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THE OHIO STATE UNIVERSITY, PH.D., 1978

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1978
TAUNTON AND MASON: COTTON MACHINERY AND LOCOMOTIVE
MANUFACTURE IN TAUNTON, MASSACHUSETTS, 1811-1861

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

John William Lozier, B.A., A.M.

* * * * *

The Ohio State University

1978

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To Robert W. Lovett, gentleman, community leader, and archivist, without whom much of the business and industrial history of New England would be inaccessible.
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iii
Ann Lozier for putting up with me. Finally, without the stout men of the Brookline and Boston Fire Departments, all would have been lost effort.
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INTRODUCTION

This study focuses on the technological and business practices of the textile machinery and locomotive builders of Taunton, Massachusetts, from the beginning of the local machinery industry in 1811. It concludes in 1861 when these shops began to yield innovative leadership. The principal machine shops examined include those of Silas Shepard (1811-1823), the Taunton Manufacturing Company (1823-1833), Crocker and Richmond (1833-1837), Leach and Keith (1838-1842), the Mason Machine Works (1842-1944), and the Taunton Locomotive Manufacturing Company (1846-1908).

In a broader sense, this is a microcosmic study of the rise of early American industry. Moreover Taunton, not Lowell, is more typical of American manufacturing development in the early and mid-nineteenth century. Lowell was unusual because of its overnight creation as a large planned manufacturing city dedicated to the production of one item—textiles. Even Lowell's imitators, Lawrence and Holyoke, were forced to diversify their industrial base from almost their inception.
The Lowell practice of running its mills with mostly young women and housing them in dormitories was very rarely copied. Indeed, by the 1840's even Lowell was abandoning its system of labor and producing a wide variety of products. Conversely, pre-Civil War Taunton exemplified a more diversified industrial pattern common to many of the early manufacturing centers of the United States. The wide range of products produced in Taunton embraced textiles, cotton machinery, locomotives, stoves, iron, hardware, silver goods, britanniaware, and machine tools.

A comparison of the mills and machine shops in Taunton with those of Lowell also reveals significant differences between the technological systems existing north and south of a line running through Boston and Springfield, Massachusetts. The greater part of the cotton goods production north of this line took place in mill towns of the Lowell and Waltham pattern. In these towns, Boston capitalists built large integrated textile mills along with the machine shops and waterpower canals and dams to service the mills. South of the Boston-Springfield line, small rivers with only enough water to operate small plants limited the size of mills.
Nowhere was the effect of restricted water supply more obvious than at Taunton. When Boston investors attempted to copy the Lowell-Waltham model by creating the Taunton Manufacturing Company in 1823, they ultimately failed because the small power potential of Mill River in Taunton forced them into operating an unconnected chain of small inefficient factories instead of a single large Lowell-type integrated mill. Supervision and coordination of so many detached operating units proved beyond the capacity of the poorly developed management techniques of the time.

Partly—perhaps largely—because of the waterpower constraints its industries faced, Taunton emerged as a leader in the development and propagation of novel textile machinery. From the 1820's through the 1850's Taunton shared this role with three other machinery centers situated south of Springfield and Boston: the Providence-Pawtucket, Rhode Island, area; Fishkill Landing (Beacon), New York, home of Matteawan Manufacturing Company; and Paterson, New Jersey, location of the shops of Charles Danforth and of Rogers, Ketchum and Grosvenor. Of these centers, only Paterson possessed a fairly large water supply. In contrast,
the Lowell Machine Shop and the other large northern New England mill centers' machine shops did not play a very active part in the creation of new textile machinery designs from the mid-1820's through the 1850's. One reason was that the large northern mills, which were the customers of the northern machine shops, stuck to the manufacture of traditional coarse goods. Staying with the same product earned large profits, but it also made the northern mills and shops conservative.

An examination of textile machines invented or perfected at Taunton demonstrates how limited waterpower made the city a center of invention as mill owners attempted to offset the inefficiency of their small mills by adopting labor and power-saving machines. For example, higher operating speeds and lower labor costs characterized the "Taunton speeder" and ring frame and consequently led Taunton industrialists Samuel Crocker and Charles Richmond to invite the developers of these machines to come to Taunton to perfect and manufacture their devices. Unable to compete with the large mills of northern New England in the manufacture of coarse goods, the mills of southern New England shifted in the 1830's to fine goods.
Since many of the leaders of the southern mills came from the British fine goods tradition, the change-over must have been additionally appealing. However, the owners of the fine goods mills soon found themselves forced to cut production costs in order to remain competitive with British imports which flooded American markets after the tariff reductions of the 1830's and early 1840's. Knowledge of this situation motivated Crocker and Richmond to fund William Crompton's invention of the fancy power loom and William Mason's development of his self-acting mule. This innovative tradition, once started, lasted several decades and carried over into William Mason's locomotive business. Indeed, Taunton is best remembered as a center of innovation because of Mason's popularization of the locomotive design reforms instituted at Paterson, New Jersey, in the early 1850's. His aesthetic improvements of the American standard locomotive influenced other builders' designs for the next thirty years.

The manner in which the shops at Taunton acquired and disseminated their progressive technology sheds light on the methods used to communicate knowledge among nineteenth century machine shops. Hiring mechanics from other builders served as the easiest and most
commonly used means of acquiring innovative designs. Thus, Silas Shepard brought John Thorp to Taunton in order to acquire his loom designs. In like manner, Charles Richmond obtained William Mason's ring frame design by employing him as a superintendent. Richmond's 1826 trip to England illustrates the effectiveness of industrial espionage in circumventing British laws designed to prevent the export of British technology. Patent rights granted to British and American firms spread Taunton's innovations quickly, as did outright piracy. Mason's 1856 locomotive designs were so symmetrical and well proportioned that other builders quickly copied them and in the process adopted the mechanical advances he had previously taken from the Paterson, New Jersey, builders.

Possibly, although not certainly, Taunton's decline after 1861 as a center of mechanical innovation resulted from the perfection of the stationary steam engine. Steam power relieved the cities south of Boston and Springfield of the disabilities of limited waterpower and thereafter reduced the incentive to adopt more labor-saving and power-thrifty machines. Large cotton mills sprang up in the coastal cities of New England
as the geographic center of the cotton textile industry moved southwestward. Taunton's William Mason, through his association with the father of the steam mill movement, Charles T. James, became deeply involved in equipping the new steam mills.

The innovativeness of the Taunton machine builders—particularly William Mason—should not be confused with invention. Their contribution to American technology consisted of improving and popularizing the original designs of others. Precisely this skill made Mason's machine shop in the late 1850's and early 1860's the largest textile machinery producer and one of the two most influential locomotive builders in America. Unfortunately, Mason late in life incorrectly claimed that he had invented the basic mid-nineteenth century reforms in locomotive design and spinning machinery. This exaggeration has discredited and obscured his, and Taunton's, real contribution to American technology.

Taunton's success as a machinery manufacturing center required capital and entrepreneurial skill, as well as skilled mechanics and progressive designs. Three groups provided the money and business ability that built the Taunton machinery industry: local petty-capitalists from the Crocker-Leonard extended kinship group;
the Boston mercantile, legal, and literary elite; and the mechanic-manufacturers of Taunton. Two members of the Crocker-Leonard clan, Samuel Crocker and Charles Richmond, initially provided the capital and leadership that developed the early Taunton mills and machine shops. Likewise, the nephews who Samuel Crocker raised, William, George, and Samuel L. Crocker, were co-founders of the Taunton Locomotive Manufacturing Company and of some of the local iron and copper works.

When Crocker and Richmond found their capital limited during the 1820's, they turned to the second group, the Boston capitalists. Samuel Crocker had become a friend of members of this group while serving on the governor's council and sitting on the Board of Overseers of Harvard College. The resources of this group were again tapped when William Mason turned to the Boston mercantile house of James K. Mills and Company for the funds necessary to set up his machine shop in 1842. These Boston investors--named "the Boston Associates"--were the leaders of New England business and society. They financed Lowell and the other large mill centers of northern New England and dominated the social, mercantile, and legal life of the region. Many American leaders in
education, the arts, and literature belonged to this group of families. Intermarriage, business connections, legal practice, politics—Federalist-Whig-Republican—and Harvard College bound the Boston Associates into one of the nation's most powerful and influential elites.

The third group, represented by Willard W. Fairbanks of the Taunton Locomotive Manufacturing Company and William Mason, provided the mechanical and business skills upon which the success of the shops of Taunton rested. However, the ability of these men, not their family or other social connections, lay at the heart of Taunton's industrial development. Ultimately, the community's experience demonstrates that success in the machinery industry depended not only on business acumen, mechanical knowledge, and the ability to recognize and adopt useful innovations but also on access to adequate capital. A suitable product was only one requirement of a prosperous machine shop. Adequate capital to outfit a factory, conduct daily business, and extend credit to customers had to be available if a machine builder was to survive recessions. Investors like Charles Richmond and James K. Mills played a vital part in Taunton's industrial development by
seeking out and financing gifted mechanics. The willingness of capitalists to assume the risk of investing in new technologies accounted as much for the progress of the industrial revolution as did the ingenuity of inventors.

The growth of the Taunton machinery industry also depended on the ability of manufacturers to market their machinery. To a high degree, well-built and designed machines sold themselves in nationwide markets characterized by few buyers and sellers. More often than not, the buyer sought out the manufacturer, so machine builders had no need for a force of salesmen in the field or for a commission merchant. Besides, most customers demanded design modifications to cotton machines or locomotives to meet their own peculiar needs or beliefs. Therefore, machine shops operated on a job-lot basis, making impossible the application of mass production techniques.

These market and production conditions required a highly skilled workforce with a large degree of self-reliance. The job contract system provided the flexibility desired by decentralizing authority within the shop. Likewise, part of the risk was passed onto the job
contractors themselves. Although the use of machinery in the Taunton shops expanded rapidly during the period under consideration, much skill was still required to set up, gauge, and operate the machine tools. Even in 1861, much hand labor remained in machine building. In such an environment, the extensive work rules and regimentation commonly found in textile mills and other large manufacturing establishments proved unnecessary and therefore were not adopted.

The machine shops of Taunton may have enjoyed an unusual degree of success prior to the Civil War, but their manufacturing, marketing, and financial practices closely resembled those of the hundreds of other machine shops in the United States. Even the causes of the successes and failures of the Taunton shops can be seen elsewhere. For these reasons Taunton's industrial experience possesses more than just local significance.
CHAPTER I

TAUNTON'S EARLY INDUSTRIAL SETTING:

THE EARLY TEXTILE MACHINERY INDUSTRY, 1810-1840

Fate authors much history, capriciously casting aside most facts while preserving only a favored few. Thus has been written much of the history of America's cotton textile mills and machine shops. Abundant source materials for the large Lowell-system machine shops and cotton mills of northern New England have led historians to neglect the Rhode Island-type shops and mills, for which fewer records survive. The objective of this study is to redress the neglect of the early Rhode Island-system textile machinery industry by examining one such machine-building and mill center, Taunton, Massachusetts.

Draw a line across Massachusetts from Boston to Springfield, taking care to run it south of Newton and north of Worcester. This line demarcates the early northern and southern cotton manufacturing and machine-building industries. There were exceptions: several enclaves of the southern industry lay north of this line, conversely Baltimore represented an outcrop of the northern industry south of the line. The early northern
textile industry and its accompanying cotton machinery builders has been called variously the northern system, the northern New England system, the Waltham system, the Lowell system, or, from the Harvard library where their records are housed, the Baker companies. South of our imaginary line the industry has been termed the southern system, the southern New England system, and the Rhode Island System. These last three terms are misleading because this system of cotton manufacture was practiced in both Rhode Island and the South, as well as in the Ohio Valley, the Middle Atlantic states, and the rest of New England. Ignoring some tiny job shops in places such as Pittsburgh and Steubenville, the southern cotton machine-building industry was confined to southern New England and the Middle Atlantic region.

The shops and mills of Taunton and other Rhode Island-type mill centers have been neglected in contrast to the large Lowell-system shops and mills. The large Lowell, Saco, and Pettee shops of northern New England are covered in depth by Gibb's fine work on the Saco-Lowell Shops; and other northern shops--Amoskeag, Springfield Canal, Ames, and Hadley Falls have been less completely surveyed by Browne, Shlakman, Green,
and Navin. The only significant book about a cotton machine builder south of the Boston-Springfield line is Navin's *The Whitin Machine Works*, which covers little prior to the 1840's. Even more one-sided has been the coverage of the region's textile mills.

The many writings on the large northern New England shops and mills have given rise to the misconception that the Lowell system of waterpower development, labor, and machinery characterized--indeed constituted--the early Industrial Revolution in the American cotton textile industry. In reality, Providence and Pawtucket, Rhode Island, not Lowell, provided the model for the largest portion of the antebellum American cotton textile and machinery industries. Far more cloth was woven in the many scattered mills of the Rhode Island

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2 Navin, *Whitin*, pp. 31-34.
system than in the few large Lowell-type mill centers. Furthermore, the Lowell-system of mill-labor, using young women rather than men and children, was rarely imitated, contrary to the impression left in so many books.

There were in fact significant differences between mills north and south of the Boston-Springfield line dictated by different geography, product lines, and degrees of attachment to British practices. These differences offer evidence that technological systems evolve in response to their physical environment, within the limits set by the attitudes of those who develop and apply the technology. Therefore, we shall look at how the evolution of cotton manufacturing technology differed north and south of Boston and Springfield.

NORTHERN NEW ENGLAND COTTON MILLS

The northern New England cotton textile industry was typified by the large power canal developments at Lowell, Manchester, Saco, Nashua, Lawrence, and Holyoke. One might add to this list Cohoes, just north of Albany, New York. Although many small mills existed in the region, it was the large developments which were best known and produced the bulk of the regional output. Significantly, most textile machinery produced north of
the Boston-Springfield line came from these large centers. Lowell and its large sisters shared several characteristics: They were financed by the merchant and lawyer capitalists of Boston and began with large dams and power canals on fairly large rivers such as the Merrimack or the Connecticut. At each center, the water power company built several mills and equipped them with machinery from the power company shop. Although the power company in some instances ran the mills, generally mills belonged to separate operating companies owned mostly by the same shareholders that controlled the other mills and the power canal company.

Large-scale production of coarse goods and low power costs were the bases of the large northern mills' success. Abundant water power enabled these mills to produce coarse, bulky goods at far lower fuel costs than the steam-powered English mills or the Rhode Island system mills, which were less well endowed with water power. Cheap power, along with other considerations, engendered a preference for labor-saving machinery over power-saving processes. Moreover, the Boston associates who developed these large mills demonstrated both their large capital resources and their recognition of the advantages of the efficiencies of large scale by building large mills averaging about
5600 spindles. Each mill was equipped for the production of one particular type and grade of cloth, often a heavy, coarse cloth for work clothes. Because of low power and cotton transportation costs, these mills were secure at home from British competition, tariff or not, and soon began to challenge British coarse goods abroad. ³

MILLS SOUTH OF SPRINGFIELD

Because the early Rhode Island system mills relied on the limited water power of small streams,

these mills were smaller and more scattered than the Lowell system mills, although collective southern mill output exceeded northern. There were few mill developments approaching Lowell in magnitude in southern New England and the Middle Atlantic states. Even large power sites such as Manayunk and Paterson were utilized by small mill companies of the southern pattern. The average number of spindles per mill in Connecticut in 1831 was 1229, less than a quarter the size of the average Lowell mill. The Rhode Island average was 2032, New York 1405, New Jersey 1235, and Pennsylvania 1803.\(^4\) Available water power more than capital seems to have limited the development of these regions prior to the large-scale introduction of steam mills after 1845. For example, wealthy New York merchants Astor, Hone, and Schenck actively promoted the progressive Matteawan and Glenham projects, but found their efforts hampered by limited water power. New York investors were also active in the development of some Paterson firms, and many Rhode Island mill promoters built mills in neighboring Connecticut and Massachusetts valleys because of the greater availability of water power.

Even the Great Falls and Little Falls projects in northern Jersey attracted some capital from as far away as Boston. Still, in Paterson, which had water power adequate for a Lowell-type development, small mills of the Rhode Island pattern were built, suggesting that in some cases tradition rather than water power restricted mill size.

Rhode Island system mills tended to be small structures of three or four stories. Because of the limited water powers, mills were less closely spaced than in the Lowell system. In Taunton, mills were spaced about two miles apart, except on Mill River where the separation averaged a half-mile. Near each mill were several small company houses and often a company store. Men, women, and children—often whole families—were employed, in contrast to the famed but localized Lowell female boarding-house system. Because of the strong English influence and the limited water power, which denied southern system mills the efficiencies of large scale enjoyed at Lowell, southern mills specialized in producing finer grades of cloth than the northern mills. The mills of Philadelphia, the Ohio Valley and the South were slower than the southern New England and New York mills in

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adopting power weaving, preferring to put out thread for hand-loom weaving of even finer goods than were normally woven in the mills of southern New England.  

TECHNOLOGICAL DIFFERENCES NORTH AND SOUTH OF SPRINGFIELD

Product lines and water power availability dictated technological differences above and below the Springfield-Boston line. Northern mills used dead-spindle frames while the southern mills relied on live-spindle frames, excepting Paterson mills which adopted the Danforth cap frame in the late twenties and Baltimore mills which used the northern system. A dead spindle frame had a powered flyer which dragged a bobbin around an unpowered spindle (a flyer was the wire, inverted-U shaped device through the end of which the yarn passed on its way from the rollers to the bobbin straddled by the flyer). In live spindle frames the powered spindle and attached flyer pulled the bobbin. Because the dead spindle of the Lowell system mills had a stationary upper bearing and was firmly connected at the base to a sleeve loosely encircling the spindle, the dead spindle frames could be run about 25 percent faster than live spindles

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6See footnote 3 for the more important sources supporting this comparison.
because of the lesser wobble. Live spindle flyers, flimsy inverted U's of wire perched upon the top of the bobbin, tended to wobble and spread when run above 4000 or 5000 rpm. However, the dead spindle frames required about 20 percent more power and produced, by contemporary accounts, a coarser yarn (I suspect that coarseness was caused by the design of the particular machine or by the higher operation speed rather than by the inherent character of the dead spindle itself). Thus, the live spindle frame was better adapted to the limited power and fine goods of the southern mills and the labor-saving dead spindle frame to the power-rich, coarse-goods northern mills. There was another difference between northern and southern spinning: The coarse yarn of the dead spindle frame was adequate for both the filling and warp in the Lowell system mills, but the fine goods mills of the Rhode Island and Philadelphia patterns required a softer filling which could only be made on a mule. Mules were also adapted to southern mills because they used less power for most counts (thicknesses) of yarn. However, hand-controlled mule spinning was costly,  

skilled, physically demanding work done only by men. Lowell's filling frames were tended by women, further increasing the north-south cost disparity.\(^8\)

The large northern mills appear to have been much more profitable than the small mills to the south, mainly because of their efficiency. Massachusetts mills—which included both the highly efficient Lowell-pattern mills and many small Rhode Island-system mills—consumed 65 percent more bales per worker in 1850 than Rhode Island mills. If only the large mills in Massachusetts had been considered, the difference would have been much greater. However, Massachusetts mills produced only 16 percent more value per worker per year than Rhode Island mills, reflecting the higher value of the fine goods produced in Rhode Island.\(^9\) Comparison of 1837 statistics for Middlesex County, including Lowell, with those for Bristol County, including Taunton, shows similar differences. Middlesex mills had 2.7 times as many spindles per mill as did Bristol mills, 2.3 times as much cloth consumed per spindle, 1.4 times more value produced per worker,

\(^8\) Again, see footnote 3 for more on this comparison.

and 1.2 times more cloth produced per worker (Bristol mills were just beginning their shift from coarse to fine print cloth at this time).\textsuperscript{10}

Because of their inefficient size and production of fine goods, mills south of the Boston-Springfield line were on the average more labor intensive than those north of the line. In the first decades of the nineteenth century, high wages paid by southern New England mills attracted a good supply of unskilled laborers from the marginal farms and rural poverty of the region.\textsuperscript{11} However, mules and looms needed skilled workers, principally British, who soon proved costly and troublesome. In order to cut costs to meet British fine-goods imports, which were not excluded by the tariff, the smaller mills sought labor-saving devices for automating hand processes and for speeding up older machine designs.

