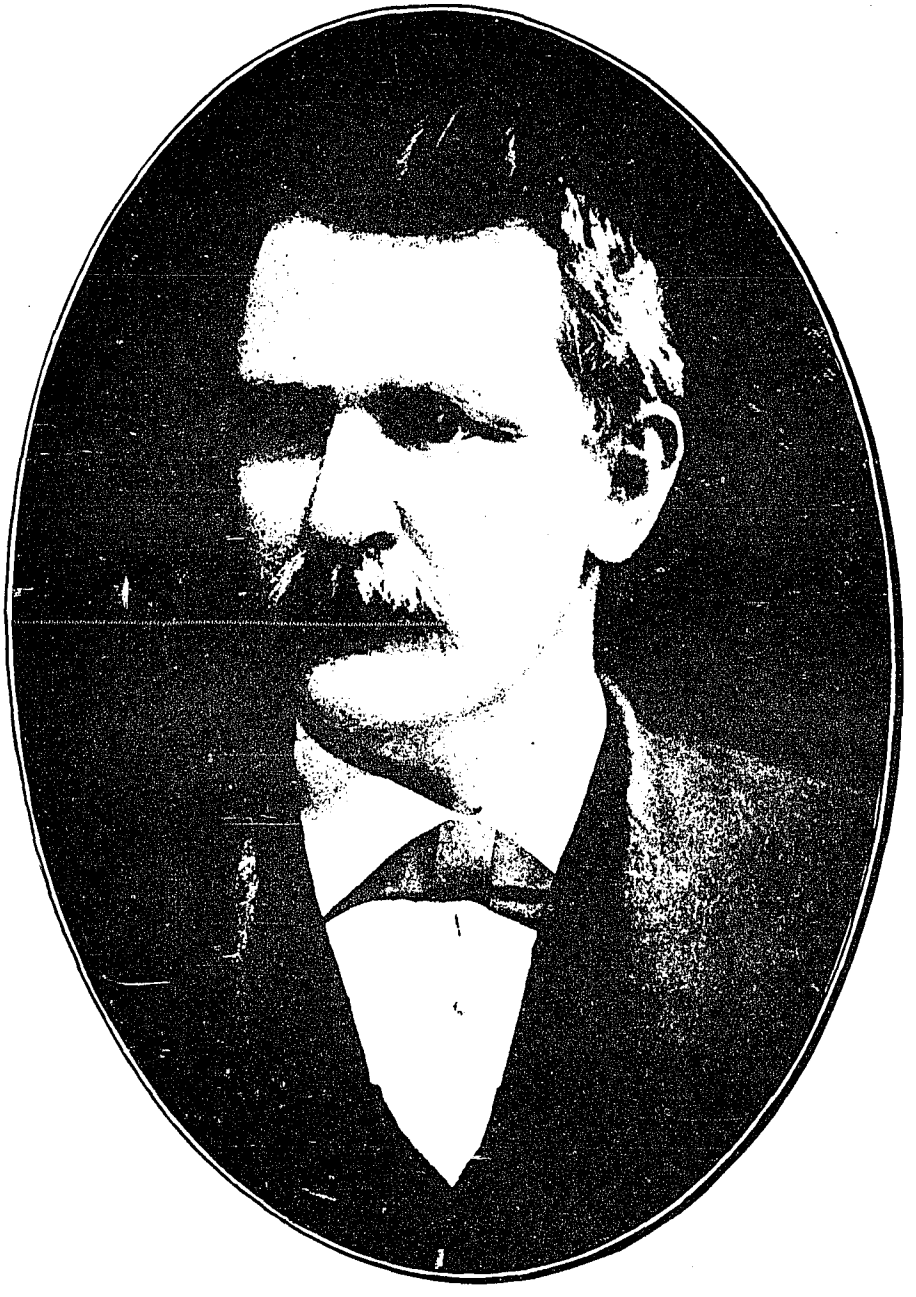


Fig. 23. Alexander Laughlin was one of the merchants to enter the nail business after the Civil War. Originally a wholesale drug merchant, Laughlin purchased stock in the Benwood Iron Works in 1864. He became a Director at the Benwood in 1868 and served as President from 1874 until 1878. Simultaneously he organized his own firm, the Laughlin Nail Company, and served as a Director of the reorganized Belmont in 1879. Laughlin gained considerable local recognition in September, 1886, when he fought a gun battle with strikers at the Martins Ferry works of the Laughlin Company. (Scott, p. 105)

Western Nail Association released figures showing the number of machines in operation was rising but steadfastly refused to discuss output. Nailers responded with an information campaign claiming that a nail shortage was imminent and by producing witnesses who criticized the quality of nails being turned out.[72]

In an effort to bring pressure on the manufacturers, the nailers organized a boycott, but the response was light. "Will the United Nailers, after opposing the feeders, as they have done for years, after sacrificing the boilers as they did, after deserting the Amalgamated Association as they did, explain by what right they assume to say that scab nails will bury in pauper's graves those that produce them?", asked one critic of the boycott.[73]

As the months passed, the nailers saw their occupations surely and steadily slipping away from them. Some reacted by seeking employment in Eastern factories. Others moved west to work in the California plants. A few returned to the Wheeling factories. And at least two groups formed cooperative factories. By the spring of 1886 it was clear that the manufacturers had won the contest. Even the Bellaire Works that had operated throughout the strike served notice on April 15 that, in keeping with its policy of paying prevailing wages, it would reduce the nailers rates from 21¢ to 17¢ per keg for 10d common and conform to the Western Nail Association's Cincinnati scale on all other sizes.[74]

The disheartened nailers, with numbers steadily dwindling, conceded defeat in May. They turned back to the Amalgamated Association asking for readmission to the union that they had so recently left. On June 1, four days shy of one year after the strike began, the nailers not only

voted to ask for readmission to the Amalgamated Association but also requested that the Association take up their cause with the manufacturers. On June 26, the Amalgamated Association settled for the 17¢ scale with adjustments upward in the lower size ranges. The manufacturers were obligated to take the nailers back only if they had machines available; the feeders who had taken over machines were to be considered as nailers; and a newly employed feeder was to be paid one-half to three-fifths of the income from the machine he worked. In July and early August the nailers remaining in Wheeling gradually found machines. In order to stretch the limited work available, the old nailers worked split shifts, sharing their machines and incomes with each other.[75]

The manufacturers had won. They had succeeded in destroying the boilers and reducing the wages of all workmen. Cost data contained in the minute books of the Belmont Mill shows the impact that the events of 1885 and 1886 had on the cost of producing nails. In 1884, while wrought iron was still being used, labor costs were $1.03 or about 39 percent of the cost of a keg of nails. Three years later, after steel had replaced wrought iron, labor costs had declined to 42¢ or about 21 percent of the cost of a keg of nails. Spotty information from other mills in the Wheeling area tends to confirm that this pattern prevailed everywhere.[76]

From 1879 on, the manufacturers had a single objective--cost cutting--which they pursued in a determined way often characteristic of that group of men who were captains of industry in the late nineteenth century. They skillfully used technology--the automatic feeder and the Bessemer converter--to achieve this objective. In both cases

the technology was not introduced because it promised a better product. Rather it was used to bring about a reduction in the cost of labor. The manufacturers used the converter and the feeder first against one group and then another. Nor did the manufacturers single out labor; it should be remembered that they also turned on the Western Nail Association. To control this organization was as much a part of their strategy as the control of labor.

The events of the 1880-1885 era had substantial continuity with those of the 1870s. Particularly, the management and accounting systems that sprang up in the 1870s critically affected the events of the 1880s. Cost accounting was behind much of the planning of the manufacturers. They broke their cost of production into several categories and had begun to analyze their successes and failures based not on the total cost but upon component parts of the total.

Taken alone, cost accounting would not have had a critical impact. After all, the LaBelle had essentially been keeping such records since the 1850s. Only when the manufacturers found that they could use their accounts to make categorical comparisons with the Eastern manufacturers did the cost accounting become really important. The Wheeling men applied their system to the operation of competitors, drew comparisons and contrasts, gauged their own weaknesses and strengths, and set about formulating a plan to take advantage of the strengths and eliminate weaknesses. The Wheeling manufacturers therefore proposed to wipe out the high cost of labor and at the same time introduce a new product--the steel nail--that could not easily be manufactured by competitors. Wheeling men realized that they had more

capital to invest than most other nail makers and that once invested in steel facilities this capital would allow them to produce a basic product at a cost far less than competitors could.