Contrary to the impressions which might be gained from Gibb, Jeremy, Gregory, and others, the southern New England and Middle Atlantic regions produced many

\textsuperscript{10}Calculated from Montgomery, \textit{Practical Detail}, p. 157.

\textsuperscript{11}See especially testimonial of Smith Wilkinson, \textit{McLane Report}, 1: 1046.
more textile inventions than did the large northern New England mills.\footnote{Gibb, Saco-Lowell, pp. 28, 38; Francis W. Gregory, Nathan Appleton: Merchant and Entrepreneur: 1779-1861 (Charlottesville: University Press of Virginia, 1975), p. 255; David J. Jeremy, "Innovation in American Textile Technology during the Early 19th Century," Technology and Culture 14 (1973): 75. Gibb asserts a lack of "creative effort" in southern New England, while Gregory claims that Lowell-built machinery was "always more advanced than that of smaller manufacturers . . . ." Although Jeremy recognizes that the southern industry produced many important inventions, even he underestimates the scope of southern inventions when he argues that these inventions did not cover as many stages of the manufacturing process as in the north.} Patent lists show that between 1810 and 1837, the large-mill towns of the north accounted for only four percent of the patents issued for the manufacture of wool and cotton. Moreover, a third of these northern patents were received by Waltham's Paul Moody between 1816 and 1821, the north's only highly fecund period prior to 1838. By comparison, New York accounted for 25.5 percent of all 1810-1838 cotton and wool manufacturing patents, the Providence region (Rhode Island and adjacent areas of Massachusetts and Connecticut) 19.9 percent.\footnote{Calculated from U. S., Commissioner of Patents, Henry L. Ellsworth, Digest of Patents Issued by the United States, from 1790 to January 1, 1839...(1840), passim (hereafter referred to as Ellsworth, Digest of Patents). Excluded: gins, cordage, braiding, felts, waste, rags, oakum patents.} Lowell was in fact
essentially a borrower of machine technology. It was small shops to the south, not Lowell, which developed the important new designs in the two decades after 1822: Whitin pickers, railway heads, differential speeders, Taunton speeders, ring frames, and self-actor mules. However, this should not obscure Waltham's and Lowell's contribution of probably the single most important business and technical innovation in the American textile industry: the large, vertically integrated, well-financed mill with power looms and a large-scale water power development. By contrast, the Rhode Island system mills imported and adopted power looms at almost the same time as Waltham, but did not produce large mill developments until the steam era.

**EARLY COTTON MACHINE SHOPS, 1810-1840**

The history of cotton machinery shops divides into six periods. During the first period, lasting to approximately 1810, textile machines largely of British design were built in cotton mill shops mainly for that mill's use. In the second, about 1810 to 1835, many of these mill shops, including Taunton's, and independent shops employing only a few men, began to build textile machinery for sale to other mills. During this period American machinery designs departed to some extent from
British patterns, particularly in the northern mills. The third period, roughly 1835 to 1870, saw the large mill shops gain their independence as a couple dozen shops came to dominate textile machinery. These shops, William Mason of Taunton included, diversified into a variety of other product lines, particularly railroad locomotives and machine tools. During the fourth period 1870 to 1895 some firms left the industry, and those who remained, including Taunton's Mason, shed product lines other than textile machinery. The fifth period, 1895 to the Depression witnessed the demise of the last Taunton shop and the concentration of the industry into just four major machinery builders. In the sixth period, following World War II, most of the firms moved to the South and were absorbed by conglomerates. This study focuses on the first three periods.

As the cotton mills north and south of the Boston-Springfield line differed, so did the cotton machinery builders the mills spawned. Each of the large northern New England mill centers had a large machine shop which supplied the mills of that city with most of their machinery. In Lowell, Chicopee, Saco, and, later, Holyoke and Lawrence these machine shops were owned by the water power companies. During the 1840's and 1850's these shops, with the exceptions of Nashua and Manchester's
Amoskeag, became independent corporations, although for many years there remained a considerable overlap of ownership with the mills and canals. Common ownership gave these machine shops virtual monopolies on cotton machinery sales to the mills in their home city, and not until the 1850's did these shops find it necessary to seek outside markets for their textile machinery.\textsuperscript{14} However, other products, such as locomotives, had long been sold to distant customers. The northern shops' size, sophisticated machinists, and fine workmanship had soon brought to their doors railroads, paper mills, print shops, and machine shops from throughout the country. Thus, the northern shops became leaders in the 1830's and 1840's in product diversification.

The cotton machinery shops south of the Boston-Springfield line, which included Taunton, were smaller and more widely dispersed than those north of it, although they too were concentrated into a few centers. Worcester, Massachusetts, had several small shops in the twenties and thirties, each with ten to thirty hands. These shops, particularly William H. Howard's, Wheelock and Prentice's (which evolved into Phelps and Bickford), and Henry Goulding's, as early as 1823 built both woolen\footnote{Gibb, \textit{Saco-Lowell}, pp. 143, 191, 243.}
and cotton machinery for sale throughout the Northeastern states. Midway between Worcester and Providence at Northbridge was the Whitin shop, which from the 1830's until the 1840's had an annual output of only a few pickers (machines which prepared the cotton for the carding process). From this modest beginning Whitin grew into modern America's largest textile machinery builder.15

The Providence area was the earliest center of American cotton machinery construction, largely because of Samuel Slater's pioneering mills. This area was also the wellspring of early southern New England textile technology. David Wilkinson, Slater's brother-in-law opened in 1810 in Pawtucket one of the first commercial shops selling looms and other machinery on what was a large scale for that time.16 His shop was joined the

15 Charles G. Washburn, Manufacturing and Mechanical Industries of Worcester (Philadelphia, 1889), pp. 21-23; McLane Report, 1: 572-575; Navin, Whitin, pp. 31-34.

same year by another Pawtucket shop which, after partnerships between Larned Pitcher and Ira Gay and later Pitcher and James S. Brown, became Brown's works in 1842.17 These Pawtucket shops sired many others, for Slater, Wilkinson, Pitcher, and Gay were mentors to many of the first generation of cotton machinists. David Wilkinson, Sylvanus Brown (James S. Brown's father), and Alfred Jenks (founder of the Bridesburg works in Philadelphia) all worked for Samuel Slater. David Wilkinson passed the Slater technology, with later additions such as power weaving, to David Fales and Alvin Jenks of Fales and Jenks, to Jonathan Thayer Lincoln of Kilburn, Lincoln and Company, to Troy, New York, machinery builder Clark Tompkins, and to James S. Brown. Wilkinson himself moved after his 1829 failure to Cohoes, New York, where he was involved in the development of that mill center. Ira Gay and Larned Pitcher were associated with Samuel Slater in

various enterprises, including the early Amoskeag Manufacturing Company of Manchester. Ira Gay later supervised the Nashua Manufacturing Company, also in New Hampshire, and helped found the outstanding North Chelmsford, Massachusetts, machine shop of Gay, Silver, and Company, which trained many leading mechanics, including Merrill A. Furbush, who helped found the Worcester loom works of Furbush and Crompton and the Philadelphia cotton machinery shop of Furbush and Gage. By this means the Slater-Wilkinson technology spread rapidly through the southern cotton mills and shops.  

Besides the Wilkinson and Pitcher shops, several other shops were opened in the twenties and thirties in the Providence area. The Providence Machine Company started about 1827 in Slater's Providence Steam Cotton Mill and evolved into a separate firm later noted for

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Thomas J. Hill's English style fly frame speeders.\textsuperscript{19} After Wilkinson's 1829 failure, still another shop, Phenix Iron Foundry at Eddy's Point, bought his patterns and continued manufacture of his machines.\textsuperscript{20} Other well known, long-lived Providence area shops included Levally, Lamphear and Company, Franklin Foundry and Machine, and Fales and Jenks.\textsuperscript{21} Slightly further from Providence were other commercial shops at Taunton, Massachusetts, at Killingly, Connecticut (about which more will be said later) and at Fall River. Earliest of the Fall River textile machinery shops was the mill shop of the Fall River Manufacturing Company organized by David Anthony, Dexter Wheeler, and others in 1813. By 1814 they were selling pickers and by 1817 Wheeler's power looms. The second Fall River firm, Harris, Hawes and Company began as an independent shop in 1821, evolving

\textsuperscript{19}Providence Iron Works Shop Books, 1827-1833, Slater Collection, Baker Library, Harvard University, Boston; Bishop, \textit{American Manufactures}, 3: 387.


into Hawes, Marvel and Davol by 1840. In 1879 the Fall River Iron Works bought this firm and soon reorganized it as the Fall River Machine Works. John Kilburn began a textile machinery firm in 1844 which later became Kilburn, Lincoln and Company.22

With the possible exception of the Taunton shop, the most progressive American cotton machinery shop in the late 1820's and 1830's was the Matteawan Manufacturing Company in what is now Beacon, New York, on the Hudson sixty miles north of New York City. Matteawan began as a cotton mill built in 1814-1815 by Abraham H., Peter H., and Peter A. Schenck. Abraham, one of the leading national spokesmen for protective tariffs in the 1820's, managed the company affairs in Fishkill Landing while ship-owner and commission merchant Peter H. Schenck was the firm's selling agent in New York City. Additional capital came from some of the leading New York merchant-banker-capitalists: Philip Hone, John Jacob and William B. Astor, Gardiner

22 McLane Report, 1: 166-167; Bagnall, "Sketches," p. 1810; Frederick M. Peck and Henry H. Earl, Fall River and Its Industries: An Historical and Statistical Record of Village, Town and City...(New York and Fall River, 1877), pp. 20-21, 26; Alanson Borden, comp., Our Country and Its People: A Descriptive and Biographical Record of Bristol County, Massachusetts (Boston, 1899), part 1, pp. 586, 600.
and Samuel S. Howland, and Henry and S. Cowling. Machine sales grew rapidly in the twenties and thirties making the firm one of the leading American cotton machinery producers, with sales ranging from northern New England to the deep South and Latin America. Matteawan superintendent William B. Leonard was the mechanical genius upon whom the firm's success rested. In 1827 he introduced a broadloom of the Scots type with a beat and take-up motion good enough to be adopted in many English mills. His railway and railway head (patented 1833) remained for a half century the standard American arrangement for combining the output of several carding engines. Between 1825 and 1840, much of the latest British technology was introduced to the United States by Matteawan, including Houldsworth differential-motion fly-frame speeders, Gore spindles, and the Smith self-acting mule. To do so, Abraham H. Schenck in 1825 and William A. Leonard (son of William B.) in 1838 engaged in industrial espionage and smuggling in England. Matteawan's technology in turn spread through the United States by licensing agreements and through the alumni of Matteawan's shop, including Saul Eddy, superintendent of William Mason and Company of Taunton, and Paterson, New Jersey machine shop operators Charles Danforth, John Cooke, and
William Swinburne. After Peter H. Schenck's 1837 embarrassment weakened Matteawan, the firm spread itself too thin by adding to its product line shafting, gearing, machine tools, wood working machines, sugar mills, stationary engines, steam fire engines, boilers, railroad equipment, and even two railroad locomotives. An 1851 failure further weakened the shop and the Panic of 1857 killed it.23

Fifty miles south of Matteawan was Paterson, New Jersey, where the Great Falls of the Passaic was the object of the first large-scale industrial water-power scheme in America: Alexander Hamilton's 1791 Society for Establishing Useful Manufactures. The first Paterson spinning mill opened in 1793, and by 1825 there were twelve mills in Paterson. However, these mills averaged only a third the size of those at Lowell. Consequently, they turned to finer goods such as muslins, and, later in the nineteenth century, silk. Wool, hemp, and flax machines were made on a small scale at Paterson between 1793 and 1796 at the shop of George Parkinson, but the first significant textile machinery shop in town was opened by John Clark about 1800. Thomas Rogers, a carpenter in Clark's shop, and John Clark, Jr., took over the firm in 1816. Admission of local businessman Abraham Godwin as a partner in 1822 enabled Godwin, Rogers and Company to expand to 66 hands by 1824, making it one of the largest textile machinery builders in the nation. When Rogers withdrew to start his own firm in 1831, Charles Danforth replaced him as both partner and the mechanical brains of the firm (more about Danforth later). When Godwin, Clark and Company failed in 1839, Danforth soon acquired the firm, which continued under the Danforth and later
the Cooke name until the 1901 formation of American Locomotive Company. Meanwhile, Thomas Rogers opened his own shop in 1831, acquiring the capital he needed by bringing in two New York capitalists, Morris Ketchum and Jasper Grosvenor. Rogers, Ketchum and Grosvenor and its successor, Rogers Locomotive and Machine, became one of the most important nineteenth century machine shops, until American Locomotive also swallowed it. Several small shops joined Rogers and Danforth to make Paterson one of the leading machine-building centers of the early nineteenth century, praised for the quality of its machinery by Montgomery and others.

Since the mills of the region specialized in fine goods, the Paterson shops made fine goods machinery. Soon the small size of local mills and the limited development of the textile industry in other parts of New Jersey encouraged the Paterson shops to develop markets in the Southern states and Latin America. By 1822 Thomas Rogers had been to Mexico selling cotton machinery. Thereafter Latin America remained an important customer both of Godwin, Clark and Company and of Rogers, Ketchum and Grosvenor. To bolster business, Rogers added locomotive building in 1837, followed by Danforth in 1852. In contrast to the
later experience of the Taunton shops, it was the textile machinery business instead of locomotives that Rogers and Danforth later dropped.²⁴

At various sites surrounding Philadelphia there were by 1824 about thirty small spinning mills averaging only about 1400 spindles each. In these mills not until the 1850's did power weaving replace the putting-out system, partly because of the difficult mechanical problems posed by the power weaving of fine goods, in which Philadelphia specialized. In 1810 Alfred Jenks, a former student of Samuel Slater, began building Rhode Island system cotton machinery at Holmesburg in northeastern Philadelphia and in 1818 literally moved his whole shop on rollers to the nearby Bridesburg section of town. Known as the Bridesburg Manufacturing Company after 1867, the firm from its establishment found the local markets too small and courted the Southern and Midwestern markets. Bridesburg was very successful until the Panic of 1873 and

continued machinery manufacture until its 1888 failure. In addition to the Bridesburg shop, Philadelphia had some important later textile machinery firms including Fairmont Machine, Eccles and Son, and M. A. Furbush. One small calico machinery shop turned to locomotive building with some success: it was Baldwin.\textsuperscript{25}

In addition to the firms and towns mentioned, many other small shops scattered throughout the country produced modest numbers of textile machines. However, their duration, output, and technology were insignificant.

\textbf{CHARACTERISTICS OF COTTON MACHINE BUILDERS}

\textbf{SOUTH OF SPRINGFIELD}

There were two basic types of pre-1845 cotton machinery builders south of the Springfield-Boston line: first, small shops owned by one or two mechanics and, second, cotton mill shops. The independent shops included those at Worcester, Killingly, Providence,

Pawtucket, Fall River, Paterson, and Philadelphia; the mill shops were Whitin, Matteawan, and, most significantly for this study, Taunton. In the independent shops, a few hands (typically 20 or 30 in 1832) worked alongside the one or two managing partners, who were generally also mechanics by training. Frequently a merchant-capitalist or two were also partners. Many firms began in leased space, very often a cotton mill basement. With rising affluence in the 1830's and 1840's, many successful firms built large shop buildings adapted to their needs. A surprisingly broad market area as early as the 1820's enabled many of these firms to specialize in the manufacture of one or two machines.

The second type of southern shop, mill shops such as Taunton Manufacturing Company's shop, originated as repair shops, common to most mill basements or attics. Often a mill shop had been made extensive enough to furnish much or most of its own mills' machinery, so once the mill was completed, the shop operated at less than capacity making mill repairs. Some of these mill shops had developed new designs of machinery, such as Whitin's picker, Taunton's speeder, or Matteawan's railway head, so when a commercial demand arose for
their machines, these shops seized the opportunity to improve utilization of their facilities by manufacturing machinery for sale. Some shops specialized in one machine and dropped out of the machinery business when their machine's vogue ended. A few, such as Taunton, Whitin, or Matteawan, broadened their lines and grew into major producers. In the 1830's and 1840's, these shops (Matteawan excepted) became independent of the mills in which they had started, largely because of the difficulty one management faced supervising two highly dissimilar businesses.

The technology of the mills and shops south of Springfield-Boston line was fairly well standardized in any given period. There were modest exceptions such as Matteawan's fast acceptance of British advances, Philadelphia's slow adoption of power weaving, or Paterson's adherence to the Danforth cap frame. Of all the factors which served to standardize this technology and to introduce innovations from outside, the most important was the migration of labor. We have already noted that many of the founders of the southern cotton machinery shops had learned their trade in the Providence area shops of Slater, Wilkinson, or Pitcher and Gay; and we shall shortly see that very high geographic
mobility of mechanics in the nineteenth century served to spread the latest technical ideas throughout the American machine building centers. Illustrating how much of the skill of machine building reposed in the minds of skilled workmen, Ira Gay confessed to a customer that, "we could not make for you a frame for twisting twine as we have no men on that kind of work." So, normally a shop acquired other cotton machinery builders' designs by hiring their workers.

British statutes of 1695, 1718, 1749, 1774, 1781, 1782, and 1786 prohibited export of textile machinery, models, and plans, while 1765 and 1785 acts forbade the emigration of trained operatives in the textile and metal working trades. "Nothing," wryly observes L.T.C. Rolt, "could have supplied a more stimulating challenge to the ambitious mechanics of the new world . . . ." So, despite the laws, there was


extensive two-way textile technology transfer between Great Britain and the United States in the early nineteenth century, as David Jeremy has capably demonstrated. Many British designs and practices were conveyed to America by British workmen—usually in their heads, but sometimes with models or plans. Starting even before Slater, American textile technology was enriched by a continuous flow of British mechanics and operatives. Drawings also brought ideas from Britain, as in the case of Lowell's acquisition of the Horrocks dressing machine. Additionally, by the 1820's industrial espionage became a well-practiced method of obtaining technology, following particularly the 1812 example of Waltham's Francis Lowell. American visitors to English mills in the 1820's included Taunton's chief manager Charles Richmond, Rhode Island's Zachariah Allen, Dover's Arthur Porter, Lowell's Kirk Boott, Paterson's Charles Danforth, Matteawan's Abraham Schenck, and Waltham's Allan Pollock. Some of this piracy was highly successful: Richmond, for instance, brought back a


29 Jeremy, "Transmission," describes the process well and classifies the various types of transfer.
model for the first successful American calico printing machines. However, the British also benefited: Richmond traded George Danforth's (Charles' brother) Taunton speeder and Aza Arnold's differential speeder motion, while Schenck provided the Matteawan broadcloth loom. 30 American acquisition of important British innovations continued unabated, so in 1843 Parliament repealed the laws, enabling British machine shops to profit from selling the machines Americans were already stealing.

Other vehicles for technological transfer existed, including the purchase of sample machines from other shops for copying and the grant of licenses for the manufacture of patented devices. Few machinists in this era had the capacity or desire to monopolize the production of an invention, especially when royalties

could be had free of risk. Circular and newspaper advertisements and word-of-mouth recommendations spread knowledge of machines and inventors. Trade fairs and even county fairs provided manufacturers an introduction of new machines. Most important of these was the American Institute's annual New York City exhibition, which began in 1823. Guided by Matteawan's Schencks and Leonards, who saw that textiles and machines were well represented, the American Institute fair regularly drew manufacturers from all industrial regions of the Northeast to observe the operating exhibits. Also, periodicals, notably British journals and the Journal of the Franklin Institute (1826- ) with its descriptions

31 The New York newspapers, Niles' Weekly Register, and the Journal of the Franklin Institute regularly covered these fairs. Niles' provided lists of American Institute honors winners in the 1820's and lists of the important guests. For example, Niles' 37 (1829): 140-142, 154-157, shows that prizes were issued to a large number of companies in New England and the Middle Atlantic states for a great variety of manufactured goods. Winners included Merrimack, Matteawan, and Slater. Matteawan's broadcloth loom won first prize for machinery (a slight conflict of interest?) and Addison and Stevens' ring frame (which we shall meet soon) was present. Many of the nation's most important manufacturers and designers attended. For typical patent rights policies, see Directors Minutes for Aug. 9 and Oct. 23, 1821, Dec. 19, 1822, Boston Manufacturing Company Collection, Baker Library, Harvard.
of patents, disseminated reports of recent inventions and discoveries to the more literate mechanics (a larger group than I suspect is generally realized).

EARLY MARKETING OF TEXTILE MACHINERY

Gibb, Bagnall, and others have left the impression that until the 1820's virtually all mill machinery was constructed in the mill shop of the mill using that machinery.\textsuperscript{32} Perhaps that was true for even a majority of mills prior to 1830, but that view underrates both the age and extent of the commercial shops. Nobody is quite sure when the first American shop began building cotton machinery for sale. As we have seen, George Parkinson of Paterson built and sold textile machinery as early as 1793, but probably only wool, hemp, and flax spinning machines. About 1800 John Clark, also of Paterson, began building cotton machines for sale, and between 1800 and 1806 Arthur Scholfield in Pittsfield, Massachusetts, began making carding engines for wool and possibly cotton. The Embargo-inspired cotton mill building boom brought the opening of three important cotton machinery shops in 1810: Wilkinson's and Pitcher and Gay's in Pawtucket

and Alfred Jenks' in Philadelphia. Significantly, all these firms seem to have been independent of any textile mill (although incidentally some may have leased space in mills). Several mill shops also began selling textile machinery in the 1810's: Silas Shepard in Taunton, the Fall River Manufacturing Company, and the Boston Manufacturing Company of Waltham. Tench Coxe reported that twelve Rhode Island establishments sold $43,500 worth of cotton and woolen machinery in 1810. While this total may have included hand devices for home use, it suggests that a fairly lively textile machinery industry existed in Rhode Island in 1810.

Northern New England cotton machinery shops built almost exclusively for local mills until the late 1830's, and it was not until the 1850's that these shops began to build on a large scale for outside markets.


Only the Nashua Manufacturing Company shop among the large northern shops sold much machinery outside its city prior to the late thirties, probably because of the small number of mills built in Nashua. Supporting this suspicion is Nashua's refusal of outside orders while local mills were being built. Once these local mills were completed, Nashua filled its otherwise empty shop with orders from points as distant as Providence, Taunton, and upstate New York.\textsuperscript{35}

Shops south of Springfield and Boston, contrary to northern practice and to what Gibb implies, from virtually their inception marketed over a wide area.\textsuperscript{36} Wilkinson sold machinery during the 1810-1829 existence of his shop to one mill center in Vermont, two in Connecticut, and at least six in Massachusetts. Wilkinson's Pawtucket area neighbors sold equipment for a 2700 spindle mill to the Phoenix Mill in Pittsburgh, Pennsylvania, in 1822, and Fales and Jenks' first sale was a spooler ordered by Cunningham and Anderson of

\textsuperscript{35}Items GB-1, GC-1, AB-1, Nashua Manufacturing Company Collection, Baker Library, Harvard University.

\textsuperscript{36}Gibb, \textit{Saco-Lowell}, pp. 45-46.
Richmond, Virginia, in 1830. Asahel Lanpher of Killingly, Connecticut, was selling ring frames as far away as Baltimore in the early thirties. In the early 1820's William H. Howard of Worcester sent his woolen and cotton Scotch looms to Millbury, Massachusetts, Providence, Rhode Island, and Middleton, Torrington, and Litchfield, Connecticut, and by 1832 four Worcester cotton and woolen machinery builders claimed sales throughout the Northeast. A Paterson shop equipped the Vaucluse Manufacturing Company in South Carolina in 1833, and Rogers, Ketchem and Grosvenor; Plunket and Thompson; and Godwin, Clark and Company all reported sales throughout the United States and Mexico in 1832. 


38 Killingly Deed Book 29, pp. 30-33, July 9, 1834 (My thanks to Ted Penn for bringing this to my attention.)


40 Gregg, Essays, p. 33; McLane Report, 2: 157-160.
Alfred Jenks of Philadelphia in 1833 equipped the Saluda Manufacturing Company in South Carolina. Nashua Manufacturing Company, resembling a southern builder in this respect, sold during 1827-1832 a full line of equipment from picker to loom, plus packing presses and lathes, to mills in Dover and Manchester, New Hampshire, Lowell, Taunton, Providence, and upstate New York. In turn, Nashua bought some machinery for its own mills, particularly patented equipment such as the Taunton speeders purchased from Taunton Manufacturing Company in 1825.

The preceding suggests that Bagnall and Gibb overemphasized the local nature of textile machinery sales in this early period. As we have seen, as early as 1810 many mills purchased much of their machinery. Gibb certainly does not deny this, although he underestimates the significance of the machinery

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41 Gregg, Essays, p. 31.
42 Items GB-1, AB-1, Nashua Collection, Baker Library.
43 Ibid.
trade, as do Bagnall and others. Interestingly, the Boston Manufacturing Company, far from making all their own machinery for the Waltham Mill, purchased in 1813 and 1814 from Luther Metcalf and Son of Medway, Massachusetts, carding engines, spinning frames and mules, winding blocks, reels, and other machines. Gibb notes this purchase without according it its significance.

There was good reason for the early development of the textile machinery trade. New mills found it difficult to find enough experienced mechanics to build all of the machinery needed to open a mill—especially in a reasonably short time. The mill boom during the Embargo and War of 1812 exacerbated these difficulties. Patents and experience soon gave the large shops and independent commercial shops an oligopolistic control of machine building skills. If Northeastern mills were encouraged by these factors to turn to commercial builders, Midwestern and Southern mills were doubly so. Early mills in the South experienced severe difficulties

\[45\text{Vol. 23, p. 83, Boston Manufacturing Company Collection, Baker Library, Harvard University.}\]

\[46\text{Gibb, Saco-Lowell, p. 24.}\]
in securing and retaining skilled labor. And, if mills were drawn to commercial builders, the builders south of Springfield and Boston were equally driven to these distant mills by the limited market for equipment in their own community. Unlike pre-1850 Lowell, they had no steady, captive local market. Thus it was with the southern shops; thus it was with the shops of Taunton.

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47 See Gregg, Essays.
CHAPTER II

EARLY TAUNTON MANUFACTURING, 1806-1837

Taunton is the county seat of Bristol County, Massachusetts. To the southeast is Cape Cod, and to the west is Rhode Island. Within twenty miles are Fall River, New Bedford and Providence. Inside a larger radius of sixty miles also lie most of the other major industrial centers of eastern New England: Boston, Worcester, Newburyport, Lawrence, and Lowell. This location was significant to Taunton's industrial development. In the early nineteenth century, Taunton, following the lead of neighboring Rhode Island cities, became both a machinery building center and a cotton mill town. Mechanics moved between Rhode Island and Taunton, carrying technological knowledge from one center to the other. Likewise, Rhode Island and Bristol County mills became the major customers for Taunton's textile machinery. When these mills closed in the 1920's and 1930's, so did Taunton's last cotton machinery builder. Boston capitalists supplied the capital which created Taunton's two largest textile companies and largest machine shop. Likewise, railroads controlled by
Boston investors were the major market for Taunton locomotive and car builders.

Twentieth-century Americans tend to think of New England as being badly located for most industry, but pre-Civil War Taunton was favorably situated. Major markets and raw materials were close, and Taunton's transportation facilities were excellent for that period. By the early 1800's daily stages tied Taunton to Boston, and in 1837 the Taunton Branch Railroad connected Taunton with the Boston and Providence Railroad. Until the late nineteenth century, most coastal ships could navigate the Taunton River to the Weir section, a few blocks from Taunton Green.

Nature did not provide Taunton with an abundance of natural resources, but the thrifty Yankees--made thrifty by their environment--put them to good use. Most early settlers subsisted on marginally productive farms, supplemented by fish from the Taunton River. Running south through the town, Mill River, in truth a modest brook,
eventually provided a ready, if meagre, power source for eight mill dams in a 2½-mile stretch. ¹

Seeking to broaden the economic base of their town by exploiting the bog iron of local swamps and the charcoal potential of surrounding forests, in 1656 leading citizens of Taunton opened an iron furnace in Raynham just outside of town. More successful than the two earlier American works at Saugus and Furnace Brook, this furnace spawned rolling mills, nail works, and foundries, making Taunton one of the most important colonial iron centers. This furnace also established a local precedent when it acquired its technology by bringing from the older iron works to the north Henry and James Leonard and Ralph Russell, practical Welsh iron furnace men. Much later when cheaper New Jersey iron supplies were developed, the Raynham iron furnace died. However, Taunton's secondary iron industries flourished into the nineteenth century. ²


By 1831 Taunton already had an extensive industrial base. Iron manufactures survived in the form of a rolling and slitting mill producing nail and tack plate and other finished products. Other iron-working establishments included a triphammer forge, a blacksmith shop, a shovel factory, and several nail and tack shops producing eight to ten tons daily. Working other metals were a copper and lead rolling mill, a bell foundry, an edge-tool maker, and tinware and britanniaware shops. Straw bonnets and hats, leather goods, boots and shoes, stoneware, paper, and eight million bricks a year were made in the town. More important were the textile mills. Representing an earlier era of textile manufacture was the old carding and fulling mill serving household spinners and weavers. Between 1806 and 1828, the modern textile industry came to Taunton with the building of seven textile mills with an aggregate 16,000 spindles. The pioneer Green (1806), Whittenton (1807), Hopewell (1818), and Brick (1823) mills located on Mill River were owned by the Taunton Manufacturing Company and managed by Taunton's leading capitalists, Samuel Crocker and Charles Richmond. The other three mills lay on the outskirts of town: the Dean (1812), the Westville (1824) owned by Crocker and Richmond, and the Oakland (1828)
of Silas Shepard. Servicing these mills as well as mills distant from Taunton were the textile machine shops of the Taunton Manufacturing Company in the Brick Mill and on School Street. Cloth from local and distant mills was bleached and printed at Taunton Manufacturing's calico plant. All this industry generated a powerful thirst in the 6,000 Tauntonians, sustaining one cider mill and two breweries—one owned by Crocker and Richmond.3

The diversity of Taunton's industry at the end of the 1820's was typical of many American industrial centers of the early nineteenth century. Baltimore in 1822, for example, had a copper rolling mill and three iron rolling mills making—as did Taunton's—rods, hoops, bolts, and sheet iron. There were also two woolen and seventeen cotton mills in Baltimore.4 In both Taunton and Baltimore


4Niles' Weekly Register 23 (1822): 1.
many interrelationships between various industries are clear. The rolling, forging, and nail industries grew up as adjuncts of the iron furnaces, the machine shops served the textile and nail industries, and the carding mills, grist mills, and breweries serviced the farmers. However, a significant change was underway in 1831: the market for Taunton's products was expanding from local to national dimensions, particularly for cotton goods and machinery.

SILAS SHEPARD AND JOHN THORP, 1806-1823

Two men, Silas Shepard and John Thorp, stand out as early Taunton designers and builders of textile machinery. Silas Shepard, although the son of a former farmer, hardly lived up to his pastoral name—he founded the Taunton cotton manufacturing industry. Silas was youngest of three sons of Benjamin Shepard, a Wrentham, Massachusetts, farmer, who about 1792 started a cotton mill powered by both horses and water. After learning cotton manufacturing in this pioneer mill, Silas moved to Taunton in 1806 to erect a brick cotton mill on Mill River near Taunton Green. Shepard served as managing partner, while the other 75 percent of the shares were held by three men named Samuel: Messrs.
Crocker, Fales, and Leonard. Called Green Mill from its location, the Taunton Cotton Manufacturing Company was the first cotton mill in Taunton. With capacity for 1000 spindles, after six years it had only 800 spindles. Its yarn was put out to Taunton women who wove checks and gingham on hand looms.5

Shepard also started the Taunton machinery industry. As did many early mills, the Green mill had a machine shop which built and repaired machinery for the mill. Finding that repairs utilized only part of the shop's capacity, the Green Mill soon began to build Shepard's patented designs of machines for sale to other mills. When the Embargo and War of 1812 spawned a mill-building mania, Shepard's machinery business prospered. It was during this period that Shepard turned his attention to the development of a power loom.

The cut-off of British cloth imports and the resulting mill boom led to a sudden increase in textile inventions and patents between 1810 and 1816. The first thirty-three United States cotton and wool machine patents

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were granted over a nineteen-year period, 1791-1809.
The issue of the second thirty-three such patents took
but two years, 1810 and 1811, while the granting of the
third thirty-three occurred in the single year 1812.  
A substantial part of this inventive flurry concerned
power weaving, as many American manufacturers experimented
with power looms between 1812 and 1816. One possible
cause of this rising interest in power weaving lie in
the rapid expansion of spinning capacity after 1807
which created a shortage of skilled weavers, a deficiency
exacerbated by the cut-off of the flow of weavers from
Great Britain during the 1812-1815 war.

When Silas Shepard began his experiments in
1811, power weaving was not a new idea. The many
experiments with power looms in the previous two
decades enjoyed only limited success in Britain and
had no lasting impact in America. Weaving remained a
household industry. In Britain the most significant
early weaving patents included Radcliff's (1803, 1804)
and Horrock's (1803, 1805, 1813) looms, dressers, and
warpers. Horrock's inventions constituted the prototypes

6 Calculated from Ellsworth, Digest of Patents.
Cordage, braid, waste, hat, felt, straw, rag, oakum, paper,
non-wool hair, fur, gin, and compress patents and hemp,
flax, and silk preparation patents have been excluded from
Class III. Unfortunately there is no easy way of separating
hand and power inventions, although obvious hand devices
have been excluded.
for successful power weaving machinery in both the United States and England. Amos Whittemore of Cambridge, Massachusetts, patented an automated duck loom in 1796, possibly the first American attempt to make a power loom. Between 1803 and 1806 Thomas Mussey of Exeter, New Hampshire, developed a power loom, but it saved no labor and gained no success. By 1806 experimental power looms operated at Dedham and Dorchester in the Boston area, and evidence suggests that more power looms must have been invented in northern New England prior to 1814. The years 1811-1816 saw intense interest in power looms develop in the Providence-Taunton region. Besides Shepard and Thorp, several

7White, Memoir, pp. 388-389; Bagnall, Textile Industries, pp. 546-549; Ure, Cotton Manufacture, 1: 315. Radcliffe's patents were in Thomas Johnson's name.


9Peck and Earl, Fall River, p. 80; Gibb, Saco-Lowell, pp. 13-14; Ellsworth, Digest of Patents, p. 109. His patents were Philadelphia, Mar. 4, 1811, and New London, Conn., June 10, 1817.

10Peck and Earl, Fall River, p. 80.

11For example, Lowell and Jackson bought looms from Ebenezer Stowell and J. Stimpson in 1814 to get ideas on the solution of problems in their prototype Waltham loom.
other area machinists designed power looms. Samuel Blydenburgh in 1812 and 1813 installed in Judge Daniel Lyman's North Providence mill several power looms with a complicated spring-and-cam lay-and-shuttle motion, but received no reorders. In 1813 Thomas R. Williams placed in another North Providence mill, owned by T. Green, a couple unsuccessful power looms with a

\[12\] A simple power loom required automation of five motions: picking (driving the shuttle from side to side), shedding (shifting the harnesses, which held all warp threads to be either raised or lowered during a given pick), beating (in which the filling thread left by the last pick was beat-up firmly against the previously woven threads to make a tightly woven cloth), let-off (unwinding the warp threads slowly from the warp beam around which they were wound), and take-up (winding the cloth onto the cloth beam). Most early looms powered these actions by cams or the superior cranks. Springs and weights powered some motions.

\[13\] Zachariah Allen, "Historical, Theoretical and Practical Account of Textile Fabrics," p. 28, unpublished manuscript in disorganized condition, Allen Collection, Rhode Island Historical Society, Providence (based on information collected from industry pioneers); Samuel Greene to Zachariah Allen, June 14, 1861, "Heirs, Misc.," Allen Collection (Greene worked in Almy, Brown and Slater's original mill and was David Wilkinson's partner in David Wilkinson and Company). Possibly this was the loom Blydenburgh and Hezekiah Healy of Worcester patented, Feb. 20, 1815, U. S., Secretary of State, Annual Report on Patents Issued, 1816. Green gives name as Bledingburg.
crank-powered lay and cam-and-spring operated shuttle, and the next year Elijah Ormsbee built two ill-fated crank-operated looms for a mill in Olneyville, Rhode Island.

These early looms suffered complicated motions, inadequate warp-smash protection, mildew, weak warp threads, and want of suitable dressing and a machine to apply it. Because power looms were rougher on warp threads than hand looms, the warp required dressing with starch to toughen it. However until adequate dressing machines were introduced to America between 1815 and 1817, power looms had to be stopped regularly.

14 Allen, "Historical Account," p. 28; Peck and Earl, Fall River, p. 80; Samuel Greene to Zachariah Allen, June 14, 1861, "Heirs, Misc.," Allen Collection; Gibb, Saco-Lowell, pp. 13-14; U. S. Patent, July 3, 1813, Thomas R. Williams, Newport, R. I., listed in Ellsworth, Digest of Patents, p. 104.

15 Allen, "Historical Account," p. 28; Green to Allen, June 14, 1861, Allen Collection; Peck and Earl, Fall River, p. 80.

16 If there is no device to stop the loom if the shuttle fails to complete its passage, the shuttle can break the warp threads and possibly part of the loom when the pick is beat up and the harnesses and warp shifted.

17 The warp is the threads already drawn (warped) into the loom, running from the let-off (warp) beam through the harnesses to the take-up (cloth) beam. The shuttle carries the filling (woof or weft) from side to side across the warp, completing the cloth.
to dress the warp, thereby negating much of their labor-saving advantage. These problems also vexed Shepard's and Thorp's efforts to develop power looms in Taunton.

Silas Shepard's first experimental power loom was built in 1811 and patented April 27 of the following year. According to Shepard, it used a "crank motion for the lay & cams for the heddles, the shuttle being thrown by a movement being derived from the lay." Oddly enough, patent reports give Philadelphia as Shepard's residence. There is no evidence that Shepard ever lived in Philadelphia, although his name is unusual enough to make one doubt that another man of the same name was experimenting with power looms at the same time. Possibly Shepard left Taunton

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18 Peck and Earl, *Fall River*, pp. 80-81 (their account of early textile machines is well-informed and is based largely on the recollections of Fall River's history-conscious textile industry pioneer, David Anthony). Patented April 27, 1812, U. S., Secretary of State, *Annual Report of Patents Issued*, 1812.

19 Allen, "Historical Account," p. 28, based on letter from Silas Shepard.

20 U. S., Secretary of State, *Annual Report of Patents Issued*, 1812, which gives Shepard's name correctly. The Ellsworth and Burke lists of patents incorrectly give the name as Cyrus Shepherd or Shepard. Researchers are cautioned that Ellsworth and Burke make a great many errors in the names of patent holders. The Secretary of State's Reports are far more accurate.
briefly to install some of his looms in a Philadelphia mill, deciding while there to find a patent attorney. In any case, he was soon back in Taunton trying to learn more about recent power-weaving advances from John Thorp, a mechanic familiar with those developments.

John Thorp: Early Life

John Thorp figured prominently in the history of Taunton's textile and machinery industries; directly through his work with Shepard on looms and winders and indirectly by his invention of the ring frame which was finally made a commercial success by William Mason, Taunton's most important machinery builder. Typical of American mechanical inventors of the period, Thorp was a journeyman mechanic of modest origins. According to one account, John Thorp was born in 1784 to Ruben Thorp, a coachbuilder from an old Rehoboth, Massachusetts, family.