The irony of the situation was that the plan was both a success and a failure. It was successful in reducing costs but a failure when it was neutralized by the sudden impetus the innovation process gave to the use of yet another technology--the wire nail. In fact, it was the move to steel and the resulting strike that hastened the widespread marketing of the wire nail, a product that was cheaper, lighter, and equally suited to most uses to which the cut nail was put.[77]

The Wheeling men won the battle but they lost the war. Their system of accounting and management allowed them to spot inefficiencies, effectively compare their operations to those of a similar nature, and take actions to correct problems. It did not have the capability, however, of adjusting to changes outside of the industry.

FOOTNOTES

CHAPTER IV

[1]The Benwood Iron Works, "Minutes of Stockholders' and Directors' Meetings from June 29, 1864 to January 21, 1880," pp. 161, 318. MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[2]Frederick Overman, A Treatise on Metallurgy (New York: D. Appleton & Co., 1873), p. 603; Henry Dickerson Scott, Iron and Steel in Wheeling (Toledo, Ohio: Caslon Co., 1929), pp. 65-67.

[3]Ibid.; F. H. Kindl, The Rolling Mill Industry (Cleveland, Ohio: Penton Publishing Co., 1913), pp. 21-36.

[4]Scott, Iron & Steel, pp. 67-68.

[5]The Benwood Iron Works, "Records," p. 123; The Belmont Nail Company, "Minutes of the Stockholders and Directors' Meetings of the Belmont Nail Company, July 11, 1879 to January 28, 1890," pp. 19, 46-48. MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia; Woodward, Bailey & Co., "Minutes of the Meetings of the Board of Directors and Stockholders of the LaBelle Iron Works from January 28, 1868-September 20, 1873," p. 46. MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[6]The Wheeling Intelligencer, April 22, 1885; The Steubenville Daily Herald, November 19, 1885; The Wheeling Intelligencer, September 21, 1882.

[7]Ibid., April 16, 1879 and June 30, 1879; The Wheeling Iron and Nail Works, "Minutes of the Stockholders' and Directors' Meetings from July 15, 1869 to July 22, 1892," p. 105. MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[8]The Benwood Iron Works, "Records," p. 365; The Wheeling Intelligencer, April 16, 1879; The Iron Age, September 13, 1877, p. 15.

[9]The Wheeling Intelligencer, December 29, 1879; The Iron Age, April 28, 1881, p. 5.

[10]Committee on Historical Statistics of the Social Research Council, The Statistical History of the United States from Colonial Times to the Present (Stamford, Conn.: Fairfield Publishers, Inc., 1965), p. 383; The Wheeling Intelligencer, December 29, 1878.

[11]Belmont Nail Company, "Records," pp. 134-194.

[12]Ibid., pp. 42, 129, 166; The Iron Age, February 23, 1882, p. 17.

[13]Ibid., October 18, 1883, p. 14; April 2, 1885, p. 14.

[14]The number of machines added by the firms has been determined from reports published in The American Iron and Steel Association, Directory of the Iron and Steel Works of the United States (Philadelphia: The American Iron and Steel Assoc., 1882), pp. 85-186; Iron and Steel Assoc., Directory 1884, pp. 131-145.

[15]The Iron Age, October 16, 1883, p. 14; April 2, 1885, p. 26.

[16]The Wheeling Intelligencer, February 21, 1884; The Steubenville Daily Herald, July 27, 1885.

[17]Iron and Steel Assoc., Directory 1882, pp. 99-122, pp. 99-122; Iron and Steel Assoc., Directory 1884, pp. iv, 162-164.

[18]The Steubenville Daily Herald, September 4, 1885; The Wheeling Intelligencer, May 27, 1885, August 28, 1885, July 27, 1885, and July 9, 1885.

[19]Belmont Nail Company, "Records," pp. 35, 49.

[20]The Wheeling Intelligencer, September 29, 1882.

[21]Belmont Nail Company, "Records," pp. 1, 34-194. The statistics for the Belmont Nail Company were taken from semi-annual statements contained in the minutes of the firm. Less complete records of the other firms show a similar picture.

[22]The Wheeling Intelligencer, September 18, 1884.

[23]Ibid., March 18, 1880, and July 8, 1880.

[24]The Iron Age, October 18, 1883, p. 14.

[25]The Wheeling Intelligencer, December 29, 1853, May 31, 1882, and August 18, 1882; Benwood Iron Works, "Records," p. 369.

[26]The Wheeling Intelligencer, May 31, 1882, and June 9, 1882. Various examples could be cited to show that the Wheeling manufacturers followed the lead of the Pittsburgh manufacturers until 1882. For example, see Wheeling Iron and Nail Company, "Records," pp. 108, 168.

[27]Benwood Iron Works, "Records," p. 365; Benwood Iron Works, "Minute Book, January 27, 1880 to August 4, 1892," p. 9. MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia; The Wheeling Intelligencer, June 9, 1882.

[28]Ibid., August 17-18, 1882, September 21, 29, 1882.

[29]The Iron Age, January 29, 1885, p. 14. Although Vance's role is clouded, his leadership in the move to steel, his election as president of the Western Nail Association after the "Wheeling Coup" in 1885, his central role in the manufacturers association during the 1882 strike, and his leadership in breaking the United Nailers Union in 1886 are evidence of his position.

[30]The Wheeling Intelligencer, April 23, 1885, and May 12, 1885.

[31]Ibid., April 23, 1885, and February 13, 1885; The Iron Age, January 29, 1885, p. 14.

[32]The Wheeling Intelligencer, March 21, 1885, and April 23, 1885.

[33]Ibid., April 23, 1885; LaBelle Iron Works Stockholders, "Minutes September 13, 1887-March 25, 1902," (pages not numbered), April 11, 1889, May 13, 1889, and May 25, 1895 meetings.

[34]The Wheeling Intelligencer, April 9, 1885.

[35]Benwood Iron Works, "Minute Book," pp. 4, 330; The Iron Age, July 5, 1877, p. 5; November 30, 1882, p. 26; The Wheeling Intelligencer, October 23, 1884.

[36]Benwood Iron Works, "Minute Book," p. 4; Scott, Iron & Steel, p. 89.

[37]The Iron Age, November 30, 1882, p. 26; Wheeling Iron and Nail, "Records," p. 168, 169, 173; Benwood Iron Works, "Minute Book," pp. 80, 82, 101, 105.

[38]Wheeling Iron and Nail, "Records," p. 173; The Iron Age, August 23, 1883, p. 30.

[39]Scott, Iron & Steel, p. 92.

[40]The Wheeling Intelligencer, April 29, 1884; Benwood Iron Works, "Minute Book," p. 178; Wheeling Iron and Nail, "Records," pp. 191-192; Belmont Nail Company, "Records," pp. 176, 177, 227.

[41]The Wheeling Intelligencer, June 30, 1880.

[42]Ibid., September 21, 1882, and May 29, 1885.

[43]At least some observers at the time saw that the strike was the outgrowth of events of the preceding years. "This strike commenced some five or six years ago," wrote the "Quiet Observer" in The Steubenville Daily Herald, October 29, 1885.

[44]Robert L. Plummer (ed.), Sixty-Five Years of Iron and Steel in Wheeling (n.p., n.d.), contains the reminiscences of Alexander Glass, a nailer who later became bookkeeper for the LaBelle Company and eventually Chairman of the Board of Wheeling Steel in 1920, pp. 9-14; James E. Reeves, M.D., The Physical and Medical Topography of the City of Wheeling (Wheeling: The Wheeling Daily Register, 1870), pp. 23-24.

[45]The Steubenville Daily Herald, September 4, 1885, has a list of employee classes in the mills; The Wheeling Intelligencer, April 26, 1875, and April 28, 1875. The current manager of the LaBelle Nail Works has in his office a check written in 1942 by a nailer that is clearly marked as wages for feeding.

[46]Belmont Nail Company, "Records," pp. 5, 9, 13; Benwood Iron Works, "Records," p. 316.

[47]The Wheeling Intelligencer, May 25, 1882; The Steubenville Daily Herald, November 14, 1885.