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21 Charles H. Clark, "John Thorp--Inventor of Ring Spinning," Transactions of The National Association of Cotton Manufacturers 124-125 (1928): 87; the basis of the DAB entry and other modern biographical sketches.

22 Some doubt is cast on this by Thorp's contemporary J. G. Dudley, who stated that calico printing was introduced to Taunton by John Thorpe, a nephew of an Englishman named Thorpe who had started calico printing in Philadelphia. J. G. Dudley, "Growth, Trade and Manufacture of Cotton," DeBow's Review 16 (1854): 2. Later patent lists and histories often spell the name "Thorpe," but all surviving patent specifications say "John Thorpe." His signature could be misread as "Thorpe" because of an embellishment at the end.
Thorpe's first patent was received March 28, 1812, for a power loom which alternatively could be hand operated.\textsuperscript{23} Considering the high cost of space in mills, this loom's huge wooden frame constituted a liability. As were most later successful power looms, the Thorp loom was powered by a crank and had horizontal warp. Ratchet wheels lowered the harnesses, which were raised by cumbersome overhead jack levers with weights suspended from the ends on the other side of their fulcrums. It must have been a slow mechanism. The pickers were horizontal rather than vertical as on modern looms, and an ingenious let-off and take-up motion used scroll pulleys connected by a rope fed from the decreasing diameter of the warp-beam pulley to the increasing diameter of the cloth-beam pulley (see footnote 12). This arrangement maintained at equal speed two inversely changing circumferences as the warp played out and the cloth wound up.\textsuperscript{24} Recalled Rhode Island

\textsuperscript{23}Reconstructed U. S. Patent, Mar. 28, 1812, John Thorp.

\textsuperscript{24}Ibid., drawings for reconstructed patent; Aza Arnold to Zachariah Allen, July 10, 1861, "Heirs, Misc.," Allen Collection. Even though this loom seems to have brought Thorp little reward, he must have thought highly of it for he reconstructed the patent after the Patent Office fire and later recorded the patent anew, Jan. 28, 1843.
mill-pioneer Aza Arnold, "I saw it at Carpenter's place near Central Falls but do not think it came into use." However, the loom did serve to bring Thorp to Shepard's attention.

Shepard and Thorp

Together in the winter of 1812, Thorp and Shepard began building looms in Taunton for sale. In addition to those sold, fifteen or twenty were installed in Shepard's own Green Mill. Whether these looms were Thorp's patented design, Shepard's, a hybrid of the two, or a new design is unknown. Poor dressing, which rotted and mildewed, improper beaming, and inadequate warp-smash protection hampered their success. Following Shepard's return from the War of 1812, he and Thorp developed a vertical loom in which the warp ran vertically rather than horizontally and the shuttle traversed on top of the lay. Some early British power looms had been vertical, but such designs were uncommon. A patent was received on July 25, 1816.

25Arnold to Allen, July 10, 1861, capitalization silently corrected.

26Peck and Earl, Fall River, p. 80; Allen, "Historical Account," p. 28.
and in the same year several mills received these looms. Judging from the large number of people who recalled these looms, they must have generated great interest in southern New England prior to the introduction of the Scotch loom the following year. Thirty or more were installed in Shepard's Green Mill, while twenty were built for the Pawtucket Company. Others went to a Rhode Island mill owner named Ingraham and the Johnson, Rhode Island, mill of Harry Franklin. This also may have been the first power loom used for American woolens. Demand for these looms was so great that Shepard and Thorp licensed David Wilkinson and Company to also build and sell them. Others, however,

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28Samuel Greene to Zachariah Allen, June 14, 1861, "Heirs, Misc.," Allen Collection.

29Arnold to Allen, July 10, 1861; Recollections of David Anthony, Peck and Earl, Fall River, p. 80. Anthony has the 1812 and 1816 looms somewhat confused.

30Cole, American Wool Manufacture, 1: 123.

31Aza Arnold to Zachariah Allen, July 10, 1861, "Heirs, Misc.," Allen Collection.
were unimpressed. In June 1816 Nathan Appleton and Francis Cabot Lowell of the Boston Manufacturing Company saw these vertical looms operating in the Taunton Cotton Mill, and Appleton concluded that they "didn't promise success." He cited no deficiencies and could be considered a biased observer since his Waltham mill produced the recently designed Waltham loom. Appleton failed to foresee the real cause of the end of the Taunton loom's success—the 1817 introduction of the Scotch loom which swept its competitors from the field.

The first truly successful American power loom was Francis Lowell's Waltham design. Lowell carefully observed power looms in England on the eve of the War of 1812, then built a prototype on his return to America. He learned quickly that observing the principles of a mechanism was far easier than putting it into practice. Problems which could not be solved by asking the enemy during war had to be solved a second time by using other American power looms as models and by developing mechanisms different from the English prototypes. So the Waltham loom was a hybrid using American temples and a cam

mechanism rather than the common British crank. The prototype went into operation at the Waltham mill of Boston Manufacturing in late 1814 and was patented the next year. Significantly, its great expense seems to have provided a considerable competitive advantage to the 1816 Shepard-Thorp loom.\textsuperscript{33}

The ultimate victor over the Taunton and Waltham looms was the so-called Scotch loom. William Horrock of Stockport, England, had invented the loom and complimentary dressing and warping machines, then gradually improved them, receiving British patents in 1803, 1805, and 1813. Fast, compact, and easily maintained, the Horrock loom soon became a success. Its acquisition by Americans demonstrates the vital role of both mechanics and operatives in technological transfer.

William Gilmour, a Scottish mechanic, arrived in Boston from Glasgow in September 1815, possibly with patterns for the Horrock machines, but more likely with drawings, templates, or just his memory. In 1816 Gilmour went to Smithfield, Rhode Island, where he interested

\textsuperscript{33}Ibid., pp. 8-9; Greene to Allen, June 14, 1861; Gibb, Saco-Lowell, pp. 13-14; U. S., Secretary of State, Annual Report on Patents Issued, 1816. Patented Feb. 23, 1815.
John Slater in the loom. When John's more conservative brother Samuel prevented an experiment, Gilmour contracted in late 1816 to build a loom, warper, and dresser for Judge Daniel Lyman, who remained undaunted by his earlier, unsuccessful use of power looms. In early 1817 the machines were placed in operation, but failed because Gilmour as a mechanic knew how to build them, but not how to operate them. Fortunately, Judge Lyman found a British weaver familiar with Horrock machines who made the adjustments necessary to their operation. Success followed and the rights to build the machines and to use Lyman's patterns were sold for a trifling $10 to David Wilkinson and Company, which in turn sold hundreds of the looms. The loom's low cost--$70 compared to $300 for a Waltham loom--constituted its most obvious advantage. Its crank mechanism was faster and more serviceable than the Waltham cam mechanism and its iron frame, first in America, did not permit the mechanism to sag out of alignment. Additionally, it was simpler, faster, and more rugged than the Waltham and Taunton looms.34

34 Bagnall, Textile Industries, pp. 546-549; White, Memoir, p. 389; Greene to Allen, June 14, 1861; Bagnall, "Sketches," 2: 1501-1502; Ware, Early Cotton Manufacture, p. 84. Horrock's Patents were Apr. 20, 1803, May 14, 1805, July 31, 1813.
One final reason the Waltham and Scotch looms were more successful than earlier power looms was that these two newcomers were not merely looms, but entire weaving systems. Both the Waltham and Scotch looms were used with dressing and warping machines based on Horrock's prototype, solving the warping and dressing problems which hampered most early attempts at power weaving. The Taunton loom and other early American power looms seemed to have lacked both these auxiliaries. The Waltham and Scotch loom also benefited from the 1816 Draper self-acting loom temple and the development of warp-smash protection and stop-motions for broken threads. By 1820 even Shepard admitted defeat and reequipped the Green Mill with Scotch looms.35

Thorpe and Shepard also patented in 1816 their best-known joint invention, the Taunton socket bobbin winder.36 At this time filling was spun on conventional throstle frames with bobbins much too big to fit the shuttles for the loom, forcing the rewinding of filling

35 Appleton, Introduction, p. 9; Lowell, Memoir of Patrick Tracy Jackson, p. 7, Gibb, Saco-Lowell, pp. 33, 38; Bagnall, Textile Industries, p. 425; Ware, Early Cotton Manufacture, p. 76.

onto smaller bobbins on a winding frame. The Taunton winder, considered superior to its American rivals, enjoyed considerable popularity in New England until the spread of Paul Moody's 1819-patent filling frame. Nathan Appleton recalled that Francis Lowell and Paul Moody visited Silas Shepard in Taunton shortly before 1819 with the intention of purchasing for their Waltham mill one of Shepard's winders. However, when in the course of bargaining Shepard demanded what Moody felt was an exhorbitant price, Moody announced that he had been thinking of spinning filling directly on the shuttle bobbins. Moody made the novel idea sound so plausible that Shepard lowered his price, but Lowell, similarly impressed, refused the new offer with a declaration that Moody's idea seemed superior to the old method. Only after they left the Green Mill did Lowell learn that Moody's suggestion had been only a bargaining gambit. Moody got out of his dilemma, according to Appleton, by designing the filling frame. Colorful as the story is, John A. Lowell implied that the real origin of the filling frame
stemmed from the desire to eliminate the expense and waste rewinding incurred.\textsuperscript{37}

Silas Shepard, Later Life

In 1818 and 1821 Shepard's Green Mill partners Samuel Crocker and Charles Richmond opened new mills at the Hopewell section of Taunton on Mill River a mile north of the Green Mill. Besides manufacturing cotton goods on the upper floors, the Hopewell Mills also made nails and textile machinery in a basement shop supervised by Elias Strange. Shepard served as the general manager of the Hopewell Mills from 1818 to 1827, selling his interest in the Green Mill in 1820 to concentrate more fully on the development of the Hopewell Mills. Thereafter Shepard was concerned more with mill management than with machine design. A speeder he and Cromwell Dean patented on March 23, 1821 was Shepard's last known invention. No description survives.\textsuperscript{38} In 1827 Shepard, looking back at his two


decades with the Green and Hopewell mills, boasted that his mills, among "the oldest now in operation, had done more to cripple the power of England than any frigate of the navy." Shepard had established another Taunton machinery builder tradition: egocentric puffery. In 1828 he left the Hopewell Mill in order to establish a mill at Oakland on the west side of Taunton. There he produced cotton yarn and flannels, but no machinery, until his death on December 23, 1864.

John Thorp, Later Life

Sometime between 1816 and 1819 John Thorp returned to the Providence area where he patented in 1819 what was vaguely called rolls for forming yarn on the shuttle bobbin. This could either have been a copping motion or a presser. This was followed by patents in 1821 and 1826 for braiding machines probably designed for Thomas and William Fletcher and Jeremiah Whipple, North Providence braid manufacturers with

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39 *Niles' Weekly Register* 32 (1827): 141.

40 Bagnall, "Sketches," 2: 1500-1501; Hall, "Taunton: Manufacturing Interests," p. 832; Seventh and Eighth U. S. Censuses of Massachusetts, years ended June 1, 1850 and 1860, Manuscript Schedules, Products of Industry, Massachusetts State Archives, Statehouse, Boston.
whom Thorp was known to have been associated in 1829. Sylvanus Brown later recalled that Thorp sold the braiding patents to the Fletchers. Thorp probably remained in Providence through the 1820's and therefore was not the John Thorp who was in Taunton in 1823-1824 installing Taunton Manufacturing's calico works (see below). His inventive activities peaked in 1828-1829, when he received patents covering eleven different machine designs. Several of these, the ring spinning patents, were the basis of modern spinning and of Thorp's later fame (see Chapter IV). Another patent, dated November 20, 1828, was for what has been described

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41 U. S. Patents, John Thorp, Nov. 20, 1819; Aug. 10, 1821; July 10, 1826, as cited in Ellsworth, Digest of Patents; and in U. S., Secretary of State, Annual Reports on Patents Issued, 1820, 1822, 1827; also McLane Report, 1: 974.


43 U. S., Secretary of State, Annual Reports on Patents Issued, 1828, 1829. Fortunately most are described with illustrations in the Journal of the Franklin Institute, British patents, and reconstructed U. S. patents.
variously as a "knot shuttle," as a "loom shuttle" capable of "tying knots," or as a "netting machine," the principle of which is "still in use." In 1829 Thorp also patented a narrow fabric loom (often called a tape loom) which seems to have been the earliest successful shuttleless power loom. In place of the shuttles this loom used pivoted arms to insert the filling into the warp and to beat up the pick. It has been accredited also as the first successful gang loom, and whether by coincidence or ancestry, later generations of tape looms closely resembled it in several respects. Showing that Moody's filling frame had not completely replaced bobbin winders, Thorp also patented a cam-operated cop-building motion for a bobbin winder. These inventions

44 Secretary of State, Annual Report, 1828.
45 Ellsworth, Digest of Patents.
46 Clark, "John Thorp," pp. 72, 78.
47 U. S. Patent, 1829, no. 436, Dec. 22, 1829, reconstruction drawing; Clark, "John Thorp," pp. 77-78. A gang loom is one which weaves several pieces of cloth at once.
of 1828-1829 marked Thorp as one of the most original and important mechanical designers of the early nineteenth century.

Thorp spent the late 1820's and the 1830's in the Providence area, probably working in the North Providence factory of Thomas and William Fletcher and Jeremiah Whipple. His brother Comfort and his nephew Reuben Thorp had worked there since about 1817, and the Fletchers and Whipple held at least the regional rights to his ring frames and cam builder motion. By 1836 the Providence Directory gave the Federal Hill Shop as his business address, but his inventive activities had slowed. Thorp and William G. Angell patented a loom harness in 1838, which the two men followed with an 1840 patent for making heddles. Thorp's last patent, for a spinning ring in 1844, gave his residence as

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49Clark, "John Thorp," p. 84. Whipple, Thorp, and the Fletchers ran an announcement of their patent rights in the Manufacturer's and Farmer's Journal (Providence), Mar. 9, 1829. Comfort Thorp received a patent in 1837 for a tongue for a shuttle, Ellsworth, Digest of Patents.

50U. S., Commissioner of Patents, List of Patents for Inventions and Designs, Issued by the United States from 1790 to 1847..., hereafter called Burke, List of Patents, its common name.
North Wrentham, suggesting that he was at the local mill owned by B. N. Shepard, Silas' nephew. When Thorp died in Providence on November 15, 1848, he left a small estate, never having earned much from his many significant patents.52

EARLY YEARS OF CROCKER AND RICHMOND

Silas Shepard's Green Mill partners, Charles Richmond and Samuel Crocker, were the driving forces of industrialism in Taunton during the first four decades of the nineteenth century. Samuel Crocker was the mentor with both capital and Boston political and mercantile connections which enabled the pair to tap outside capital. The more youthful Charles Richmond conceived and with abounding energy supervised the day-to-day operations of the duo's enterprises.

Richmond was a skillful, visionary promoter. When he planned the Hopewell Mill, he broadly declared his intent "to make Hopewell shine with industry."53

52Clark, "John Thorp," p. 87.
53Quoted in Hall, "Taunton: Manufacturing Interests," p. 826.
Not only did he have the vision to make Taunton an industrial center, he also had the energy to bring that dream to fruition. "He was everywhere, early and late," marveled one contemporary. Often Richmond's drive turned to impatience, leaving him unloved by many. He also suffered another weakness; he was "too much given to speculation." Richmond's gambles succeeded until the 1830's, but thereafter they undid him and Crocker.

Samuel Crocker (1772-1853) provided the firm capital and business contacts through his political connections and his leadership of the Crocker-Leonard extended kinship group, which dominated Taunton industry from the eighteenth century to the mid-nineteenth. Many Taunton industrialists were members of this group: Charles Richmond first married the widow of Samuel Crocker's brother, then took Crocker's daughter Abby as his second wife. Another of Samuel Crocker's daughters, Sarah, was married to a minor Taunton


\[55\] Ibid.

\[56\] Mass. vol. 9, p. 561, Dun.
industrialist, Samuel Bass King, while Crocker's mother Abigail and his wife Sally were both members of the iron-making Leonard family. John West, husband of Crocker's sister Abigail, was a Boston merchant who became associated with Crocker and Richmond in the Westville mill. Until his death in 1805, Crocker's brother William Augustus was his partner, and thereafter Samuel was guardian to his brother's sons, Samuel Leonard, William Allen, and George Augustus. After reaching adulthood these three nephews formed the Taunton Copper Manufacturing Company and helped create and lead the Taunton Locomotive Manufacturing Company. Finally, Samuel Crocker's second wife Elizabeth was the sister of Francis and William Baylies, leading lawyers who served extensively in state and national government where they could tend Crocker and Richmond's political interests. We will meet all these relatives again.  

Of even greater value to Crocker and Richmond were Crocker's political activities which brought him

into the orbit of the Boston merchant capitalists. From 1806 to 1813 Crocker served in the lower house of the state legislature and from 1813 to 1817 in the state senate. In 1816 and from 1818 to 1823 he served on Governor John Brook's Council and, ex officio, on the Board of Overseers of Harvard College. These offices acquainted him with the Harvard-educated merchant-lawyer-politician Boston elite, including Harrison Gray Otis, Israel Thorndike, William Prescott, the Eliots, and the Dwights. A Federalist and Liberal Unitarian, Crocker easily befriended these men. Dazzled by the success of Boston Manufacturing Company's Waltham mill, they were easily enticed by Crocker and Richmond's plans for similar industrial development in Taunton.\footnote{Atwood, Reminiscences, pp. 124-125; Massachusetts Registers, 1819, 1823; Historical Register of Harvard University: 1636-1936 (Cambridge: Harvard University, 1937), s.v. "Overseers of Harvard College."}

Much of Crocker's success in soliciting these men's investments was due to his "quiet" and "dignified" manner and his reputation as a "farseeing and sagacious" person. Yet, despite his well-bred manners, Crocker was as vain as Richmond. When a bell he bought from Paul Revere for one of his mills did not ring as loudly as

\begin{itemize}
\item \textit{Atwood, Reminiscences, pp. 124-125; Massachusetts Registers, 1819, 1823; Historical Register of Harvard University: 1636-1936 (Cambridge: Harvard University, 1937), s.v. "Overseers of Harvard College."}
the other bell in Taunton, he demanded that Revere take back the bell.\textsuperscript{59} Prestige, it would appear, was as important a motive as wealth in the building of Crocker's industrial empire.

Crocker and Richmond got their start, along with Thomas Bush, as clerks in Samuel Leonard's iron business.\textsuperscript{60} It was a family affair since the Leonard, Bush, Crocker, and Richmond families were interwoven by various marriages.\textsuperscript{61} When Taunton lost its importance as a primary pig-iron producer in the early eighteenth century because of the development of superior iron deposits in New Jersey, the Leonards and other Taunton area iron masters shifted to the production of semi-finished iron products such as nail plates and rods, nails, shovels, and stoves. Late in the eighteenth century, Crocker, Richmond, and Bush's mentor,

\textsuperscript{59}Quote, Atwood, Reminiscences, p. 28; also American Whig (Taunton), Apr. 7 and 28, 1853; Taunton Democrat, Apr. 7, 1853; file C872SL, Old Colony Historical Society; Samuel Crocker and Company to Paul Revere and Sons, Feb. 17, 1811; Aug. 22, 1811, 1810-1817 Letterbook, Revere Papers, Massachusetts Historical Society (Boston).

\textsuperscript{60}Emery, History of Taunton, pt. 1, p. 633.