[48]The Wheeling Intelligencer, January 6, 1875; Wheeling Iron and Nail, "Records," pp. 108, 109, 157, 165; The Wheeling Intelligencer, August 17, 1882, September 30, 1882, and May 25, 1882.

[49]Ibid., September 18, 1884.

[50]Ibid., February 28, 1872, April 26, 1875, April 24, 1875, and May 11, 1875. Company records do not show which particular model(s) of feeders the workmen purchased. See The Iron Age, March 12, 1874, p. 3, and December 30, 1875, p. 5, for discussion of the state of automatic self-feeders. Also see Chapter I of this study for discussion of self-feeders in more detail.

[51]The Wheeling Intelligencer, April 26, 1875.

[52]Ibid., August 8, 1884.

[53]LaBelle Nail Company, "Records," p. 72; Benwood Iron Works, "Minute Book," p. 111; Belmont Nail Company, "Records," p. 98; The Steubenville Daily Herald, July 27, 1885 and July 9, 1885; The Wheeling Intelligencer, June 12, 1885.

[54]Ibid., May 10, 1886, and April 22, 1884.

[55]Ibid., January 16, 1884, April 29, 1884, May 10 and 16, 1884.

[56]Ibid., August 8 and 12, 1884; The Iron Age, April 23, 1885, p. 17.

[57]The Wheeling Intelligencer, August 9, 1884.

[58]Ibid., September 20, 1884; The Steubenville Daily Herald, November 19, 1885.

[59]The Wheeling Intelligencer, September 15, 1884, January 19, 1885, and March 27, 1885; The Steubenville Daily Herald, July 15, 1885.

[60]The Wheeling Intelligencer, May 23, 1885.

[61]Ibid., May 29, 1885, and June 2, 1885.

[62]Ibid., July 10, 1885; Belmont Nail Company, "Records," pp. 184, 206.

[63]The Wheeling Intelligencer, July 10, 1885, and August 24, 1885.

[64]Ibid., June 12, 1885; The Steubenville Daily Herald, July 7, 1885.

[65]Ibid., July 9, 1885.

[66]The Wheeling Intelligencer, July 10, 1885; The Steubenville Daily Herald, July 17, 1885.

[67]Ibid., July 27, 1885; The Wheeling Intelligencer, January 6, 1886. On January 13, 1886, 1,157 machines were producing under the Cincinnati Scale and 606 were producing on the Nailers Scale.

[68]Ibid., July 10, 1885.

[69]Wheeling Iron and Nail, "Records," p. 207; Benwood Iron Works, "Minute Book," p. 190; The Wheeling Intelligencer, January 20, 1886, and August 13, 1886.

[70]The Steubenville Daily Herald, September 28, 1885.

[71]Ibid., November 11, 1885, and November 12, 1885.

[72]The Wheeling Intelligencer, December 5, 1885, and November 6, 1885; The Steubenville Daily Herald, November 4, 1885, and October 30, 1885.

[73]The Wheeling Intelligencer, April 14, 1886.

[74]Ibid., April 22, 1886.

[75]Ibid., June 1, 1886 and June 26, 1886.

[76]Belmont Nail Company, "Records," pp. 173, 294.

[77]Earl C. May, Principio to Wheeling 1715 - 1945: A Pageant of Iron and Steel (New York: Harper & Brothers, 1945), pp. 188-191.

CHAPTER V

COMPETITION FROM THE WIRE NAIL

> The wire nail appeals to certain characteristic national traits. It is cheap, easy to handle, can be driven by any creature that can lift a hammer, and can be rapidly pulled out again. In an age of shoddy materials and shoddy mechanics, it is inevitable that the cheap, facile wire nail should hold sway.[1]
>
> Henry Dickerson Scott
> Iron and Steel in Wheeling, 1929

Scarcely half a year after the Great Strike was concluded, The Wheeling Intelligencer published a special sixteen page edition celebrating the arrival of natural gas at Wheeling. In this edition the editor commented extensively on the future of Wheeling, citing "splendid facilities," "solid men of means," "established industries," "health," "low taxation," and a host of other advantages. The editor concluded by proclaiming that "Wheeling stands on the threshold of a new era. It is on this foundation [of established industries] that the superstructure of a new and greater Wheeling is to be built."

The observation and optimistic prediction of the editor proved to be at once true and false. Within a few years the marvelous new fuel the paper heralded had vanished, at least temporarily, and the coal bins that had been ceremoniously whitewashed were again pressed into service. Moreover, the great nail factories, like the natural gas, vanished. The blast furnaces, the Bessemers, and the rolling mills, all built to provide nail plate, had to be turned to other products. Herein lies the

final chapter in the history of Wheeling's nail industry. It is the story of a tenacious adherence to the cut nail that had put Wheeling on the map and the frustrating search for a new product to replace the cut nail.

From the standpoint of those who were proponents of the cut nail, the decade and one-half after the Great Strike was a difficult period. Wheeling manufacturers could not cope with the wire nail, and for a time they seemed unable to withdraw from their old enterprises. After the initial shock of wire nail competition had passed, the manufacturers did regroup and turn their facilities to other products. After successive waves of reorganization and after almost forty years, the Wheeling nail firms ended up merged into a major steel corporation.

The origin of the wire nail, a nail with a round shank of constant diameter, is uncertain. Small nails that fit this description appeared in the early eighteenth century and were used by cabinet makers to attach decorations to furniture. Any similarity between these nails and the wire nails of the late nineteenth century is little more than coincidental, however. Peter Priess, one of the few researchers to consider the origin of the wire nail, suggested that it originated in France sometime around 1820. His evidence rests largely on several French patents for machines to manufacture wire nails and the common name--"French nails" or "pointes de Paris"-- used to identify nails with round shanks during the nineteenth century.[2]

Throughout the first half of the nineteenth century the manufacture of wire nails appears to have occurred only in Europe. The nails were limited to smaller sizes used primarily for upholstering, picture frames, and similar types of construction. Although several sources give 1877

as the date of the first American patent for wire nail machines, one New York manufacturer, T. C. Richards & Company, advertised "Richards Patent Porcelain-Headed Picture Nails" as early as 1873. A drawing of the Richards nail which appeared in The Iron Age shows clearly that it was a wire nail. The Richards advertisement also contained reference to imported nails and specifically mentioned "wire nails."[3]

After the initial notation of wire nails in the Richards advertisement, The Iron Age, which served also as a trade journal for the hardware industry, contained frequent references to the wire nail. In 1878, for example, the Dunbar Hobart & Whidden Tack Company of South Abington, Massachusetts, advertised "French wire nails . . . made to order from description or samples," and the ad included an illustration showing wire nails up to two and a half inches in length. Two years later, in 1880, The Iron Age carried the first description of wire nail manufacturing, describing a German wire nail machine in a lead article. These references and several others that appear in The Iron Age continued to suggest that the wire nail was not comparable to the cut nail. The wire nails advertised were for use in furnishings, boxes, saddles, decorative work, picture frames, and the like and not as an element in buildings or other types of heavy construction. As such, the wire nail offered no competition for the American cut nail manufacturers during the 1870s.[4]

During the early 1880s, larger size wire nails, potentially suited for construction purposes, appeared. The availability of cheap steel wire appears to have been of importance for the wire nails. Iron wire simply did not have sufficient strength to serve as a material for the

relatively small shanks of the wire nail. But as domestic steel production increased during the late 1870s and steel wire became more readily available, three American wire nail manufacturers appeared. The first, the American Wire Nail Company of Covington, Kentucky, began operations sometime around 1880. This company was joined by the H. P. Nail Company of Cleveland, Ohio, in 1882. By 1885, the latter company had a full range of wire nails on the market, including "wire spikes for track, bridge, and dock work." A third wire nail manufacturing firm, the Salem Wire Nail Company of Salem, Ohio, joined the two older firms in 1886. Like the H. P. Nail Company, the Salem firm produced large as well as small wire nails.[5]

All three of the wire nail manufacturers grew up in the Western Nail Association territory, and the Salem Wire Nail Company was literally in Wheeling's back yard. Yet, there is no indication that the cut nail manufacturers took any note of the presence of these firms. During the early 1880s when the market for nails was rapidly expanding, the cut nail manufacturers would have had little reason to be concerned. As the market began to contract in 1883, the Wheeling manufacturers turned their attention to acquiring steel facilities and placed their faith in the development of a superior, cheap steel nail. Even if they did take note of the presence of the wire nail, they were most likely of the opinion that the steel cut nail would be of superior quality and sufficiently inexpensive to compete with the wire nail.[6]

Proponents of the cut nail also assumed that the "holding power" of the cut nail was superior to that of the wire nail. Swank noted in 1892, "Deep rooted prejudices of all kinds had to be overcome before the wire

nail could be accepted." The first step toward overcoming the prejudices was taken in 1884 when the wire nail manufacturers convinced the Watertown Arsenal to run tests on the holding power of the wire nail. Results of the test showed that the wire nail, particularly in the smaller and intermediate sizes, had holding power comparable to that of the cut nail. The Salem Wire Nail Company took note of these tests in its advertisement by showing the wire nail and the cut nail side by side driven through a board. The advertisement pointed out that wire nails did less damage to the wood, a particularly important point for carpenters who did interior trim work.[7]

Without question, however, the most important factor in the initial acceptance of the wire nail was the Great Nail Strike of 1885 and 1886. By early 1886 hardware jobbers and dealers had exhausted nail stocks. The Eastern mills that continued in operation simply could not fill the orders coming in from the West. In January of 1886, the editor of The Iron Age took note of the opportunity the strike was offering for wire nail manufacturers.

> Another factor, of course, which cannot be overrated was the wire nail. The strike offered a splendid opportunity for its introduction . . . . There can be no doubt that a very large number of important customers have learned . . . to appreciate the economy of wire nails [and] . . . have been taught to value them for many points of excellence they possess for specialty work. The wire nail has conquered territory which in the future it may claim as its own. Loss to the cut nail is greater than even has appeared on the surface . . . .[8]

The loss was great, indeed far greater than anyone at the time, including that editor, imagined that it might be. Cut nail production peaked in 1886 at 8,160,973 kegs and began a rapid decline thereafter. A decade later, in 1897, cut nail production had declined to 2,100,000

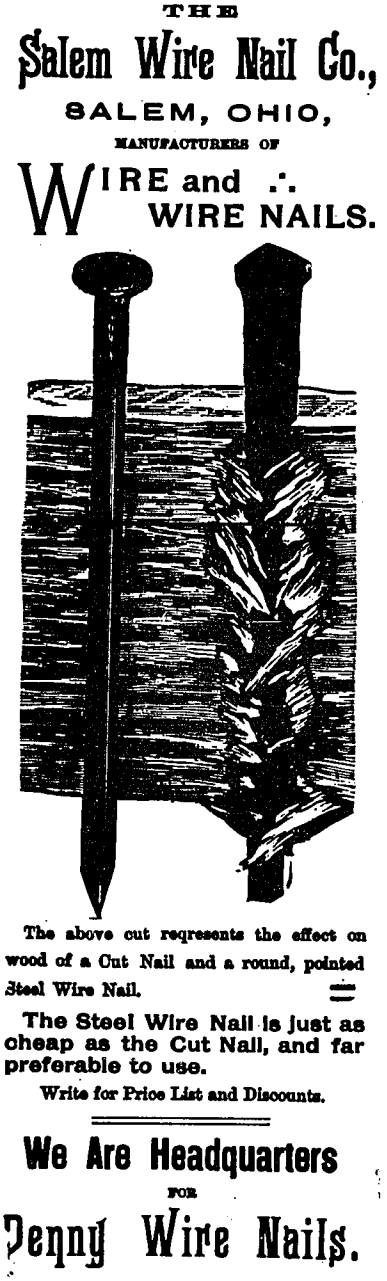


Fig. 24. Advertisement for the Salem Wire Nail from The Iron Age, November 19, 1885. The illustration summarizes the conclusions of the tests performed at the Watertown Arsenal in 1884. During the Great Nail Strike, the wire nail manufacturers heavily advertised the desirable qualities of the wire nail. See Report of the Test of Metals and other Materials for Industrial Purposes (Washington, D.C.: Government Printing Office, 1886), pp. 448-450.

kegs. During the same period of time wire nail production had risen from about 500,000 kegs to just slightly more than 9,000,000 kegs. By 1912, the wire nail accounted for 92 percent of the total nail production in the United States and had effectively replaced the cut nail.[9]

During the disruption in supply created by the Great Strike, several superior qualities of the wire nail quickly became apparent. Most notably, the wire nail was cheaper. Less metal was required to make the nail, and the technology was more automated. A spool of wire replaced the nail plate, and the attendant who either fed the machine by hand or filled the automatic feeder was no longer needed. Furthermore, the wire fed continuously into the machine which eliminated the necessity of flipping plate and therefore increased the rate of production. The wire nail was also easier to use. It did, as advertised, less damage to the wood and could be straightened if bent and even removed if necessary.[10]

In December, 1885, some members of the Wheeling manufacturing community began to talk about the dangers presented by the wire nail. A writer in The Wheeling Intelligencer sounded the alarm on December 1 in an article entitled, "A New Nail Competing." The newspaper reported that "the short production of the nail mills throughout the West has introduced a new and dangerous nail for the trade--the wire nail . . . ." Little more than a month later, on January 5, 1886, the directors of the Belmont Mill discussed the wire nail and appointed a committee to purchase shop rights for the Bradford wire nail machines. Throughout the spring and early summer both the Intelligencer and The Steubenville

Daily Herald contained several articles on the wire nail, and at least one other mill, the Benwood, appointed a committee to investigate the "workings of the wire nail machine."[11]

One of the more interesting commentaries on the new nail appeared in February, 1886, when The Steubenville Daily Herald carried an account of a meeting of wire nail manufacturers held at Pittsburgh. William Taylor, a wire nail manufacturer from Albany, Pennsylvania, summarized what seemed to be the prevailing attitude of his colleagues. Taylor commented that, "The constantly recurring difficulties in the nail trade have led inventors to work on various plans . . . to dispense with manual labor. The wire nail," he continued, "is destined to drive the cut nail out of the market, as it answers all the purposes fully as well, and does not require so much skilled labor . . . ." Obviously the wire nail manufacturers had gained some insight into the problems of their colleagues in the cut nail field and had, moreover, identified as crucial for their industry the same factor that the cut nail manufacturers had emphasized :- labor costs.[12]

Aside from the two companies that appointed committees to investigate the wire nail, there is little to suggest that the cut nail manufacturers took any direct action to counter the potential threat of the wire nail in the years immediately after its introduction. The attitude that David Spaulding, secretary of the LaBelle Nail Works, took towards the steel nail also prevailed in the wire nail matter. "Why is it the American people want everything new? It is one of those fantasies which I think will wear out."[13]

In the short term, the manufacturers could easily have concluded that the fantasy had worn out. Sales rebounded after the strike and did reach an all time high in 1886. Furthermore, sales remained brisk during early 1887. The skilled labor problem had been taken care of with the demise of the puddlers and the demoralization of the nailers. Moreover, the Western factories appeared to be in a position to eliminate Eastern competitors who publicly lamented that they could not compete unless they added Bessemers.[14]

Beginning in late 1887, however, cut nail prices began to slide, and by 1890 the Wheeling companies were selling for less than it cost to manufacture nails. In July, 1888, for example, the Belmont records showed that the cost of manufacturing a keg of nails was $2.04 per keg and the selling price was $2.07 per keg. Six months later the Belmont's manufacturing cost was $2.05 per keg and the selling price no more than $1.93. The Wheeling Iron and Nail Company had a similar experience. By 1890, the firm was losing 33¢ on each keg of nails it sold. Even the operators of the venerable LaBelle found conditions intolerable. In 1889, the directors finally "after general review of the conditions of the business," considered the purchase of wire nail machines.[15]

Insofar as can be determined, no Wheeling manufacturer ever actually switched to wire nail production. Several writers, most notably Scott, have puzzled over why the wire nail was so universally rejected in the Wheeling manufacturing community. He theorized that the strong prejudices in favor of the cut nail refused to yield and allow the manufacture of what many in the industry regarded as

an inferior product. This theory contains a grain of truth, but it must be taken in conjunction with other explanations.[16]