\textsuperscript{61}William R. Deane, A Genealogical Memoir of the Leonard Family... (Boston, 1851).
Samuel Leonard, built a nail-rod rolling and slitting mill at the site of the present-day Reed and Barton factory on Mill River in the Britanniaville section of Taunton. Leonard's mill had a one-ton-capacity, pine-fueled furnace and two water wheels powering two pairs of rolls which rolled and slit wrought iron plate into nail rods the thickness of the rectangular shanks of nails. Farmers then took the nail rods to nail sheds next to their homes where they and a couple helpers handcut, headed, and pointed nails during the winter months. Inside the approximately twelve-foot-square nail sheds was a fire for heating the rods. Around the fire each person hammered the rods into nails at his own block. When finished, the nails were traded at the company store for goods and groceries. For a while at the turn-of-the-century this store was run by Samuel Crocker and Bradford Leonard. Crocker proved so capable that he, along with his brother William Augustus, was admitted as a partner of Samuel Leonard in both

the rolling and slitting mill and the store. Following the deaths of William A. Crocker in 1805 and Samuel Leonard in 1808, the rod mill and store passed into the hands of Crocker, Bush, and Richmond who operated under the title of Samuel Crocker and Company.63

Three years earlier, in 1805, Samuel Crocker, Thomas Bush, and Charles Richmond had established a partnership which, less Thomas Bush who died in 1817, lasted into the 1840's. Crocker, Bush, and Richmond's first enterprise was a one-story nail mill which they erected in 1805 at Whittenton on Mill River two miles north of Taunton Green and a half mile north of the Britanniaville rolling and slitting mill. From the start the Whittenton nail factory reflected two characteristics of Crocker and Richmond enterprises: vertical integration and advanced machine technology. The Whittenton operation was an extension of the Britanniaville rolling mill and reflected an attempt to control not only the nail rod manufacture, but also the production of the final consumer product. In the 1820's Crocker and Richmond would also extend the

vertical integration of their enterprise downward by helping to found the East Taunton iron works for the manufacture of the wrought iron plates used in the Britanniaville rolling and slitting mill. Crocker, Bush and Richmond—particularly Richmond—conceived their nail mill as a factory using water-powered machines rather than hand labor in a farmer's nail shed. Only in this way could they monopolize the local nail industry and its profits. The Whittenton mill was one of the leaders, possibly the leader, in the application of machinery to nail manufacture. Recalled a contemporary, "This business was in its infancy, and many experiments were tried." 64

Since nail manufacture was one of the most common eighteenth-century American domestic industries, automation of nail cutting, heading, and pointing became one of the most common objects of early patents. In the 1790's 22 nail manufacturing patents were granted by the United States Patent Office, in the 1800's 35, and in the 1810's 50. In Taunton, as in other nail-making centers,

64L., "Reminiscences of the Iron and Cotton Business," Taunton Weekly Gazette, Dec. 17, 1874 (there are no clues to L's identity, other than the internal evidence in the article that he was in at least his teens in the 1800's).
the first machine-made nails were cut by a crude machine and put out to be headed and pointed by hand. The next logical step was to acquire a machine that did the heading and pointing. As early as 1796 Isaac Garretson of Pennsylvania and George Chandler of Maryland had each patented machines to cut and head, and by 1807 a dozen such patents had been granted, however the continuing flood of patents suggested that a satisfactory design was yet to be developed. About 1808 Crocker, Bush and Richmond installed a nail-heading machine patented by Asa Chandler and Silas Shepard on September 16, 1808. The machine succeeded in depriving local farmers of a badly needed supplement to their meager farming income, but it was no match for Samuel Rogers' machine which cut and headed in one operation. Since Rogers patented one machine in 1807 and two in 1814, it is unknown which design was installed in Taunton. Soon after, Rogers' machine was in turn replaced by Thomas Odeorne's design, which gripped the nail flatwise, making a better nail than Rogers, but doing it much more slowly. Restlessly Charles Richmond searched for a faster machine. Melville Otis of Wareham, who had previously patented nail and iron machines with Samuel Rogers, developed a machine that cut, headed, and pointed
in one operation, but Otis unwisely attempted to obtain advice by showing a model of the device to Jesse Reed, a gifted Kingston, Massachusetts, mechanic. Reed, already the holder of several nail-machine patents, kept his ideas for modifications to himself and incorporated them into an improved version of the Otis design, for which he received a patent on November 14, 1811. Recognizing the speed and superior product of the Otis-Reed nail machine, Charles Richmond acquired the patent. Later, the Whittenton factory adopted further improvements by Melville Otis: first a gripper that grasped the nail edgewise, then a nipper that turned the nail so as to grip it flatwise. These modifications were probably those patented by Otis on December 31, 1817. With these improvements, the Otis-Reed machine now produced nails equal in quality to those from the Odeorne machine, and much more rapidly. Soon the design dominated the industry, along with the rival device patented in 1817 by Samuel Rogers of Bridgewater and Thomas Blanchard of Millbury, Massachusetts.65

65 Ibid.; Burke, List of Patents, pp. 51-54; Horace Greeley, et al., The Great Industries of the United States... (Hartford, Chicago, Cincinnati, 1872), pp. 1072-1074; McLane Report, 2: 873; Emery, History of Taunton, pt. 1, p. 634; Hall, "Taunton: Manufacturing Interests," pp. 822-823; Bristol County Deed Book 113, p. 76. The Reed patent was one of Crocker and Richmond's properties which was passed on to the Taunton Manufacturing Company in 1823.
In 1806 the Green Mill in the center of Taunton had been built for cotton yarn manufacture by Silas Shepard, Samuel Fales, and the two surviving slitting mill partners, Samuel Leonard and Samuel Crocker. As the other partners sold out or died, Crocker and Richmond came to control the Green Mill.\(^6^6\) Thereby introduced to cotton manufacture, in 1807 Samuel Crocker persuaded his two Whittenton partners to add to the Whittenton nail mill a second story for housing cotton spinning machinery. Yarn produced in this mill was, according to the usual American practice of the time, put out to farm women living within fifteen miles. When finished the women traded the cloth for goods at the Whittenton company store, in much the same manner as in the nail putting-out system. This system worked well in Taunton's cash-starved economy and served somewhat to offset the farmer's loss of nail revenue.\(^6^7\)


In 1810 Crocker and Richmond acquired from Lee Leonard a second slitting mill, near the Whittenton factory. The following year the Whittenton nail and cotton factory burned. Charles Richmond's characteristic impatience and his respect for machines showed during this fire. Seeing the building beyond hope, he ordered the firemen to play upon the machines; alas, the cold water cracked the hot, cast-iron parts. Had they been allowed to cool gradually, they might have been uninjured. Before the embers were cold, Richmond was planning reconstruction on a larger scale. A three-story-with-attic cotton mill rose on the old site while a separate nail mill was erected on the opposite bank to reduce the fire risk. 68

The succeeding three years, 1812-1814, were profitable for the Green and Whittenton cotton mills as war afforded freedom from British competition. But three years of troubles followed. First a flood of inexpensive British imports drove down cloth prices, rendering unprofitable many small, inefficient American spinning mills, including Taunton's, then, in 1817, partner Thomas Bush died. Undaunted, Crocker and

68 Ibid.
Richmond met their problems by building a larger mill at Hopewell midway on Mill River between the Green and Whittenton mills. The Hopewell Mill's 150 power looms, together with smaller numbers of similar looms installed in the Whittenton and Green mills, represented Crocker and Richmond's response to low yarn prices: they would manufacture the yarn into cloth themselves rather than putting-out yarn to domestic weavers. The adoption of power weaving may have been encouraged by the example of the Waltham mill of Boston Manufacturing Company, but the Hopewell Mill used the superior Rhode Island Scotch looms. In one decade, through the vision of Shepard and Richmond and with the financial support of Crocker, the putting-out system in Taunton had been supplanted by the factory system in both nail and cotton cloth manufacture. So successful was the mechanization of weaving that in 1821 a second mill was built near the first Hopewell Mill, and a few years later the two mills were connected by a weaving shed. To equip these additions, Crocker and Richmond sought to purchase the outstanding warpers, filling frames, and speeders produced by the Boston Manufacturing Company. Finding Boston Manufacturing full of work Crocker and Richmond obtained patent rights to build Boston's filling frame.
Ironically it was the very design which had replaced Shepard's winding frame. 69

Crocker and Richmond also developed several metal and textile factories away from Mill River. When William Augustus Crocker died in 1805, he left to his three infant sons a copper rolling mill on Wading River in Norton, just north of Taunton. Since Samuel Crocker was guardian for his brother's three sons, Crocker and Richmond operated the mill, producing copper sheets, bolts, spikes, nails, and penny blanks for the United States Mint until 1831 when Samuel Crocker's three nephews began operating the mill themselves as the Taunton Copper Company. 70 Besides operating the copper rolling mill in Norton, between 1821 and 1823 Crocker and Richmond acquired a seven-eighths interest in the Norton Manufacturing Company. This mill, which had been built in 1810 by Ephraim Raymond and Josiah Dean of Raynham, was used by Crocker and Richmond to make cotton sheetings for the Boston,  


70 Emery, History of Taunton, pt. 1, pp. 668-669; McLane Report, 1: 180-181; File C872S1, Old Colony Historical Society.
New York, and Philadelphia markets. Crocker's brother-in-law John West, a former Boston merchant, operated a paper factory at, appropriately, Westville in western Taunton. In 1823 he joined Crocker and Richmond in erecting a 2000-spindle cotton mill on the opposite bank of the creek from the paper works. From West's death in December 1827 until 1841, Crocker and Richmond operated both mills.

At the opposite end of town in East Taunton, Crocker and Richmond became partners in 1824 with Horatio Leonard in a new forge. The initial product was charcoal iron nail plate for the Britanniaville rolling and slitting mill. Soon nails, hoops, and shovels were added. Seeking to improve the quality of their product, in the late 1820's Richmond hired several experienced workmen from older rolling mills, including Enoch, Increase, and Charles Robinson, who had worked in the Bridgewater iron works. At the same time two Englishmen were hired for their knowledge of


the system of puddling with bituminous coal. Thus, the same method Richmond used to acquire textile technology was repeated in the iron works. By the late 1830's Crocker and Richmond also owned a forge, a grist mill, a saw mill, a warehouse at the Weir, and 20 houses. In 1844, following Crocker and Richmond's bankruptcy, the mill was acquired by the Old Colony Iron Works.  

Crocker and Richmond operated one other business in Taunton, a brewery they built at the Weir in 1811. They also held stock in the Taunton Branch Railroad, the Nantucket Steamboat Company, the Weymouth Manufacturing Company, and the Cohannet Bank, and Crocker alone was involved in the Boston and Providence Railroad and in the Marine Bank of Boston. In the 1830's Crocker and Richmond attempted to benefit from the rapid growth of Taunton by speculating in local real estate, a venture which stretched their scarce capital resources too thin and may have been the cause of their undoing. 


74 Bristol County Deed Book 158, pp. 266-269, 373-377; Insurance Applications, Samuel Crocker Collection, New York Public Library; Inventory of Sales of Property Sold by Trustees of Crocker and Richmond and Surveyors' Bills, file VC871R, Old Colony Historical Society; Atwood, Reminiscences, p. 29; R.Y.R., Letter to Editor, Taunton Weekly Gazette, Dec. 31, 1874.
Insufficient cash and capital was a persistent and serious problem for the Taunton partners. When the putting-out system still reigned in the cotton and nail industries, Crocker and Richmond paid for nails and cloth by credit at the company store. Even in the 1820's their factory workers were paid in the same manner. Likewise, Crocker and Richmond were obliged to pay for some of their supplies by barter. The eventual solution to this capital shortage was to join with Boston capitalists in forming the Taunton Manufacturing Company to acquire and expand the Taunton mills.  

TAUNTON MANUFACTURING COMPANY

On February 25, 1823, the Taunton Manufacturing Company acquired Crocker and Richmond's most important factories; Whittenton and Hopewell, along with some incidental minor properties for $65,862 credited toward shares of stock in the new company. Included with the Whittenton property were the nail and slitting mills and Jesse Reed's 1811 nail machine patent. Later the


76Bristol County Deed Book 113, p. 76.
Green Mill was also purchased by the Taunton Manufacturing Company.

A joint enterprise of Boston capitalists and of Crocker and Richmond, the Taunton Manufacturing Company was incorporated by legislative act, January 24, 1823. The principal incorporators and shareholders were Crocker, Richmond, Israel Thorndike, Jr. and Sr., Edmund Dwight, William Howard Eliot, Harrison Gray Otis, Sr. and Jr., and James W. Otis. Crocker held 150 of the 600 shares, Richmond 145, giving the Taunton pair five shares less than half.??

The Boston Investors

Harrison Gray Otis, with the younger Otises, Harrison Gray, Jr., James W., and William F., eventually controlled 105 of Taunton's 600 shares. Until the 1830's when he lost interest in Taunton, the elder Otis was the most important of the Boston investors because of his key role in the firm and because of his civic eminence.

??Act of Incorporation and Directors Minutes, Feb. 27, 1823, vol. 1, Taunton Manufacturing Company Collection, Baker Library, Harvard University, the latter hereafter referred to as Directors Minutes.
As the man who had gotten most of the Boston stockholders interested in Taunton, Otis' advice bore considerable weight. His father had failed as a merchant and found refuge in politics, but Harrison's marriage to a merchant's daughter restored the family fortune. After Harvard Otis became famous as a lawyer and as a leader of the Federalist Party. He served as presiding officer of both houses of the legislature, in both houses of Congress, and as Boston mayor. Samuel Crocker interested Otis in the industrial possibilities of Taunton while both were serving as Commonwealth Justices and as overseers of Harvard College during the governorship of John Brooks (1816-1823).

Israel Thorndike, with his son Israel, Jr., owned 66 of the 600 shares. The elder Thorndike had

78 Ibid.; Shareholder Minutes, Jan. 22 and July 29, 1834, vol. 2, Taunton Manufacturing Collection, Baker Library, Harvard University, the latter hereafter referred to as Stockholders Minutes.


80 Massachusetts Registers, 1819 and 1823; Historical Register of Harvard University.
made his fortune as a Revolutionary War privateer and in the China Trade. Despite losses in the pioneer Beverly mill, he later invested in mills at Norwich, Waltham, Lowell, and Chicopee. His involvement in the Taunton Manufacturing Company was a natural result of his family and political connections: he married his son to Otis' daughter and served in the legislature and on the Board of Overseers of Harvard College with Crocker, Otis, and William Prescott. With William Prescott and Peter Chardon Brooks, father of Taunton shareholder Gorham Brooks, Thorndike was also a member of the Society for Promoting Theological Education at Harvard. 81

Ultimately more important than the Otis and Thorndike families to Taunton's development were Samuel A. and William H. Eliot and Edmund Dwight. Together the Eliots and Dwight eventually controlled 132 shares directly and 78 indirectly by virtue of Dwight's

partnership in James K. Mills and Company. William Harvard Eliot and Samuel Atkins Eliot were the sons of English-trade merchant Samuel Eliot, who had accumulated $1.2 million by his 1820 death. Marriages linked the Eliots to many other Boston merchant capitalists. William's and Samuel's sisters Mary and Catherine wed Taunton investors Edmond Dwight and Andrew Norton, while William H. Eliot's son married the daughter of Taunton shareholder William Foster Otis. Also the Eliots were intermarried with the Lymans, Bootts, and Appletons, important developers of other mills. Various social and educational activities further tied the Eliots to other Boston capitalists. Both William and Samuel A. attended Harvard while president John Kirkland was elevating a formerly undistinguished provincial institution to a role of academic leadership. While at Harvard both Eliots were members of the Porcellian literary club, along with future Taunton investors Gorham Brooks and William H. Prescott. After graduation many Porcellians became active in the informal group known as The Club, which met in the homes of the members for dinner, papers, and discussion of art, literature, politics, and business.

82Directors Minutes, Feb. 27, 1823; Stockholders Minutes, Jan. 22 and July 29, 1834.
Many corporations must have been conceived in The Club. Samuel A. Eliot's connections with Harvard continued as treasurer, as author of a history of Harvard, and as father of Charles W. Eliot, president of Harvard for forty years. Samuel was a patron of the arts and music and a vocal opponent of slavery. He was also a leader of the movement for expanded free public education, as were his partners, James K. Mills and Edmund Dwight. As a legislator, Boston mayor, congressman, and part owner of the North American Review, Samuel was able to effectively promote his causes. His brother William, probably encouraged by brother-in-law Edmund Dwight, was one of the original investors in Taunton Manufacturing Company. While Samuel was on the almost obligatory post-Harvard European tour, William purchased Taunton shares for Samuel and involved himself and Samuel in the 1823 Chicopee mill project along with Dwight, Thorndike, and Mills. Following William H. Eliot's death in December 1831, Samuel assumed the responsibility of watching both his own and his brother's investments. Together these included mills at Paterson, Nashua, Lowell, Lawrence, Taunton, Chicopee, and Holyoke. The last three were projects of his relatives and partners in Mills and Company: Edmund Dwight, Sr., and Jr., James K. and
Charles H. Mills, and Patrick Tracy Jackson, Jr. With many other Taunton shareholders, Samuel invested in Boston banks, insurance companies, coastal steamboats, and railroads. His idle funds were employed in discounting notes, including many of Crocker and Richmond.  

Edmund Dwight, unlike most other Boston merchant-capitalists was originally from western Massachusetts. He was the son of a well-to-do Springfield store, ship, and land owner. Despite the disadvantage of a Yale degree, Dwight was accepted into Boston area society and business as a protege of his relative, Fisher Ames, last of the great Federalist leaders. As a state legislator in 1810-1813 and 1815, Dwight forged lasting

ties with fellow legislators Crocker, Otis, and Thorndike. His marriage to the elder Samuel Eliot's daughter brought him further Boston mercantile connections. Finally, in 1822 he became a partner of James K. Mills and Company, a cotton goods commission merchant house, which would over the next thirty-five years play a central role in the development of Taunton, Chicopee, and Holyoke. A dynastic marriage of Dwight's daughter and Mills' cousin further linked the two families.  

James K. Mills, although not an original investor in the Taunton Manufacturing Company, was by 1827 a shareholder. Thereafter he played an important role in the firm's operation. By 1829 directors meetings were being held in his Boston office, and by 1834 James K. Mills and Company held seventy-eight shares, not counting partner Dwight's fifty-eight personal shares.

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From the 1830's through the 1850's, Mills and Company (which later also included Edmund Dwight, Jr., Charles H. Mills, Samuel A. Eliot, and Patrick Tracy Jackson, Jr.) would contribute significantly to Taunton's industrial development through its control of the WhITTenton Mills and by its partnership in William Mason and Company. Mills had few social ties with the Boston elite since he devoted most of his time to the affairs, major and minute, of a dozen major industrial enterprises. Neither he nor cousin Charles attended Harvard, nor were they engaged in the political avocation of their fathers. The Club was not to the tastes of either Mills; nor the reverse, so Mills belonged to the more plebeian Friday Evening Club which devoted its informal fortnightly get-togethers to whist and conversation. 85

William Prescott and his historian son, William Hickling Prescott, became involved in the Taunton Company through their many social and political contacts with the other Boston shareholders. A son of Colonel Prescott of Bunker Hill fame, William Prescott had a

85Stockholders Minutes, October 24, 1827, Jan. 22 and July 29, 1834; Directors Minutes, Feb. 21, 1829, Gregory, Nathan Appleton, pp. 193-196. See Chapter V for more on the Mills cousins.
highly successful law practice in Beverly and Salem before he moved to Boston in 1808. While serving as a Federalist in the legislature, he became friends with many future Taunton shareholders. Prescott also sat on the Board of Overseers of Harvard College with many people associated with the Taunton Manufacturing Company either directly or indirectly: Crocker, Otis, the senior Thorndike, Edmund Dwight's brother Jonathan, and Gorham Brooks' father Peter Chardon Brooks. With Otis he went as a delegate to the Hartford Convention and with Crocker and Otis he sat as a Commonwealth Justice. The elder Prescott was an early investor in textile companies and was a founder and long-time president of Massachusetts Hospital Life Insurance Company, in which most great mill owners were involved. His famed son, historian William Hickling Prescott, was, as his close friends the Eliots, the model of the Boston gentleman-capitalist: a Harvard man (third generation), a Porcellian, a member of The Club, a taker of "the trip" to Europe, and a writer.  

The Boston investors in Taunton composed much of the mercantile, legal, and political elite of New England. They divided into two groups: the elders such as the senior Otis, Thorndike, and Prescott; and the young men typified by the Eliots and younger Prescott. The men of the older group made their fortunes in trade and business-associated law practice in the years between the Revolution and the Embargo while the members of the younger group generally inherited their wealth from the older. Both groups were active Federalists who became Whigs after the demise of the Federalist Party. Most of the older group had served and become closely acquainted in the legislature and in the administration of Governor John Brooks. Many of the older and almost all of the younger men attended Harvard. Furthermore, meetings of the Board of Overseers of Harvard College brought most of the older investors together. Harvard was important since it created life-long ties and produced the social graces which opened so many doors in Boston society, politics, and business. The Harvard man was, "one loyal to his club, an inveterate diner-out, a connoisseur of wines, a witty conversationalist, and one with unfailing ways with
the ladies—a gentleman." Another tie was Unitarianism, the predominant religion both at Harvard and among the Taunton investors. Dwight had been a founder of the Unitarian church in Springfield and Samuel A. Eliot had been educated for the Unitarian ministry, a calling which he never adopted. The Unitarians rejected the Puritan belief in the depravity of man, accepting instead that man was inherently good. In more practical terms, Sunday became a day for more than prayer and charities became important. It was not chance, then, that many of the Taunton investors worked together on charitable enterprises. If all this was not enough to draw together the Taunton investors, intermarriage of their families was.

One explanation of the Boston mercantile elites' extensive 1820's investments in industrial enterprises is that steam navigation on the Hudson and on the Erie Canal enabled New York to siphon away Boston's foreign trade, leading Boston merchants to seek other investments


88 Holland, History of Western Massachusetts, 2: 119-120; James, Charles W. Eliot, 1: 10-11, 32-33.
for their idle funds. Whether or not New York's superior location limited at that time Boston's growth as a port, Boston investors seem to have had investable funds in excess of the capital demands of the city's trade. These funds were drawn into mill projects by the prospect of duplicating the high yields of the Boston Manufacturing Company's Waltham mill. Rather than putting his brother's money into "Bank Stock which yields so small an interest," William H. Eliot bought for his brother stock in the Taunton Manufacturing Company and in the Boston and Springfield Manufacturing Company. To justify his purchase, Eliot cited the low cost of the Chicopee property, and "the prosperity of Cotton Manufactories in our Country" and the "Waltham dividend of $25 PCent last year." Clearly the demonstration effect of the Waltham mill bore a large measure of responsibility for the Boston investors' interest in Taunton.

89See for example Salsbury, Boston & Albany, pp. 6-7.

90William H. Eliot to Samuel A. Eliot, January 5, 1823, Samuel A. Eliot Collection, Harvard. William was handling Samuel's investments while Samuel was in Europe.

91William to Samuel Eliot, Nov. 25, 1823.
This 1822-1823 revival of mill building, of which Taunton was a part, occurred despite renewed competition from British mills and the almost continuous 1814-1825 decline of cotton goods prices. It was the continued profitability of Waltham in the face of declining prices which so impressed the wealthy Bostonians and encouraged them to invest in Taunton, Lowell, and Chicopee. Their interest rose in the early 1820's when cotton prices plummeted to sub-1814 levels, greatly increasing the prospective profitability of cotton mills. Thus drawn together by kinship, politics, business, and the demonstration effect of Waltham, the Boston investors and Crocker and Richmond formed the

92 Niles' Weekly Register 32 (1827): 354, said that the April 1823 price of brown sheetings was 44 percent of April 1815; according to U. S., Dept. of Commerce, Bureau of the Census, Historical Statistics of the United States: Colonial Times to 1970, Bicentennial ed., 93d Cong., 1st Sess., House Doc. 93-78, pt. 2, Series E 128, hereafter referred to as Historical Statistics of the U. S., Bicentennial ed., 1823 cotton sheeting prices were 72.5 percent of 1815, 63.9 percent of 1814.

93 Niles' Weekly Register 32 (1827): 354, holds April 1818 cotton prices to be 220 percent of April 1815, and April 1823 to be 55 percent of April 1815 and 32 percent of April 1822. Historical Statistics, Bicentennial Edition, found similar trends in cotton prices.
Taunton Manufacturing Company in 1823 to take over the existing mills and to expand by adding more mills and a calico printing factory.

Establishing the New Company

On February 25, 1823, Taunton Manufacturing Company began operations with two mills for cotton textiles and nails, the Whittenton and the Hopewell, and a few minor properties. Reflecting the diverse operations acquired from Crocker and Richmond, Taunton Manufacturing's charter authorized it to roll copper and iron, to manufacture nails and other iron products, and to manufacture cotton and wool. However, it was the cotton textile business which most interested the investors. During the summer of 1823, the three-story Brick Mill, 45 feet by 100 feet, was built and equipped with 700 spindles and the necessary looms and preparatory equipment.  

Although only $300,000 in capital stock was originally issued, expansion required several assessments which raised the stockholdings to $600,000 in 1827.

giving Taunton the second largest capitalization of a New England manufacturing company. By one contemporary estimate, the investment in Taunton was 0.4 percent of the national investment in mechanical factories, and 2.3 percent of the Massachusetts investment; figures which I suspect overstate the ratio, but nevertheless illustrate the importance of the Taunton company.

One of the first acts of the Board of Directors was to appoint the firm of Crocker, Richmond and Otis—James W. Otis—as managing agents. Management by a firm rather than a single agent was unusual in the New England textile industry, and in the case of Taunton, this diffusion of authority soon caused problems. For financial and legal purposes, Samuel Crocker was appointed president, treasurer, and general agent. Later, as company problems mounted, many shifts in management took place: James W. Otis resigned from the managing agency in 1827, and Crocker was replaced by Richmond

95Directors Minutes, February 27, 1823, Apr. 3, 1827; Ware, Early Cotton Manufacture, pp. 301-302. Only the Belvidere at Tewkesbury had a larger authorized capitalization, $700,000, although other contemporary capitalizations were equal to Taunton, notably the Merrimack.

96Computed from national and state figures given in Niles' Weekly Register 31 (1826): 118.
as general agent in 1828 and by James K. Mills as treasurer in 1832.97

The Calico Works

After three months of operation, the directors voted "to make the Experiment" of a calico-printing factory, an action which established the product line in which the company would specialize.98 Hand printing of calicos with blocks had first taken place in the United States in the late eighteenth century, generally in "back-room" shops operated by immigrants who brought the requisite skills to America from England and Europe.99

97 Directors Minutes, Feb. 27, 28, August 23, 1823, July 12, 1827, Shareholders Minutes, Aug. 6, 1828, July 11, 1832.

98 Directors Minutes, May 30, 1823.

99 Dudley, "Growth," p. 2, claims that, "As early as 1790, Herman Vandausen, a German, settled in East Greenwich, R.I., and commenced block printing by hand," and that block printing "also commenced very early in Philadelphia, by an Englishman of the name Thorpe." Freedley, Leading Pursuits, p. 192, agrees that calico printing in the United States began about 1790, using wood blocks, one for each color, on a cloth spread on a flat table. However, Stuart Robinson in A History of Printed Textiles... (Cambridge: The M.I.T. Press, c. 1969), pp. 122-123, mentions calico block printing by John Hewson, an Englishman who settled in Philadelphia in 1774, and Anna Doolittle of New Hampshire, who used copper plates about 1780. The insignificant physical plant makes identification of the first calico operations difficult.
Continuous printing machines had been attempted at least as early as 1701 in Europe, and rotary presses with intaglio cylinders had been successfully adopted in England by the 1780's. In 1809 the first known American cylinder printing machine was either imported from England or built to original plans by Joseph Siddall, who joined with a John Thorp (not to be confused with the John Thorp associated with the ring frame and Silas Shepard) to operate a bleaching and calico printing works in Germantown, Pennsylvania. Thorp, Siddall and Company printed cylinder calicos for a few years starting in 1810, but apparently the machines were only partly successful. It was the New England calico plant of the 1820's that really established machine calico manufacture in the United States.

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100 Robinson, History, p. 25, credits Glorez, a Moravian, with a continuous press in 1701, one of first attempted, and rates Thomas Bell's 1783 rotary printing machine the first successful cylinder calico machine.


As did many beginning textile industries, the New England mills had begun by producing heavy, coarse goods which could be made easily on crude machinery tended by relatively unskilled labor. Then as the New England industry matured, the mills moved to the manufacture of finer grades of textiles. This evolution took place in southern New England first, followed by northern mills later. The process was repeated in the Southern states almost a century later. As with the adoption of power weaving after 1816, the spread of calico manufacture in America in the 1820's exemplified the evolution to a higher level of technology. New England manufacturers appear to have turned to calico manufacture in an effort to capture part of the English fancy goods business, possibly, as Theodore Z. Penn suggests, because the adoption of power weaving had flooded markets with plain cloth.\(^{103}\) True or not, several mills turned to calico manufacture at about the same time as Taunton.

The Merrimack Manufacturing Company at Lowell started preparations for calico manufacture first,\(^{103}\)

\(^{103}\) Conversation with Penn, Oct. 17, 1976.
in 1822. However, Taunton, which did not add printing facilities until the following year, was the first New England firm to produce calicos on large scale, probably in 1824, well before Merrimack and the Dover Manufacturing Company.\(^{104}\) In the following four years calico factories were opened in Warren, Maryland, Fall River, Massachusetts, and Providence and Pawtucket, Rhode Island, followed shortly by plants at Hudson, New York, Belleville, New Jersey, and Rockland, Maryland.\(^{105}\) As did Taunton, most of these early calico factories also included spinning and weaving operations. Dover even made nails.

Since calico manufacture was a technology virtually alien to New England, Taunton's directors authorized the agents to "contract with any person or persons skilled in that business."\(^{106}\) To supervise the construction and

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\(^{104}\) *Niles' Weekly Register* 22 (1822): 67; 26 (1824): 363; 30 (1826): 424; Eagnall, "Sketches," 3: 2163-2164; Andrew Robeson, Jr., to Zachariah Allen, July 1, 1862, and Allen Diary Mar. 20, 1824, Allen Collection, Rhode Island Historical Society. Dover started to add printing facilities at the same time as Taunton, but did not print until 1827, *McLane Report*, 1: 579, 634. Merrimack seems to have started in 1825.


\(^{106}\) Board Minutes, May 30, 1823.
operation of the calico plant, the agents hired John Thorp, a nephew of the Thorp who had introduced calico printing to Philadelphia. He was of no known relation to Providence's John Thorp, who worked with Silas Shepard and invented the ring frame. One reason for hiring the Philadelphia Thorp was the hope that his family's experience with the pioneer American calico printing machine would enable him to supervise construction of a similar machine at Taunton, as well as oversee the dye.

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107 Dudley, "Growth," p. 2, identifies the calico Thorpe with the Philadelphia Thorpes, yet in no way connects the ring frame Thorp with the Calico Thorpe. Dudley spells the calico expert's name Thorpe and the ring frame inventor's name Thorp, indicating that these are two different persons. Penn, "Introduction," p. 239, suggests that the ring frame John Thorp and the calico John Thorp are the same man. So I thought until I became more familiar with the two men. According to Penn, p. 245, in 1823 the calico Thorp was "lately from a manufactory of this kind in England." However, the 1816, 1819, and 1821 patents place the ring frame Thorp in the Taunton-Providence area. Likewise, his 1821 and 1826 braiding machine patents suggest that in the early and mid-twenties he was already associated with his later partners, braid manufacturers Thomas and William Fletcher; Notes by Zachariah Allen on Sylvanus Brown's recollections, 1860's, Allen Collection, Rhode Island Historical Society, Providence; Clark, "John Thorp," p. 85. Penn also cites 1825 Dover Manufacturing Company correspondence dealing with the attempts of the calico John Thorp and his father to secure employment following their departure from Taunton (p. 246), but, according to Clark, "John Thorp," p. 88, the ring frame inventor was heirless and his father died in Providence in 1824. Finally, the ring frame John Thorp was a compulsive patentee, yet patented nothing even remotely related to calico printing. In contrast, Dover Manufacturing Company correspondence (Penn, "Introduction," p. 246) shows the calico Thorp to be secretive with his technical knowledge.
bleaching, and block-printing facilities. Construction of the print works began in 1823, but hand-block printing did not begin until mid-1824, and then only at the rate of 150 pieces of calico per day. Spring 1825 arrived, but not a printing machine. Disgusted, Charles Richmond released Thorp and sailed for Manchester to acquire an English calico machine. 108

Richmond's 1825 trip is an unusual case of bilateral technological exchange by barter. For trading material, Richmond took to England models of Danforth's tube speeder and of Aza Arnold's differential fly frame speeder motion. Without the inventor's permission or knowledge, Richmond traded a model of Arnold's motion to Manchester machinery-builder Henry Houldsworth, and in turn received Houldsworth's assistance in procuring and in exporting a rotary calico printing machine. 109


Probably the latter was the calico machine model which
William J. Breed smuggled, along with calico cylinders,
from England that year. 110 Since Thorp and Siddall's
machine seems to have been mostly experimental, the
machine based upon the model Breed brought to Taunton
could be classed as the first successful calico machine
in America. 111 Three years later Jonathan Thayer
Lincoln, a graduate of David Wilkinson's seminal
Pawtucket shop, was engaged by Taunton to change the
machine from single-color to three-color. 112 The
salutary effect of mechanization of Taunton's production
was soon evident: by 1827 output had more than doubled
to 2,000 printed pieces per week, and by 1831 the
addition of another three-color machine had doubled
production again. Although Taunton used a coarse cloth
for its calicos (the other American calico shops of the
period did likewise), its machine prints were good enough to
win some awards at fairs such as New York's American Institute
fair. 113

112 Emery, History of Taunton, pt. 2, pp. 48-49.
Directors Minutes, Sept. 29, 1830.
Taunton had its calico machine, but it still had difficulty finding and, apparently, keeping skilled Englishmen and Europeans to supervise and operate the calico facilities. Not giving up, in October 1827 the directors instructed the agents to obtain from England an experienced calico-works superintendent and a printing-machine overseer. Once more, in February 1832, the agents were ordered to secure a printer from Europe as soon as possible. Since Taunton Manufacturing required about a thousand operatives, securing experienced mill, shop, and calico workers was also troublesome. English immigrants were actively recruited and soon filled the mule, weaving, and calico departments. Finding the Englishmen an unruly workforce, Taunton set up an apprentice program to train young Americans to take over the skilled jobs.

The addition of two new factories in 1823 and 1824 was at least easier than finding the men to staff them. Although efficiency would have been served better

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114 Directors Minutes, Oct. 26, 1827; Feb. 15, 1832. The company built a large tenement which was known as the British Block from the predominant nativity of the residents.

by the expansion of one of the two existing mills, the limited water power of Mill River dictated dispersion. The calico works itself was built between what is now Court Street and Mill River on the north edge of the business district, and was enlarged in 1828, 1830, and 1831. In 1826 a brick print mill annex was erected astride Mill River on the north side of Cohannet Street. Then, over the following two years, the Green Mill was acquired and converted into the Lower Print Works. Finally, to manufacture more cloth for the print works, the company built the Brick Mill north of Washington Street in 1823 and erected a second mill at Whittenton in 1832.

No detailed description has been found of the calico works in its first decade, but after the expansion of the early 1830's it possessed two, three-color, copper-cylinder printing machines. Sometime before the mid-1840's at least two four-color machines were added in the old Green Mill. Both the lower and upper print works seem to have been self-contained, complete operations, each

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with its own print machines, bleach houses, boiling kettles, cisterns, dye-making shops, and drying houses.\textsuperscript{117} In the absence of an account of the processes used, the list of materials consumed by the print works inspires the imagination: oil vitriol, blue and white vitriol, tartaric acid, alum, prussiate potash, bichromate of potash, pearl and potash, madder, sumac, indigo, Prussian blue, brazilwood, quercitron bark, logwood, Persian berries, copperas, gum Senegal, gum Arabic, orpiment, sugar lead, lime, bleaching powder, starch, flour, oil, anthracite and bituminous coal, firewood, and, finally, cow manure.\textsuperscript{118}

Thirty percent of the cloth printed was made in Taunton, the rest being purchased from other New England mills on long-term contracts.\textsuperscript{119} In 1828 New Hampshire's Nashua Manufacturing Company converted one mill to the manufacture of print cloth specifically for sale to Taunton under a long-term contract. So much cloth was rejected by Taunton for thin spots and other defects

\textsuperscript{117}Directors Minutes, Sept. 29, 1830; July 13, 1831; \textit{American Whig} (Taunton), Dec. 17, 1846.

\textsuperscript{118}Elijah Howard, "Information on the Subject of Manufactures in the Towns of Taunton...," Box 7, Willard Phillips Papers, Massachusetts Historical Society.

\textsuperscript{119}Ibid.
that the Nashua contract was not renewed the following year.\textsuperscript{120} There was a reason for Taunton's insistence on quality. By the end of the twenties American print works were supplying most of the coarse calicos the domestic market could absorb. The ensuing competition induced Taunton and other firms to switch from the printing of coarse fabrics to fine goods printing. In 1831 a new fine print cloth mill was erected by Taunton to supply its print works.\textsuperscript{121} About the same time the company began to purchase mousseline de laines, a finer cloth for calico printing, from the Hooksett Mill in Manchester, New Hampshire. Hooksett had previously unsuccessfully attempted to print its own cloth and was happy to sell its output to Taunton, which had better printing machines.\textsuperscript{122} The New England textile industry was moving to the next higher level of technology.

The coarse calicos Taunton produced were mainly sold through commission merchant houses in Boston, 


\textsuperscript{121}Directors Minutes, July 13, 1831; \textit{Niles' Weekly Register} 33 (1827): 204; 40 (1831): 290.

\textsuperscript{122}Browne, \textit{Amoskeag}, pp. 55-56.
New York, Philadelphia, and Baltimore. Of these, James K. Mills and Company in Boston and Stone and Otis in New York were the most important and, not by chance, had at least one partner who was a Taunton shareholder. Through standing agreements, the commission merchants received a 2.5 percent commission on sales of Taunton's goods and a special 4 percent commission on sales at the semi-annual auctions. By the late 1820's the growing efficiency of American mills and print works, coupled with a high protective tariff had virtually excluded coarse British calicos from the American market, although English mills could still underprice American fine-goods producers in the United States. When the calico overproduction of the early 1830's saturated the domestic market, coarse American calicos began to challenge British and French prints in Latin America, Africa, and Asia. Manchester print cloth mills and print works attempted to cut wages to meet American competition, but were met by a labor strike.

123 Directors Minutes, Jan. 22, 1828, Feb. 6 and 19, 1829.

Taunton's Troubles

Initially Taunton manufacturing was very profitable. "Taunton in fact is doing better than any of them," boasted Harrison Gray Otis.\(^{125}\) Dividends for the first 4½ years of operation totaled 65 percent, but at a cost: The company borrowed heavily and even paid the 20-percent 1825 dividend in one-year, six-percent notes. Its only dividend after 1827 seems to have been the 3-percent one of July 13, 1831. In fiscal 1827-1828 Taunton lost $30,000, about 10 percent of its total sales, and rarely did it sell at a profit thereafter.\(^{126}\)

A major cause of these difficulties was the textile industry's overproduction of coarse goods, which led to falling prices.\(^{127}\) Even high-tariff advocates had to admit in the early 1830's that all but the finer grades of British textiles were excluded by the


existing tariff. A scapegoat was needed, and Andrew Jackson served well. The tariff reduction law of 1833 and the Jacksonian opposition to the national bank were the major sins charged to the president. Charles Richmond encouraged Representative William Baylies in his congressional fight against Jackson's currency stand, complaining that Taunton Manufacturing had "yet to learn" where they could get discounted the $20,000 in notes which would pay for the next month's operating costs. Samuel Crocker agreed that, "it is certain that the Government must finally have a National Bank," in order to stem the spreading tide of bankruptcies threatening New England industry. The flood of failures to which Crocker referred had included in neighboring New Bedford alone suspensions totaling a million-and-a-half dollars in 1833 and early 1834.