There can be no question that, in the first few months after the wire nail threat became apparent, the Wheeling manufacturers displayed an aloof attitude. The euphoria from the victory over the puddlers and nailers, from new Bessemer plants, and from the profitable market seemed to suggest that the cut nail could become even more profitable than it had been in the early 1880s. When the profits disappeared in 1887, 1888, and 1889, the manufacturers assumed that the problem was a matter of overproduction, as it had been in 1883 and 1884. Their initial response was to attempt to control production and thereby drive prices up. To control prices and production the Wheeling manufacturers attempted to form a corporation to control the mills. While the specifics of the proposed organization and the events surrounding it are unclear, the organization seems to have been very similar to that which had existed in the tack industry. Individual firms and stockholders were to surrender their stock in exchange for stock in a corporation that controlled all of the mills. The effort failed miserably. In 1889 the LaBelle Corporation not only withdrew from this venture but also dropped out of the Western Nail Association.[17]

Actually, the market was substantially changed from that which had existed in the late 1870s and early 1880s. The cut nail manufacturers had lost control. With every attempt to limit production in the cut nail industry, the wire nail simply gained new customers. That the cut nail manufacturers did not understand this is almost beyond comprehension in the light of hindsight; at the time, however, such a

misreading of the situation was not only plausible but quite possible. The assumption about the quality of the two products, the lack of accurate sales information (the wire nail manufacturers were never a part of the Western Nail Association so the cut nail manufacturers could not obtain production figures), and the prevailing opinion expressed by The Iron Age that overproduction was solely responsible for the price decline made an accurate assessment of events almost impossible.[18]

Once the manufacturers did conclude that the wire nail was competing for traditional markets, they had insurmountable problems. The technology of the two products, while appearing at first glance to be similar, was actually very different. Here technology, rather than business, became the dominant influence. The cut nail was a product of the rolling mill. Wrought iron (and later steel) was rolled into slabs and then into plate. Wire nails were the end product of an entirely different process. The steel ingots were converted first to blooms, to billets, and then into bars from which the wire rod was formed. Consequently, to convert to the wire nail, manufacturers would have had to retool not only the nail factories but also the rolling mills.[19]

Under the most favorable conditions, this conversion would have been expensive. For Wheeling manufacturers, it was all but impossible. Their heavy investment in Bessemer converters in the mid-1880s had consumed the capital that had accumulated from the flush period between 1880 and 1883. Furthermore, the Great Strike had kept income down during the mid-1880s. In the final analysis, cut nail manufacturers simply did not have the resources available for retooling their nail factories and rolling mills.[20]

Finally, the Wheeling manufacturers and the rest of the cut nail industry in general faced competition from a vigorous new industry that quickly became organized and developed rapidly. By 1889 there were thirty-seven wire nail works in the United States. Four years later, in 1892, the number of firms had increased to forty-nine, and this trend continued through the end of the century. By 1901 there were fifty-eight manufacturers of wire nails producing the 9.8 million kegs turned out that year.[21]

Not only were the number of producers growing but the wire nail manufacturers were becoming increasingly well organized. In 1897, John H. Parks, a seasoned industrial promoter from Indiana, undertook a combination of wire nail mills. A year later he was joined by John W. Gates, a fellow Indianian, who was attempting to consolidate barbed wire manufacturers. The two combined their efforts and in 1898 formed the American Steel and Wire Nail Corporation, a company that brought most of the nation's wire producers under its control. By the turn of the century, when United States Steel purchased the American Steel and Wire Corporation, the firm owned 11 blast furnaces, 15 steel works, 13 wire rod plants, 23 wire drawing plants, 16 nail mills, 8 iron mines, almost 12,000 acres of coal land, 1,800 coke ovens, and a fleet of lake steamers. Furthermore, the marketing system developed by the American Steel and Wire Corporation reached to every corner of the United States, to most of the Western European countries, and to the larger cities in the Near East.[22]

Cut nail manufacturers simply could not compete with this well organized industry. Many cut nail manufacturers outside of the Wheeling

district switched partially to wire nails and managed to retain a portion of the local market. At Wheeling, all of the cut nail manufacturers clung to the old product, but by the early 1890s most firms ceased to hold any hope of a revival of the market and had instead begun the search for alternative products.[23]

Between 1890 and 1900, three of the Wheeling nail mills discontinued operations completely. The first to go was the Benwood Mill, followed by the Bellaire Mill and later the Junction Nail Works. Additionally, those mills remaining showed a steady decline in production. "The nail factory was entirely idle during the months of January and February," the secretary reported to the directors of the Belmont Mill, "because the price at which nails was selling was too low." Scott commented that the Laughlin factory, "once the pride of the Ohio Valley, was little better than a junk heap" by 1900. By 1914 only the LaBelle Mill at Wheeling remained in operation. All of the others had been disassembled or sat idle.[24]

The Wheeling firms did finally turn to other products. The Riverside was the first to diversify. In 1887 the firm opened a tube works, becoming the first mill in the country to produce butt and lap-weld Bessemer steel tubing. This venture proved very successful. The Riverside pipe found a lucrative market in West Virginia and Ohio oil fields. The Wheeling Iron and Nail Company switched to the production of sheet in 1888, and, along with the Whitaker Iron Company, gained a sizeable share of the roofing and metal utensil market. The Belmont and Benwood attempted to shift a portion of their nail works to tack production, although never very successfully. The two latter firms

also went into the production of sheet, converting much of it into shovel plate.[25]

Salvation for the faltering mills did not finally arrive until the mid 1890s when the full effects of the McKinley Tariff on foreign tinplate stimulated domestic tinplate production. Two small firms, the Etna-Standard Works of Martins Ferry and the Wheeling Corrugating Company (neither had been nail producers) added tin mills in 1893 and 1894. The following year the Laughlin Nail Works and the LaBelle followed suit. For about five years these firms prospered. The LaBelle tin mill, for example, showed almost $60,000 profit in the first full year of operation.[26]

Just as the Wheeling firms' tin mills were allowing the firms to recuperate from the loss of nail markets, they became caught up in a round of mergers. The first merger, a local one, came in 1892, when the Wheeling Iron and Nail Company, the Belmont Iron Works, the Benwood Nail Works, and the Wheeling Steel Works combined to form the Wheeling Steel and Iron Corporation. This new firm, with an authorized capital stock of $5,000,000, became the largest and the most stable of the Wheeling firms during the 1890s and the first decade of the twentieth century. The new company built a substantial trade in semi-finished products--muck bar, steel billets, steel slabs, and sheet production. Additionally, the Wheeling Steel and Iron Company built a tube works and sporadically operated the old nail mills.[27]

Beginning in 1897, the firms (except for Wheeling Steel and Iron) that had developed finished product mills participated in a series of reorganizations that radically altered the manufacturing community in

Wheeling. In late 1897 the Riverside sold its tube works to the National Tube Corporation. Initially only the tube works was sold, but by 1901 National Tube, which by that time had become part of the United States Steel Corporation, had controlling interest in the Riverside furnace, Bessemer, and abandoned nail mill. That pattern became a common one. The LaBelle sold its tin mill to the National Tin Plate Corporation, as did the Bellaire, the Laughlin Nail Company, and the Etna-Standard Company. By 1901, the only tin mill that remained under local control was the Wheeling Corrugating Company works. Like the Riverside, the Bellaire, the Etna Standard, and the Laughlin Company were eventually consumed by other larger corporations in horizontal combinations.[28]

At the time of the reorganization not a single objection was heard. The "combinations" brought considerable profit to the firms and to the stockholders. Events that took place at the LaBelle Company may serve as a typical example of the impact that the combinations had on individual firms and stockholders. In September, 1898, the directors held a special meeting to consider an offer to purchase the LaBelle tin mill. The minutes of the meeting record that "the meeting was called for the purpose of considering a proposition that had been made . . . by F. S. Wheeler, representing Judge Moore, et al, of Chicago, who are working to effect a consolidation of the full production capacity of tin, terene, and black plate in the United States . . . ." The directors agreed to recommend to the stockholders that Judge Moore be granted an option to purchase the company's tin plate works for not less than $500,000. On November 22, 1898, the National Tin Plate

Corporation exercised this option, offering, instead of cash, $500,000 in preferred stock. The LaBelle accepted the offer plus a $91,615 cash settlement for the inventories on hand. The LaBelle made an immediate net profit of almost $300,000 on the sale; the real value, however, was boosted to almost $750,000 when American Tin Plate stock was exchanged for United States Steel stock in 1901.[29]

Insofar as can be determined, all of the deals were made along similar lines. Some, like the Riverside, took place in two stages, but the method was similar. In every instance the purchasing firm paid in stock, or exchanged its stock for that of the old firm. Everyone appeared to profit, particularly after the National Tin Plate Corporation and National Tube were absorbed by United States Steel.[30]