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128 Reports, Convention, Friends Domestic Industry, p. 6.
Serious internal problems also contributed to Taunton's growing unprofitability: technological start-up difficulties, limited waterpower, small decentralized factories, inadequate capitalization, underspecialization, and management shortcomings. Referring to the calico operations, Harrison Gray Otis concluded that the firm was "conducted under peculiar disadvantage owing to the . . . novelty of the principal operations . . . ," and Richmond's endless search for new workers, superintendents, and machines is evidence supporting Otis.\textsuperscript{132}

Big, northern New England mills such as those at Lowell generally remained profitable during the late twenties and the thirties because they operated large, integrated mills which specialized in one product. With six small, scattered, unspecialized factories, Taunton was a poor competitive match. In its early years, the Taunton company manufactured iron rods, nails, pins, textile machinery, yarn, cloth, and bleached, dyed, and printed goods, and additionally operated stores and boarding houses. Managing such a conglomerate proved beyond the abilities of Taunton's agents. By 1826

\textsuperscript{132}Stockholders Minutes, Oct. 13, 1826.
the directors and shareholders were disenchanted with the nail business and replaced it with wood screw and pin manufacture. An 1826 contract with Timothy Wiggin of Manchester permitted Taunton to manufacture pins on Wiggins' machine, but either the business or the machine was unsatisfactory because in October 1827 the Wiggins' contract was dropped by the directors. At the same time, the directors ordered the agent to lease out the iron mill, to sell the nail tools, and to fill the Hopewell with spindles in place of nail machinery, then oddly one year later the directors and shareholders voted to resume the iron business. At last, in 1830, the directors began to manifest concern with the firm's lack of specialization and voted to sell the company stores. The following year they directed the agent to sell the iron works and the screw manufactory.133

A more serious production problem was the small, unreliable waterpower furnished by the little stream misleadingly named Mill River. The creek's inadequate water supply forced Taunton to spread its operations

among six small factories, while periodic water shortages forced shutdowns. One visitor observed: "There will not be water enough to operate more than 1500 spindles through the summer . . . ." Therefore, although large enough to contain 3000 spindles, the Brick Mill operated but 700 at first.\(^{134}\) As early as 1825 the shareholders instructed the directors to examine a Babcock steam engine. Again in 1826, 1829, 1831, and 1835 the directors or shareholders called for investigations of the use of steam. Either the agents were irresolute or were unable to find a suitable engine, for none was in use at the time of Elijah Howard's 1831 McLane Report survey. Given Charles Richmond's love of new technology and 1825 visit to the successful English steam mills, it is surprising that he installed none before 1831. Samuel Slater's Providence Steam Cotton Mill had been in successful operation since 1827, making Richmond's reticence even harder to understand. Without steam, 

\(^{134}\)Zachariah Allen Diary, Mar. 20, 1824, Allen Collection, Rhode Island Historical Society.
Richmond sought power-saving designs of machinery, notably the lightweight Gore spindle and the ring frame.\textsuperscript{135}

With six factories scattered along two miles of Mill River, agents found it difficult to maintain effective control over diverse operations without being overburdened. During the first few highly profitable years, stockholder committees examining Company affairs gave perfunctory, glowing reports, but, when profits disappeared in the late 1820's, the shareholders and directors quickly identified management control as a serious problem. In 1828 a committee of directors attempted to divide more clearly the functions of general corporate agent and plant superintendents by advising the agent to leave operational details to the superintendents. The superintendents were in turn instructed to give the

agent daily reports, which the agent was to check on his regular factory visits. In order to free more of the general agent's time, the functions of general agent and selling agents were to be separated by ending sales in Taunton by the general agent. To facilitate the board of directors' overall supervision of management, the agent was further ordered to report monthly to the board.  

Too many small factories complicated accounting procedures, and this lead to repeated recommendations for simplification of bookkeeping. As part of the 1828 decentralization, the general corporate accountant was relieved of the burden of keeping the accounts of each factory. Thereafter each departmental agent or superintendent was responsible for keeping his own departmental accounts and for making monthly financial reports. The problems were not at an end. Next the directors and shareholder committees began to exhort the general agent to keep a closer check on the departmental agents' performances. New bookkeepers were hired and more regular bookkeeping was demanded.  

136 Directors Minutes, Jan. 22, 1828.  
137 Stockholders Minutes, Aug. 6, 1828; Directors Minutes, Feb. 10, 1829, Aug. 14, 1829.
Slow collection of accounts receivable and of bills due also brought frequent shareholder and director criticism. In 1828 a directors' committee recognized that overdue accounts compounded the bookkeeping problem and recommended that management make schedules of debts and credits due. Thereafter at least one committee a year reported on the slow collections, and one in 1831 attempted to limit customer credit to six months. On the other side of the ledger, the shareholders charged the agents in 1832 with having issued bills too freely.\textsuperscript{138} As both these financial problems increased, so did the involvement of James K. Mills and Company in Taunton's affairs. After 1829 Mills and Company discounted much of the commercial paper Taunton held, marketed a considerable portion of Taunton's output, and accepted part of Taunton's own notes. In return, Mills was given an increasingly influential voice in Taunton's basic policies.

In 1832, the history of Taunton Manufacturing rapidly approached denouement. A modest industrial recovery from the 1829 depression had led to small profits and renewed mill building in 1830. Almost as

\textsuperscript{138} Directors Minutes, Feb. 10, 1829, July 13, 1831, Jan. 21, 1831; Stockholders Minutes, Jan. 22, 1828, July 11, 1832.
quickly as overproduction had disappeared in 1829-1830, it recurred in 1831 as cheap British calicos flooded the market, dropping cloth prices below even 1829-depression levels. Average 1832 cloth prices were 9 percent below 1830 and 36 percent under 1823, but 1832 raw cotton prices were only 6 percent under 1830 and a mere 18 percent below 1823. During the next year the squeeze continued as cloth fell slowly while raw cotton prices rocketed over 30 percent, forcing many mills throughout the eastern United States to close. By 1833 Taunton was so deeply in debt that a special 20-percent assessment on the shareholders became necessary. 139

In February 1832 the directors discovered that:
in the past three months "a considerable amount has disappeared" and that six month earnings are greatly short of estimates. Although management could furnish no satisfactory explanation of these losses, the directors

concluded that the problem arose due "to the complicated concern and undefined connexion of the different departments." The director's response was to further decentralize by making the print works completely autonomous of the general agent. Still the losses mounted. Finally in July 1832 the shareholders voted to "close the concerns of the corporation." They instructed the agents to complete the equipping of the new mill at Whittenton, to finish "the building of Machines already contracted for," to use up the stock at the print works, and to pay the firm's debts. By January 1833 $480,000 in debts were still outstanding and only $351,420 in assets remained, so the shareholders voted to advance to the corporation money or personal notes equal to 10 percent of their stock in Taunton. In return, the company gave the shareholders one-year notes. So weak was the company that Samuel A. Eliot anticipated that these notes "will probably never be paid." He was correct. Six months later another 10-percent assessment was made. However, these assessments were

140 Directors Minutes, Feb. 21, 1832.
141 Shareholders Minutes, July 11, 1832.
not voted because the shareholders were particularly altruistic; they were individually liable for the company's debts.\textsuperscript{143}

By now, observed Harrison Gray Otis, the company had attained "such a bad odour" that the assets had to be sold to new companies.\textsuperscript{144} On May 31, 1833, the print works were sold to the Bristol Print Works, a new company started by Samuel Crocker and other Taunton Manufacturing stockholders, at a price of 150 of the 600 Taunton shares and $90,000 cash. A month and a half later Charles Richmond, probably with the aid of Samuel Crocker, purchased the Brick Mill and its machine shop for $70,000.\textsuperscript{145} After two years the Whittenton Mill was traded to James K. Mills and Company for 141 shares of Taunton stock.\textsuperscript{146} The rump of Taunton, consisting of

\textsuperscript{143}Harrison Gray Otis to Eliza H. Otis, n.d., Box 8, Otis Collection, Massachusetts Historical Society.
\textsuperscript{144}Ibid.
\textsuperscript{145}Ibid.; Stockholders Minutes, Jan. 31, Apr. 17, July 19, Aug. 6, 1833; Bristol County Deed Book 140, pp. 110-115.
\textsuperscript{146}Bristol County Deed Book 164, pp. 504-507; Stockholders Minutes, July 19, 1834. The deed says for $85,000, but the minutes say by exchange of stock.
only the Hopewell mill, continued until 1843, but the
lesson had been learned: The Lowell model would not
fit tiny Mill River, so southern New England's big mill
era would have to await the development of reliable
large steam engines in the 1840's. In the interim
Charles Richmond, James K. Mills, and a newcomer,
William Mason, gave Taunton a different industrial
base, machinery building.

CROCKER AND RICHMOND: LAST YEARS

Samuel Crocker and Charles Richmond still retained
the 4000-spindle Brick Mill and machine shop, the Fayette
(School) Street machine shop, a company store, the
Taunton Foundry, the Taunton Brewery, a three-fourths
interest in the Norton Manufacturing Company, much of
the Taunton Iron Works, 84 shares of the Taunton
Manufacturing Company--now merely the Hopewell mill--and
120 shares of the Bristol Print Works. Additionally
they owned a great number of building lots and residential
properties. Except for the machine shop, little of

147 Hall, "Taunton: Manufacturing Interests," p. 826.

148 Ibid., p. 827; Bristol County Deed Books 155,
p. 379; 158, pp. 266-269, 373-377; Surveyor's Bill,
Samuel Crocker Collection, New York Public Library.
particularly unusual or great interest happened in Crocker and Richmond's mills during the next few years. In an effort to circumvent the over-production and low prices of coarse goods, Charles Richmond re-equipped the mills for fine goods production, however, the Compromise Tariff of 1833 provided for semi-annual tariff reductions, opening fine goods mills to increasing British competition. Thereafter slowly-falling cloth prices, doubled raw-cotton prices, the 1834 drought, the nation's currency problems, and overextension weakened Crocker and Richmond.\textsuperscript{149} A contemporary Tauntonian, Charles Atwood, recalled of Crocker and Richmond that "prosperity blinded them to their true interests, and they undertook to monopolize all the manufacturing business." They also tried to monopolize the local real estate, a policy which Atwood charged led to "the final disasters and failure which befell them."\textsuperscript{150}

\textsuperscript{149} See, for example; Ware, Early Cotton Manufacture, p. 106; \textit{Niles' Weekly Register} 45 (1833): 66, 414-415; Samuel Crocker's and Charles Richmond's correspondence with William Baylies, William Baylies Letters, vol. 1, Old Colony Historical Society; \textit{Historical Statistics of the U. S.}, Bicentennial ed., Series E 126 and E 128 show that cotton prices rose 86 percent from 1832 to 1835 and that cloth prices fell 7 percent in the same years.

\textsuperscript{150} Atwood, \textit{Reminiscences}, pp. 28-29.
When in 1836 the Bank of England raised its discount rate, reducing the credit and capital available, the resulting panic and recession was communicated to the United States through the cotton market. In March 1837 the Panic gripped New Orleans, working its way northward in April and May. Cotton prices fell, public works failed, banks closed.\textsuperscript{151} Faced by $600,000 in debts and unable to convert their real estate and commercial paper to cash, Crocker and Richmond placed their properties under the control of court-appointed trustees, Francis Baylies and William A. F. Sproat on April 12, 1837.\textsuperscript{152} Crocker and Richmond's failure, according to one contemporary, shook "the credit and interests of our town from centre to circumference."\textsuperscript{153} So severe was the shock to Taunton that a committee of ten leading citizens was appointed to review the financial state of the community. Within six weeks


\textsuperscript{152}Atwood, \textit{Reminiscences}, p. 29; Bristol County Deed Book 158, p. 266; \textit{Niles' Weekly Register} 52 (1837): 113.

\textsuperscript{153}Atwood, \textit{Reminiscences}, p. 29.
the population of Taunton fell several hundred and many businesses and banks failed.\(^{154}\)

As the national economy partially recovered from the Panic of 1837, so did Crocker and Richmond.\(^{155}\) Although Crocker and Richmond's property remained in trusteeship until 1842, the trustees permitted the pair some voice in the operation of these businesses. However, the Brick Mill, nominally owned by Richmond, was operated by Robert S. Dean, and the Brick Mill machine shop was run by James Leach and Edwin Keith. Crocker and Richmond still had a proprietary interest in some of the research and other activities in the mill and dictated some of the conditions of the shop's operation, including the choice of shop superintendent.\(^{156}\)

A decline in the flow of British funds to the United States in 1839, coupled with the bumper cotton


\(^{155}\)Ware, *Early Cotton Manufacture*, p. 103.

\(^{156}\)Hall, "Taunton: Manufacturing Interests," p. 827; Gibb, *Whitesmiths*, p. 96; *Bristol County Deed Book 158*, p. 266; Trustees' Letters and Bills, Samuel Crocker Collection, New York Public Library; "Mason's Claim against Leach and Keith," File M381W, no. 6, Old Colony Historical Society.
crop and falling export prices, led to distress in American money markets. Excepting a slight recovery in 1841, the economic decline continued until 1842, causing the final failure of Crocker and Richmond.  

Starting in April 1841 the trustees began selling the partners property, a process which lasted into 1845, and in December 1841 the partnership went into formal bankruptcy.

When Crocker blamed Richmond for the failure, Richmond retorted that father-in-law Crocker had destroyed his, Richmond's, credit and turned his wife Abby against him. Still, gambler Richmond was unwilling to leave the game. "The ground work is laid and without some very bad move on the hoard of enterprise, my success is certain," he proclaimed. "I will," he boasted, build the "most extensive manufactories in the United States without running into debt."  

157 North, Economic Growth, pp. 84, 234; Temin, Jacksonian Economy, pp. 113-171; Ware, Early Cotton Manufacture, pp. 103-106, 143-144, 152.


159 Charles Richmond to Samuel Crocker, May 19, 1844, File VC871R, Old Colony Historical Society.
realistic credit-rating agent warned that Richmond possessed "untiring energy . . . but not . . . much prudence or faculty for business" because he was "too much given to speculation." 160 Shortly after, Richmond's bride Abby heeded her father Samuel Crocker's advice and placed her property in trusteeship, beyond the grasp of her husband and his creditors. 161

When prosperity returned to the nation in 1843, Charles Richmond regained control of the Brick Mill and even managed to construct behind it a gingham mill. In a further attempt to gain success through technological innovations, Richmond experimented with a carpet loom. However, the inventor, whose name is lost, broke with Richmond and took the loom to Thompsonville, Connecticut, where it was reportedly a success. Fate still stalked Richmond: the old Brick Mill burned in 1845. Although he rebuilt it in 1846, he finally lost all his property to his creditors in 1848. In one last machine-building gamble, Richmond employed about twenty men to build a


rotary speeder in the School Street shop. Supposedly the machine was of his design, but it may have been based on either Mason's or Danforth's speeders.\textsuperscript{162} Unfortunately, the superior fly frames had rendered the tube speeders obsolete, so Richmond soon failed. Destitute, he made one last gamble in the California Gold Rush—and lost. Dysentery claimed his life in Sacramento, December 19, 1849, and his son, also sick with dysentery, and a friend buried the former industrialist in an unmarked grave. His sole asset was an uncollected debt of $5.\textsuperscript{163} Thirty years later J.W.D. Hall lamented that Richmond who "made Taunton what it is . . . deserves a monument at home contributed from the wealth he was instrumental in building and making."\textsuperscript{164} None was forthcoming.


\textsuperscript{163} Samuel Crocker to William Baylies, November 12, 1850, William Baylies Letters, vol. 2, Old Colony Historical Society; Probate Records, Charles Richmond, Taunton, 1852, Bristol County Hall of Records, Taunton.

\textsuperscript{164} Hall, "Taunton: Manufacturing Interests," pp. 826-827.
Samuel Crocker fared better. His last years in retirement were marked by genteel poverty, and he had even regained a measure of respectability in Taunton by his death at age eighty, April 3, 1853.\textsuperscript{165}

\textsuperscript{165} Undated reprint, p. 26, File C872SL, Old Colony Historical Society; Taunton Democrat, Apr. 7, 1853; American Whig (Taunton), Apr. 7 and 28, 1853.
CHAPTER III
TAUNTON'S TEXTILE MACHINERY BUSINESS, 1823-1837

At its organization in 1823, Taunton Manufacturing Company acquired the Whittenton, Green, and Hopewell mill shops along with their machinery designs and patterns. Previously the Green Mill, and probably the Hopewell, had conducted a business of selling textile machinery to mills outside Taunton. Taunton Manufacturing continued this business, greatly enlarging it. With the firm's disintegration in 1833, the machinery business passed first to Crocker and Richmond (1833-1837), then to Leach and Keith (1838-1842). Finally in 1842 it became the Mason Machine Works, Taunton's most important machinery builder during the 1840's and 1850's.¹

Taunton Manufacturing's principal shop for machinery building was in the Brick Mill basement. Superintending both the shop and the print cloth mill in the upper stories was Jesse Hartshorn, who had formerly been agent of the old Dean Cotton Mill in eastern Taunton and had assisted Silas Shepard in managing the Green Mill. Eventually Hartshorn would

¹Bristol County Deed Book 140, pp. 113-115; Shareholder Minutes, July 19, 1833.

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become the agent for William Mason and Company, a further link in the chain between Taunton Manufacturing and Mason. Elias Strange, who had had charge of the Hopewell machine shop, became head of the Brick Mill shop. These two men brought to the Brick Mill shop from the older shops of Taunton an extensive knowledge of textile and machine shop technology.²

The Brick Mill continued in the 1830's as an important machine building shop for Crocker and Richmond. So extensive was their business that the Brick Mill shop was supplemented by a steam-powered brick shop on School Street (then called Fayette Street). Having been built in 1827 for Babbitt and Crossman's britanniaware shop, the latter had been vacated in 1830 when the hollowware makers moved to a water power site on the north side of Taunton.³

Although housed in two facilities several blocks apart, Crocker and Richmond possessed one of the 1830's

²Hall, "Taunton: Manufacturing Interests," pp. 826-827; Bristol County Deed Book 140, pp. 113-115.

³Hall, "Taunton: Manufacturing Interests," p. 825; Bristol County Deed Book 158, pp. 266-269; July 11, 1843, insurance policy, Samuel Crocker Collection, New York Public Library. Crocker and Richmond bought the building in 1836, and may have used it before purchase.
better manufacturing facilities for cotton textile machinery. The Taunton shop had excellent transportation facilities—an important asset considering the firm's dispersed market. One mile away were the wharves of the Weir. Seagoing ships brought Appalachian coal and New Jersey, Pennsylvania, British, and European iron and steel; then took textile machinery to the Southern and Middle Atlantic states. In 1836 the Taunton Branch Railroad opened a direct rail link with many major textile machinery customers throughout southern New England. Besides being close to its markets, Taunton was also near many of its raw materials. In the early nineteenth century, New England provided more in raw materials than it does today: lumber came from Maine or closer, Massachusetts and Connecticut furnaces still produced much of the pig iron, and several forges near Taunton provided wrought iron. Some coal came from a small mine a few miles away in Rhode Island.

Although the exact relationship was unclear, the Taunton Manufacturing Company either patronized or owned the Taunton Foundry by 1833. Crocker and Richmond soon acquired this foundry, possibly at the same time as the Brick Mill.4 Ownership of a local

4 Shareholder Minutes, July 19, 1833; Bristol County Deed Book 158, pp. 266-269.
foundry was significant, since even in the days of wooden-framed textile machinery, many working parts were of cast iron. Moreover, the 1830's shift to cast iron frames increased machine shop's need for a foundry. By owning a foundry, Crocker and Richmond not only saved the cost of another firm's profit, but also avoided the delays that came from shipping patterns and castings, a process that could take weeks by the slow transport of the day. Also, replacements for broken or defective castings could be obtained more quickly.