Of less concern to the stockholders, but of great significance to the companies, was the change in managerial leadership prompted by the sales. Frank Hearne left the Riverside when the tube works was sold to become the vice president of National Tube. Cecil Robinson, of the LaBelle, W. T. Graham, of Etna-Standard, and about two dozen other top managers also left to become officers or managers in the firms that had purchased the tin mills. In addition, a considerable number of engineers and middle level managers also took positions with the purchasing corporations. This talent drain severely hurt several of the firms and was at the time regarded as a key factor in the demise of the Etna-Standard and Bellaire Nail Works.[31]

After the flurry of buying and selling settled in late 1901, Wheeling was left with two firms intact (the Wheeling Steel and Iron and the Whitaker Iron Company) and four firms (the LaBelle, Laughlin,

Etna-Standard, and Wheeling Corrugating) that were partially dismembered. All of the firms, but particularly the ones that had engaged in the mergers, were wealthy from the sale, from capital gains, and from the dividends they received from United States Steel stock. Beginning in 1901 several of the firms expanded, attempting to fill in the gaps left by the sales and mergers. The LaBelle reinvested its profit from the tin mill sale in another tin mill after a four-year absence from the industry stipulated as part of the agreement with National Tin Plate. The Laughlin Company purchased, in concert with the Wheeling Corrugating Company and the Whitaker Iron Company, the Burgess Steel Corporation, an open hearth works at Portsmouth, Ohio. In 1903 these three companies combined to form Whitaker Glessner Corporation, and the old Laughlin Company passed completely out of existence.[32]

By 1905, only three locally owned firms remained. The LaBelle, with blast furnaces and a steel works at Steubenville and Mingo Junction, a tin mill at Mingo Junction, and a rolling mill at Wheeling, was the smallest. The Whitaker Glessner Corporation owned blast furnaces at Wheeling, Martins Ferry, and Portsmouth, Ohio, steel works at Portsmouth, and a sizeable rolling mill, tin works, and sheet mill at Wheeling. Wheeling Steel and Iron Corporation owned three blast furnaces, a steel works, three rolling mills, and a tube works, all at Wheeling. The three corporations and their component works, plus related mining and transportation facilities, formed the basis of what would become in 1920 the Wheeling Steel Corporation.[33]

The preceding pages have recorded the events that led to the decline of cut nail manufacturing in the Wheeling area. Because the

firms had integrated structures, the loss of the nail market was not as disastrous to them as it might have been. As the prices declined for nails, the firms turned to selling pig iron and steel thus retaining solvency, at least until adjustments could be made in their operations.

Within a short period, each of the firms had begun to search for alternate finished products and in short order had integrated forward into other lines. This strategy suggests that the manufacturers, individually and as a group, perceived the market to be more lucrative in finished products than unfinished metal products. That manufacturers chose to search out and produce new finished products is also not surprising in light of the developmental patterns of the firms. Undoubtedly, forces that led firms to integrate forward after the Civil War exerted some influence. The manufacturers, nurtured in an environment in which production was viewed as a mine-to-market process, felt more comfortable with finished product sales. As observed in Chapter III, the urge to exercise maximum control and thereby alleviate the uncertainties inherent in the intermediate products market had considerable influence upon the industry.[34]

The very practical matter of profitability was also an important factor. Data contained in the records of several firms show that while profits were realized from the sale of steel and pig iron, they did not approach the levels that had been previously associated with nails. Perceiving the price to be unsatisfactory, the manufacturers moved to circumvent the market by becoming, once again, the primary consumer of their own unfinished products.

The combination of these factors--low profitability of unfinished products and the experience with an integrated business structure--worked to favor rebuilding the old integrated structure with a new product in place of nails. During the late 1880s, the firms, except for the Wheeling Iron and Steel group, chose to retain their individual identity and separately select their own course of development. For a brief period they were successful, then the tin trust purchases and succeeding combinations reduced the firms to the status of unfinished product manufacturers again by 1900. Feeling no less uncomfortable with the condition in 1900 than they had in the 1880s, the individual firms set out to once again reestablish the mine-to-market structure. The agreements with the "trusts" that left some firms free to enter the tinplate or pipe production market, and prohibited others from such activities, and uneven growth patterns that had resulted in more modern furnaces and rolling mill equipment at various firms, dictated a different approach after 1900. Instead of striking out as separate firms, they eventually concluded to combine resources, integrate horizontally, and through a succession of combinations that circumvented the "trust" agreements form a single company--the Wheeling Steel Corporation. Just as vertical integration in the 1870s had been a response to market conditions and management's perception of the most advantageous method of controlling certain transactions, so, too, the decision to combine the firms under single ownership after 1900 resulted, at least in part, from a desire to keep transactions internal.[35]

FOOTNOTES

CHAPTER V

[1]Henry Dickerson Scott, Iron and Steel in Wheeling (Toledo, Ohio: (Caslon Co., 1929), p. 99.

[2]Peter Priess, "Wire Nails in North America," The Association for Preservation Technology Bulletin, Vol. V, 1973, p. 7.

[3]The Iron Age, January 2, 1873, p. 2; Priess, "Wire Nails," pp. 88-89.

[4]The Iron Age, March 28, 1878, p. 25. The first American made wire nails were probably produced by tack manufacturers. Because tack and nail manufacturing were regarded as separate industries throughout the nineteenth century, this study has not looked carefully at manufacturers who specialized in tacks. The industry does deserve more study because, unlike the Eastern nail manufacturers, the tack producers modernized and by the mid-1870s, as noted earlier, a trust had been formed. Every major manufacturer in the East and West surrendered stock to a controlling corporation in return for shares.

[5]Priess, "Wire Nails," p. 89; The Iron Age, July 3, 1879, p. 2, March 19, 1885, p. 34; The National Cyclopaedia of American Biography, XV, (New York: James T. White & Co., 1916), p. 306.

[6]Just how much information the Wheeling manufacturers had about wire nail manufacturing is unclear. If they read The Iron Age, as they almost certainly did, they had to be aware of the new technology and the existence of the Salem Wire Nail Company.

[7]James M. Swank, History of the Manufacture of Iron and Particularly in the United States from Colonial Times to 1891 (New York: Burt Franklin, 1892), pp. 450-451; Report of the Tests of Metals and Other Materials for Industrial Purposes made with the United States Testing Machine at Watertown Arsenal, Massachusetts (Washington, D.C.: Government Printing Office, 1886), pp. 448-463. "Holding power" was an imprecise term used by nailers. It referred to the amount of force required to withdraw a nail from a piece of wood.

[8]The Iron Age, Janury 7, 1886, p. 22.

[9]F. H. Kindl, The Rolling Mill Industry (Cleveland, Ohio: Penton Publishing Co., 1913), p. 41

[10]The Wheeling Intelligencer, December 1, 1885; Priess, "Wire Nails," p. 89; J. Bucknall Smith, A Treatise Upon Wire, Its Manufacture and Uses (New York: John Wiley & Sons, 1891), p. 335.

[11]The Wheeling Intelligencer, December 1, 1885; The Benwood Iron Works, "Minute Book, January 27, 1880-August 4, 1892," p. 214; The Belmont Nail Company, "Minutes of the Stockholders and Directors Meetings of the Belmont Nail Company, July 11, 1879-January 28, 1890," p. 214. Both manuscripts are in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[12]The Steubenville Daily Herald, February 1, 1886.

[13]Ibid., March 25, 1886.

[14]The Wheeling Intelligencer, August 16, 1886.

[15]Belmont Nail Company, "Records," pp. 292, 304; The Wheeling Iron and Nail Company, "Minutes of the Stockholders' and Directors' Meetings from July 15, 1869-July 22, 1892," pp. 253, 266. MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[16]Scott, Iron & Steel, pp. 99, 107.

[17]Wheeling Iron and Nail, "Records," p. 253; The LaBelle Iron Works, "Stockholders' Minutes, September 13, 1887-March 25, 1902," May 13, 1889 entry (pages not numbered). MS in the possession of the Wheeling-Pittsburgh Steel Corporation, Wheeling, West Virginia.

[18]The Iron Age, January 7, 1886, p. 22, June 30, 1886, p. 20.

[19]Kindl, Rolling Mill Industry, pp. 20-23.

[20]Scott, Iron & Steel, p. 91; The Steubenville Daily Herald, June 24, 1885.

[21]The American Iron and Steel Association, Directory to the Iron and Steel Works of the United States (Philadelphia: The American Iron and Steel Association, 1892), pp. xiii, 387; Kindl, Rolling Mill Industry, p. 41.

[22]American Iron and Steel, Directory 1901, pp. 29-38; Joseph M. McFadden, "Monopoly in Barbed Wire: The Formation of the American Steel and Wire Company," The Business History Review, Winter, 1978, pp. 472-474.

[23]American Iron and Steel, Directory 1901, pp. 381, 385; Scott, Iron & Steel, p. 99.

[24]Belmont Nail Company, "Records," p. 250; Scott, Iron & Steel, pp. 147, 158, 159; American Iron and Steel, Directory 1901, pp. 390-381.

[25]Scott, Iron & Steel, pp. 110-112, 114; The Wheeling Intelligencer, July 12, 1886.

[26]Scott, Iron & Steel, pp. 120-129.

[27]Wheeling Iron and Nail, "Records," p. 274; Scott, Iron & Steel, p. 114; American Iron and Steel, Directory 1901, p. 121.

[28]Scott, Iron & Steel, pp. 137-141.

[29]LaBelle Iron Works, "Minutes," September 16 and November 22, 1898 entries.

[30]Scott, Iron & Steel, p. 137; LaBelle Iron Works, "Annual Statement July 14, 1898-July 1, 1899."

[31]Scott, Iron & Steel, pp. 112, 121; LaBelle Iron Works, "Minutes," January 12, 1899 entry.

[32]Scott, Iron & Steel, p. 145.

[33]American Iron and Steel, Directory 1901, pp. 119-121; Scott, Iron & Steel, p. 158; The Wheeling Steel Corporation, "Annual Report to the Stockholders, April 15, 1921."

[34]Oliver E. Williamson, Markets and Hierarchies and Antitrust Implications (London: Collier MacMillan Publishers, 1975), pp. 83-99.

[35]Scott, Iron & Steel, pp. 146-157.

CONCLUSION

> Major product change is often introduced from outside an established industry and is viewed as disruptive. . . .
>
> William J. Abernathy
> "Patterns of Industrial Innovation"[1]

This study has examined one industry that seemed to have a unique and peculiar tie to the American experience. Born of Yankee ingenuity, the cut nail industry supplied fasteners that allowed the nation to use its plentiful supply of wood effectively. Evidence in preceding chapters has shown that a variety of factors stimulated and played a part in the evolution of the industry. Unquestionably the invention of machines and their application to what had previously been a labor intensive manufacturing process was the most important factor in the early development of the industry. In this sense, technology may be given top billing. Technology, however, springs from and exists, succeeding or failing, in a broader environment of needs, attitudes, and public policy. Ready acceptance of the cut nail by the labor poor nation; flexibility that permitted the machine to be used in a variety of situations and circumstances; official encouragement manifest in favorable tariffs, premiums, and official statements; as well as coincidental development of complementary technologies--all were critical.

Basically, too, a sizeable and constantly expanding market that could absorb an ever-increasing number of nails was essential for the

growth of the industry. The rapid increase in the population and related demands for housing and other structures alone created a demand for nails. Moreover, the development of balloon frame construction, an architectural style that, in part at least, resulted from nail technology, intensified that need for nails.

It is neither useful nor necessary to assess the importance of the technology, the markets, and the other factors that have entered into the story. Each was an essential condition. Furthermore, as the nation and the industry developed, the relative importance of several factors changed. In the early part of the nineteenth century, the machine seemed to be the most critical, while later in the century, after the technology had matured, management and capital assumed a much larger role.

Cut nail manufacturing embodied several concepts that scholars have identified as being of importance. Most notably, the history of nailmaking affords an opportunity to examine the impact of mechanization on a single industry. From the late eighteenth century, when the first cutters appeared, inventors sought to perfect machines that completely automated nailmaking. Developments in the industry during the early nineteenth century were largely associated with efforts to perfect headers, more efficient cutters, and automatic feeders. The result was a significant increase in the rate of production and output per employee.

Along with attempts to mechanize was a subsidiary but important attempt to reduce waste. The cutter eliminated wasteful slitting and resulted in more nails per ton of metal. Moreover, the cutter

standardized both the size and weight and thereby reduced variations in metal consumption that were inevitable when each nail was a unique product.

Finally, the cut nail process introduced specialization into the industry. The machine initially divided the work into several distinct stages. The feeder, the nailer, and, until the 1830s, the header all performed specialized tasks demanded by the machines. By the mid-1870s the definition of work tasks imposed by the machine had become the basis for worker unions. Eventually, the separation of nailer and feeder, and the associated status and pay differences, led to a confrontation that culminated in the Great Strike of 1885-1886, an event that had major consequences for the industry.

The cutter, header, and related equipment also prompted basic organizational changes within the industry. Gradually nail manufacturing ceased to be an activity undertaken in small shops or on the farm. In settled areas of the country, nail factories came into existence, and by the 1830s small integrated firms, such as the Phoenixville, Pennsylvania, firm that combined puddling, rolling, and nailmaking, had appeared. The new technology and the new organization produced striking results. Productivity increased, prices decreased, and per capita use of nails rose dramatically. After the 1840s, when the factory system had become firmly established in the nail industry, the potential for large scale production was present. From that point progress in the industry depended primarily on the development of a management strategy and marketing techniques that recognized and took advantage of the potential for mass marketing.[2]

When nail manufacturing was introduced at Wheeling in 1833, therefore, the technology and the factory system had been established in the industry. The Top Mill and later the Virginia and Belmont Mills copied the prevailing pattern of organization and, with some improvements, the existing technology. Throughout the 1840s and 1850s Wheeling firms were state-of-the-art manufacturers. Neither the technology, the form of organization, nor the size or capability distinguished them greatly from nail manufacturers in Pittsburgh or the Mahoning Valley. Cheap, readily available coal and transportation appeared to be the major advantages of the Wheeling firms. But it must be added that entrepreneurial skills, particularly the capacity for raising capital, present in a few key individuals such as Edward Norton, were of significant importance during the 1840s and 1850s.

Tracing the development of the Wheeling firms from the founding to the end of the cut nail industry has allowed an examination of the growth and of the changes that occurred in the manufacturing process, management, and technology. There is no suggestion that the cut nail industry was typical, or that generalizations can be made that will apply to other industries or to industrial development in general. Several trends noted by others who have studied industrialization have been noted here. Increasing size of operations, vertical integration, the quest for larger markets, and the professionalization of management all appear in the Wheeling firms as they developed over the course of the nineteenth century. Beyond these general observations that apply broadly to American industrialization, this study has taken note of some occurrences that have not been so widely noted or so unanimously

accepted. These bear some additional comments and consideration.

First, the role of mechanics in the establishment and growth of the industry in the 1846-1862 period is far different from that which might have been expected. The mechanics were speculators who organized firms, built factories, and after showing an initial profit sold out to local businessmen, making huge profits on capital gains. The build-and-sell approach appears to have been a fairly effective mechanism for attracting local capital and for permitting not only new but also more modern units to be added to the industry. As was noted, each new factory that was organized was slightly larger and in some other way more efficient than the preceding one.

During the first phase of expansion, technician and manager were merged into a single individual, and the coordination of various units--puddling, rolling, and nailmaking--was accomplished through cooperative efforts of various partners, each of whom either had extensive knowledge of, or actual working experience in, one or more of the three areas. When new partners, who did not have the particular set of skills possessed by the old ones, purchased the factories during the prewar era, the new owners were less successful simply because they could not exercise the same level of control and judgment. It was during this phase that management first became a problem, although because of the size of the mills the difficulties were not severe enough to cause insurmountable problems for most firms as long as the new owners relied upon the remaining craftsmen for advice.

Between 1861 and 1870, a new set of conditions, resulting largely from the Civil War economy, placed a strain on the firms. Erratic supply

of pig iron during the War and high costs afterwards forced the firms to add blast furnaces. At this point the old system broke down completely. Since the blast furnaces cost more than the other components combined, the organize-build-and-sell approach to entice capital no longer worked. The existing firms had to raise money from other sources, usually through bringing in local businessmen or through reinvesting profits earned during the War.

Furthermore, the nail factories, puddling operations, and rolling mills had grown during the immediate postwar period, and size alone was having an impact on the working partner management system. A single individual could not effectively oversee a nail factory that had sixty to eighty machines, participate in the construction of a blast furnace, coordinate the flow of nail plate with his colleagues in the rolling mill, and be heavily involved in funding and marketing efforts. Moreover, there was no working partner to oversee the blast furnace. The firms simply did not have ironmasters among the partners who could function as the nailer, puddler, and heater had in the early 1840s and 1850s. By 1870, the scale of operations had become too large for the old management system.

Alfred Chandler, in his book The Visible Hand, argues that the advantages of several business units within a single enterprise "could not be realized until a managerial hierarchy had been created." Among the Wheeling firms this appears to be only partially true. Diverse units (i.e. puddling, rolling, nail manufacturing, and even coal mining) existed within the same firms from the very outset, and management through working partners was effective. Two factors--the size of the

individual units, and the addition of new units with which none of the old working partners were familiar--appear to have been largely responsible for the evolution of a new management hierarchy.

Only when the scale increased to a point where a few people could not effectively exercise control and where new units about which the original managers had little knowledge were added, were the firms forced to develop new methods of managing and controlling the operations. Essentially the problem of control had three parts. First, personnel had to be found either to replace or to extend the reach of the working owner. In the 1870s, managers and subordinate assistants replaced owners as direct overseers of the mills, and by the end of the decade paid employees were even beginning to replace the working president as the chief executive. Actually, employment of managerial personnel was relatively easy, and, except for the blast furnace units, finding effective managers appeared to be no problem.

No matter how good the employed managers were, they could not effectively exercise intra-unit control and coordination, nor were they in a position to make marketing decisions. In fact, a gap existed between those who did the work and those who had to make the decisions in the early 1870s. The two groups needed some method of reducing technical and operational information to terms that were understandable and easily communicable. Cost accounting filled this need and quickly became the basic language of daily operations. Just as the scientific world had used mathematics to define natural phenomena, so these businessmen began to describe the technological and marketing operations of their factories in mathematical terms.

As Chandler has pointed out, multi-unit enterprises and their managers took as an objective the replacement of the market as a controlling and coordinating mechanism. When this began to occur, a third problem arose. As units, such as the blast furnaces, were internalized, managers had to devise a mechanism to insure that production costs were competitive with that reflected by the market price. Once again the mechanism to which they turned was cost accounting. By determining the cost of labor, material, energy, and capital that went into a ton of pig iron, the company could compare the cost of its operations with the market price.

During the early 1870s the Wheeling nail manufacturers learned to operate large, multi-unit enterprises effectively. Most notably, they came to understand the significance of costs (particularly fixed costs), the relationship of production cost to marketing policy, and the importance of volume in determining per unit price. As a result, the Wheeling manufacturers became industrial leaders, prospering in a time when competitors were hard pressed by the panic of 1873.

When competitors did arise in the early 1880s, the Wheeling manufacturers relied heavily upon their philosophy of cost control to defeat the Easterners and to humble Western competitors. When "the profit went out of the nail business," the Wheeling manufacturers did not rely primarily upon concerted action to fix price or to control production. Instead, they compared their operation with competitors and found that competing firms had substantially cheaper labor costs. As a result, they set about to reduce wages. After direct efforts to negotiate wage reductions produced only limited results, the

manufacturers devised a technological solution that was more effective. They decided to replace wrought iron nail plate with steel and in the process eliminate the boilers, a group of highly paid employees. This solution had the added advantage of forcing competitors to make huge capital expenditures for Bessemer converters if they were to remain competitive, a move that few could afford to make.

By the mid-1880s, the Wheeling manufacturers appeared to be in a position to dominate the industry for decades to come. They had well organized, highly integrated firms that realized substantial advantages through conversion to steel. Additionally, they had successfully destroyed the nailers union and gained a free hand to deal with labor as they chose. Finally, their control over the Western Nail Association effectively gave the Wheeling firms control over marketing and pricing matters for the entire industry. These advantages that appeared to be so firm at the time were to go for naught, however. The wire nail, a cheap alternate to the cut nail, quickly became a formidable competitor and within a few years markets that had once been the exclusive domain of the cut nail had disappeared.

Just as the success of the Wheeling manufacturers in the late 1870s and early 1880s was due in large part to management, so, too, was their failure after 1887. The Wheeling firms were caught by surprise when the wire nail came on the market, because their management system was not geared to take account of new products. The Wheeling manufacturers had devised methods of understanding the cut nail industry and had become adept at controlling almost every facet of the manufacturing process. They had detailed information about their own operations and

those of other competitors in the industry, but there was no mechanism for providing information about, or understanding of, possible competitors from outside the industry, particularly those based on a different technology. Consequently, wire nail manufacturers even within the immediate geographic vicinity remained anonymous to cut nail producers, and the new manufacturing process likewise remained a mystery.

It may be argued that this condition came to exist because the cut nail manufacturers had ceased to be interested primarily in nail production as an end. Instead, nail production had become primarily a means of making money. While impossible to know with certainty, it is difficult to imagine that the wire nail would have gone unnoticed by the nailers, such as Norton, who had had a primary interest in the product.

The inability of the Wheeling firms to cope with the wire nail was not atypical. William J. Abernathy and James Utterback observed in an article that as production units become more concerned with standardization, low unit costs, and high volume, they become more equipment intensive and more dependent upon product improvement rather than product innovation. Simply put, the firms with high capital investment in equipment and facilities had a tendency to continue to utilize the equipment and facilities.[3]

Wheeling firms followed just this course in the early 1880s. They first investigated the possibility of rolling used rails into nail plate, and they settled upon the steel nail without investigating other possible solutions. Both of the approaches examined had the advantage of permitting the firms to continue to utilize the existing

rolling mills and nail factories. Even after the cut nail became unprofitable, the Wheeling mills continued to emphasize products that permitted utilization of existing facilities. In short, it appears that the clear understanding of the role of fixed cost that had emerged from the cost accounting system effectively screened out consideration of major product changes.

Additionally, the faith of the Wheeling manufacturers in their ability to make the cheapest nail and their ability to control the market through the Western Nail Association provided a sense of security. Even after the alarm was sounded, the cut nail manufacturers took no action either to convert, to counter competition, or to bring wire nail manufacturers into the Western Nail Association where some control could be exerted.

In the final analysis, the management system and form of organization that evolved in the Wheeling firms was imperfect. Effective control of the production process was possible, as was linkage of production to market decisions. The emphasis on cost contributed directly to the rise of highly integrated firms that depended upon high volume and high levels of capital investment. Under this system, however, no account could be taken of factors such as new technology that did not fit into the system. As a result, the nail producers at Wheeling quickly became technologically and, in a way, managerially obsolete. They ended up in horizontal integrations that involved a minimum amount of innovation.

FOOTNOTES

CONCLUSION

[1]William J. Abernathy and James M. Utterback, "Patterns of Industrial Innovation," Technology Review, June/July 1978, p. 43.

[2]J. Leander Bishop, A History of American Manufacturers from 1608 to 1860 (Philadelphia: Edward Young & Co., 1864), II, pp. 125-126.

[3]Abernathy and Utterback, "Patterns of Industrial Innovation," p. 43.

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PERSONAL ACKNOWLEDGMENTS

I would like to express my gratitude to several people whose assistance has been invaluable. Mr. Jay Gaynor initially called my attention to the nail manufacturers in and around Wheeling and along with Mr. Don Hutslar and Mr. John Barsotti generously shared notes and nail specimens collected over the past few years.

I am especially indebted to Dr. John C. Burnham, Dr. Merritt Roe Smith, Dr. Mansel Blackford, and Dr. Julia Bonham for their encouragement, numerous suggestions, and excellent constructive criticism. Along with Mr. William G. Keener, Dr. Burnham directed my attention to business practices when the technology failed to offer an explanation of Wheeling's prominence.

I also wish to thank Mrs. Saundra Ball, who typed several drafts of the manuscript, Mr. Bernie Stockwell, who helped prepare the illustrations, and Mr. Christopher S. Duckworth and Mr. Don F. Wittekind, who prepared the photographs.

Finally, I wish to express my gratitude to the Ohio Historical Society for its support during the two years the research and writing required.