The Taunton shops were one of the first to own their own foundry. Most New England competitors sent their patterns to an outside foundry such as Shepard Leach's Easton foundry which was used by Boston Manufacturing Company, Locks and Canals, the Elliot Company, Otis Pettee, James S. Brown, and the Nashua Manufacturing Company.\(^5\) Ames Manufacturing did not add a foundry until 1836, followed by Locks and Canals in 1836, Amoskeag in 1842, Providence Machine about 1846, Garibaldi, Saco-Lowell, pp. 50, 82-83, 155, 158; frequent entries, vol. 23, Boston Manufacturing Company Collection, Baker Library, Harvard University; Bishop, American Manufactures, 3: 398; frequent references, vols. AB-1, GB-1, GC-1, Nashua Manufacturing Company Collection, Baker Library.

\(^5\)Gibb, Saco-Lowell, pp. 50, 82-83, 155, 158; frequent entries, vol. 23, Boston Manufacturing Company Collection, Baker Library, Harvard University; Bishop, American Manufactures, 3: 398; frequent references, vols. AB-1, GB-1, GC-1, Nashua Manufacturing Company Collection, Baker Library.
James Brown in 1847, and Fales and Jenks in 1860. As late as the 1880's Knowles Loom Works and Cleveland Machine Works in Worcester still contracted out their castings. Only the Middle Atlantic builders seem to have had their own foundries as early as the Taunton shops.

Besides the foundry, the Brick Mill was equipped with a blacksmith shop and some of the latest machine tools. Incomplete tool inventories listed roller, fluting, cutting, polishing, and screw cutting lathes and grindstones common to textile machinery shops of the time. Although no bevel nor spiral gear cutting engines were listed, the Brick Mill probably possessed them. The most interesting machine in the shop in 1833 was a planing machine, unusual in the United States

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6 Freedley, Leading Pursuits, p. 312; Gibb, Saco-Lowell, p. 82; Bishop, American Manufactures, 3: 387, 398, 400; R. I. vol. 6, p. 176, Dun.


prior to the 1840's. Only two years earlier Gay and Silver had made the first planing machine known to have been built in America (English planing machines date from at least as early as 1814), and not until 1839 did Locks and Canals install a planing machine.¹⁰

As early as 1825 Taunton Manufacturing, through the agency of Crocker, Richmond and Otis, was selling textile machinery to mills as distant as New Hampshire.¹¹ The company reported in 1831 that it sold machinery, "to fill up new factories and replace worn out machinery in the old ones in the vicinity." One hundred men during 1831 used 57 tons of anthracite, 32 chaldrons of bituminous, 180 tons of pig iron, 50 tons of wrought iron, 3 tons of steel, and large quantities of Maine lumber to make $60,000 worth of machinery.¹² The Taunton shop had

⁹ Shareholder Minutes, July 19, 1833; Bristol County Deed Book, vol. 40, pp. 113-115. Compare these with the various machine shops' tools listed in Gibb, Saco-Lowell, pp. 25, 49, 81-82, 108, 163.

¹⁰ Rolt, Short History, pp. 158, 104. In contrast, Ure observed the best English planers in French mills in Lorraine in 1835, Cotton Manufacture, 1: xc.

¹¹ Ira Gay to Crocker, Richmond and Otis, June 24, 1825, Letterbook, vol. GB-1, Nashua Manufacturing Company Collection.

¹² Howard, "Information;" also later in the McLane Report, 1: 162-163.
become a large commercial enterprise. Because the seven small mills in Taunton offered an inadequate market for the shop, its machinery was sold throughout New England and possibly in the Middle Atlantic states and South.¹³ This was in sharp contrast to the limited marketing areas of the large northern New England shops, such as Lowell, which enjoyed large captive markets of local mills.

Since Taunton's customers were predominately the capital-starved small southern New England mills owned by local merchants and other petty capitalists, Taunton found itself forced to grant long-term credit. At the time of the sale of the machinery business to Crocker and Richmond in 1833, the Quinnebaug Manufacturing Company of Windham County, Connecticut, owed Taunton $11,977 under a long-term contract, the Mansfield, Massachusetts, mill $9,097, and others lesser amounts. The longest of these contracts had two years to run.¹⁴

¹³No sales records, per se, exist, only lists of customers granted long-term credit. Since successors Leach and Keith sold to the South and Middle Atlantic states, it is quite likely some of their customers were formerly their predecessors' customers.

¹⁴Shareholder Minutes, July 11, 1832, July 19, 1833.
Taunton's Role in Cotton Machinery Innovation

The greatest historical importance of the early Taunton shops was their role in the development of textile machinery. During the 1830's and early 1840's two textile-machinery shops seem to have led the American industry in innovation, Matteawan in Beacon, New York, and Taunton. Significantly, the large northern shops such as Locks and Canals kept pace by obtaining the rights to build the machines patented at Taunton and Matteawan, a reversal of the relationship of the early 1820's when Crocker and Richmond paid Locks and Canals' predecessor, Boston Manufacturing, for rights to build machinery covered by Boston's patents.15

The Taunton shops were responsible for either the invention or commercial development of several significant early textile machines: William Crompton's fancy power loom, the first (or at least arguably the first) commercially successful American rotary calico

15See the extensive correspondence of Patrick Tracy Jackson with William B. Leonard and William Mason in 1842-1844, Letterbooks A-32, A-33, DA-2, Locks and Canals Collection; and the Directors Minutes for Dec. 19, 1822, Boston Manufacturing Collection; both Baker Library, Harvard University, Boston.
printing machines, George Danforth's Taunton speeder, and several other speeders. Most notably, it was in Taunton that the ring frame--today's standard spinning device--was first produced on a large scale. There, too, William Mason developed his version of the self-acting mule.

Initially Taunton Manufacturing and Crocker and Richmond developed these textile machinery designs for their own mills' use, although they probably hoped to defray partially development and pattern-making costs by selling to other mills. Their goal was faster, labor-saving machines to offset the small water supply limiting their mills' size and efficiency. In 1840 the streams of Taunton powered fewer than 20,000 spindles spread among six mills; an average of 3300 per mill. Significantly, Matteawan, the other highly progressive shop of the thirties, faced the same problem: the Fishkill ran only 8,000 spindles in the Matteawan and sister Glenham mills. Conversely, in 1839 the Merrimack River at Lowell powered 163,404 spindles in twenty-six mills operated by nine corporations; an

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16 J. R. Mc'Cuolloch, Mc'Cuolloch's Universal Gazetter..., 2 vols. (New York, 1846), 2: 903; Hunt's Merchants' Magazine 15 (1846): 371, 374. Spindles have been the traditional measure of mill size.
average 6285 spindles per mill—twice Taunton—and 18,156 per corporation.\textsuperscript{17}

To offset the inefficiencies stemming from limited waterpower, Taunton and Matteawan, as well as many of their small neighbors, turned to cost-cutting machinery and to fine-goods production. Peter H. Schenck, one of Matteawan's founders, reported in 1832 that in his mills, "the reduction of cost of manufacturing the same kinds of goods is about fifty per cent. since 1822, principally by the introduction of labor-saving machinery."\textsuperscript{18} Peter's brother, Abraham H. Schenck, made it clear that the purpose of Matteawan's development program was to produce "labor-saving machinery," while simultaneously improving "the quality, style and finish of the cloths" produced.\textsuperscript{19} Although there survives no known statement by Charles Richmond on the purposes of his efforts, an examination of the innovations he sought reveals the same goals as the Schencks: The Taunton

\textsuperscript{17}Montgomery, \textit{Practical Detail}, p. 170.

\textsuperscript{18}Quoted in \textit{McLane Report}, 2: 61. Schenck did not say if he had made allowances for the decline in cotton prices, which could account for much of this reduction in manufacturing costs.

speeder and ring frames were primarily labor-saving devices, and the Crompton loom and Mason self-actor mule were part of an effort to produce finer goods using less skilled labor. Given the shortage and high cost of skilled weavers and hand-mule spinners, the Crompton and Mason inventions were vital to Richmond's efforts to make the Taunton mills cost-competitive fine-goods producers and to tap the growing demand of the other southern New England mills for self-acting machinery for fine-goods manufacture.

Further incentive for innovation may have come from labor problems caused by the skilled English mill hands in Taunton. Recalled a contemporary resident: "There was always more or less trouble with this class of employee; they knew the necessities of their employers, and took advantage of the same . . . , no dependence could be placed upon their whereabouts." While a touch of xenophobia may have colored these remarks, the problem was frequently reported in other early New England mill towns. In retrospect it is striking that in the 1830's southern New England mill owners attacked their uncompetitive position and labor troubles by

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20 Atwood, Reminiscences, p. 127.
developing new manufacturing processes, but that their twentieth century counterparts responded to the South's competitive advantages, which included less troublesome labor, by closing.\(^2\)

Charles Richmond led the efforts of the Taunton Manufacturing Company and Crocker and Richmond to acquire new textile machine designs. Ever the visionary plunger, Richmond gambled on inventions to ease his firms' problems—particularly in 1836 and 1837 when Crocker and Richmond's financial difficulties mounted. Richmond's first effort at acquiring new technology was his 1824-1825 English visit to acquire British textile technology.\(^2\)

As we have seen, this method was used by the other leading shops. Indeed, Providence's Zachariah Allen, Dover's Arthur Porter, and Lowell's Kirk Boott were in Britain at the same time as Richmond.\(^2\)

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acquired machinery designs by recruiting skilled laborers and machinists familiar with the technology of other textile centers. In 1832 the directors of Taunton Manufacturing voted that, "C. Richmond Shall unite with James K. Mills & Co. to procure from England a practical manager for the print works."24 Indeed, a significant number of Crocker and Richmond's operatives, foremen, and superintendents were Englishmen hired for their knowledge of British technology.25 Additionally, Richmond attracted many mechanics and other skilled workers from other American mills. So aggressive were his efforts that Nathan Appleton, more attuned to the gentlemanly way of the Milk Street merchants than to the competition of emerging industrialism, complained to the directors of the Taunton Manufacturing Company about Richmond's theft of workers from the Lowell factories.26 Among the machinists and inventions brought in by Richmond were William Mason and his ring frame and George Danforth and his Taunton speeder.

24Directors Minutes, Feb. 8, 1832. A similar request was made Oct. 26, 1827.

25Atwood, Reminiscences, p. 125; Shareholder Minutes, Sept. 24, 1833.

26Directors Minutes, Jan. 22, 1828.
EARLY SPEEDERS

Speeders, also called roving frames, were intermediate machines between the carding and spinning processes. Because the cotton came out of the carding machines in a thick, loose bundle of parallel cotton fibers, it had to be drawn into a thinner roving suitable for spinning. Therefore, cotton from several carding machines was combined and drawn through the three pairs of rollers of a drawing head or railway head. No twist was imparted to the cotton by this head. However, the succeeding roving machines twisted the roving just enough to prevent breakage in the later processes, but not so much as to hinder the drawing-out of the mass of fibers. For a half-century before the invention of Danforth's Taunton speeder, the Arkwright process had used the lantern frame in which the roving was fed from the drafting rollers into a rotating can with an attached tube at its top. Friction imparted a slight twist to the roving as it passed through this rotating tube. In alternative versions of the lantern frame, rollers replaced the tube. After costly, time-consuming hand winding on bobbins, American mills further drafted and twisted lantern frame rovings on mule-like
slubbing-billeys or, in some southern New England mills, on mules themselves.\textsuperscript{27}

"The want of a better roving machine was a serious evil in early manufacturing, greater speed of process being sadly wanted," recalled Fall River mill pioneer David Anthony.\textsuperscript{28} To increase speed and cut labor, many new machines, including the Taunton speeder, were developed in the early nineteenth century. One of these inventions, which eliminated the hand-winding of roving on bobbins, was a modification of the lantern frame called the jack-in-the-box. This colorfully named device, situated inside the lantern can, was a revolving horizontal drum which drove by friction a flanged wooden bobbin. But the jack-in-the-box proved slow and produced poor roving, so soon it was replaced by the fly frame and the Taunton speeder.\textsuperscript{29}

To appreciate the simplicity of the Taunton speeder, and its short-run success, it is helpful to

\textsuperscript{27}Leigh, Cotton Spinning 2: 174-176; Clement J. Charnock, The Roving Frame (Manchester and London, n.d. [ca. 1900]), pp. 6-9; Montgomery, Practical Detail, p. 67; Ure, Cotton Manufacture, 2: 59-61.

\textsuperscript{28}Peck and Earl, Fall River, p. 19.

\textsuperscript{29}Charnock, Roving Frame, p. 10; Ure, Cotton Manufacture, 2: 61.
examine its chief rival and eventual successor, the fly frame. To the uninitiated the fly frame resembled a common spinning frame with oversized flyers and bobbins. But there was an important difference: all three motions—the rollers, the flyer, and the bobbin—had to be separately powered and synchronized so that the delicate roving was under no strain. The synchronization was complicated by the increasing peripheral speed of the roving wound on the bobbin as the bobbin filled. If the bobbin's axial speed was constant, each successive layer of roving was wound on the bobbin at a speed greater than the previous layer, placing the roving under increasing strain. In synchronizing these three motions, the speed of the rollers and the degree of twist desired were the independent variables. The twist chosen determined the ratio of flyer speed to roller speed. The speed of the bobbins at the periphery of the rovings wound on them had to lag behind the flyer at a rate equal to the speed at which the rollers played out the rovings. Otherwise, the rovings would be placed under strain or would be too loosely wound. Therefore, the bobbin had to be accelerated to prevent it from winding too rapidly on its periphery.
Joseph Rayor of Sheffield, England, is generally credited with developing and patenting the first fly frame in 1813. The key to Raynor's frame was a differential motion activated by a drive wheel which, whenever a new layer of roving was to be wound on the bobbin, was shifted to the next larger of a graduated set of spur wheels. However, Raynor's fly frame, ingenious as it seemed, was slow, cumbersome, complex, and troublesome—a far cry from the elegant English fly frames which vanquished all rivals thirty years later.

The fly frame began to find acceptance in the United States in 1819-1820. William Hines of Coventry, Rhode Island, built fly frames and patented an improved fly frame on February 6, 1819, as did Jonathan Fisk of Medway, Massachusetts on December 7, 1820. Paul Moody and Francis Lowell of Waltham's Boston Manufacturing Company obtained from England a description of a fly frame, from which they designed the Waltham double speeder of 1819. Their Waltham speeder utilized a differential motion with an epicycloidal compound gear train not subject to the belt slippage of the British fly frames. The gear shapes and ratios and the differential equations governing them were computed by Francis Lowell in one of the infrequent applications of
science to the early Industrial Revolution. Because its flyers were not suspended from the top of their spindles, but were firmly supported at top and bottom, the Waltham double speeder could be run faster than the English fly frame. For this reason large American mills used the Waltham speeder for the next three decades. Compared with the British fly frames, the Waltham speeder turned out more work and consumed more power; a classic example of the American preference for labor-saving speed and the British desire for thrift in materials and power. Further limitations of the Waltham speeder were its cost and the difficulty of changing it for different numbers of thread; no particular problem in the wealthy, single-product mills of northern New England, but a serious deficiency with the changing, fashion-oriented product lines of the less affluent mills to the south.  

The inadequacy of the lantern frame and the high price, power demands, and difficulty of adjusting the Waltham speeder and similar fly frames encouraged southern New England mills, led by Taunton, to find alternatives. In 1821 Silas Shepard and Cromwell Dean of Taunton patented a speeder of unknown design. Apparently it was not very successful since by 1823 or 1824 Shepard along with Crocker and Richmond became interested in two new speeders: George Danforth's tube frame and Aza Arnold's differential fly frame. Aza Arnold of North Providence, Rhode Island, had patented in 1823 a fly frame differential motion which produced the required retrograde motions with only one set of drive cones. In contrast to the complicated adjustments needed to adapt the Waltham speeder to a different size roving, a simple gear change was all that was needed on the Arnold speeder. On his 1824-1825 English trip, Charles Richmond—without Arnold's knowledge--traded a model and plans of Arnold's motion to Manchester machinery builder Henry Houldsworth in return for Houldsworth's aid in copying a cylinder calico printing machine. Because the differential motion of the Arnold speeder was simpler than any English design, Houldsworth applied the Arnold motion to the otherwise superior
English fly frame. Patented in Britain in 1826, the resulting hybrid eventually vanquished all rivals. However, that victory was slow coming in America. In its crude original form, Arnold's speeder was quickly rejected in Taunton in favor of George Danforth's Taunton speeder. Even though Richmond brought back from England one of Houldsworth's fly frames equipped with Arnold's differential motion, it was not adopted in Taunton. Above all other reasons, high initial and operating costs delayed the acceptance of the differential fly frame in Taunton and the rest of southern New England. Thirty-five years later, Silas Shepard could recall of no use of the Arnold speeder in Taunton.31

GEORGE DANFORTH'S TAUNTON SPEEDER

More than any other product, Crocker and Richmond were known for George Danforth's Taunton speeder, also called the counter-twisting speeder, the tube speeder, 

or the Dyer frame. George Pitts Danforth, the inventor, was born on March 29, 1791, in nearby Rehoboth. Soon after his father Thomas bought a fulling mill in eastern Norton, just north of Taunton. During the 1811 cotton mill boom, several local investors built a cotton mill on the elder Danforth's waterpower privilege. Both George and his younger brother Charles, future cap frame inventor and Paterson industrialist, learned the art of cotton manufacture there. According to Silas Shepard, in 1823 or early 1824 George Danforth conceived the idea of replacing the fly frame flyer with a rotating tube which used its friction to twist the yarn passing through it. When he first ran the prototype in the Norton mill, he was surprised to discover that the twist that the leading end of the tube inserted was removed by the trailing end. Considering it still useful, he sought Shepard's opinion. Shepard was favorably enough impressed that he, Danforth, Charles Richmond and Samuel Crocker joined in a partnership to produce and license the speeder. After Shepard and Danforth improved the crude prototype in the Taunton shop, the four partners secured a 1824 patent in Danforth's name. So lucrative was his share of the royalties that Danforth forsook the mechanic's trade
for politics. At his death, September 1, 1838, he was Taunton's representative to the legislature.32

Because it was fast, simple, inexpensive, and economical of power for twenty years George Danforth's 1824 Taunton speeder kept its technically superior rival, the fly frame, at bay in the small mills of southern New England. That simplicity came from a clever avoidance of flyers and the differential problem associated with their use in making roving. The Taunton speeder drafted the roving between rollers in the ordinary manner of the fly frame and other roving frames. From the rollers, the roving passed lengthwise through a hollow, band-driven, rotating tube, which temporarily tightly twisted the roving for the duration of its passage from the rollers to the bobbin, thereby preventing breakage of the delicate roving. The Taunton speeder also circumvented the difficult alterations of the axial speed of bobbins as those bobbins filled by using a peripheral bobbin drive in which a fluted drum, turning against the outer layer of roving wound on the

Bobbin, drove that peripheral layer at a constant speed equal to the delivery speed of the front rollers. These arrangements did away with the fly frame's complex, costly mechanism for synchronizing the changing motions of the rollers, flyers, and bobbins. Danforth also introduced a presser to lay the roving more compactly on the bobbin, thereby reducing the frequency and labor cost of doffing the bobbin. The principle of using a presser was sufficiently original that the British patent office issued a patent for it in 1825. The early Taunton speeders also incorporated an unwieldy bobbin-traversing mechanism. Such devices moved to and fro to evenly distribute the roving over the length of the bobbin, but had to be slowed as the bobbin filled and took longer to complete the winding of each successive layer. Danforth's device wound yarn onto a special bobbin at the bottom of the frame at the same rate as roving was wound on the main bobbins above. This special bobbin was powered by a friction cylinder in the same manner as the other bobbins. The shaft upon which this bobbin was mounted drove the traverse

Even an invention considered as original as was the Danforth speeder had many of its elements anticipated by earlier inventions. Joseph Dyer in his 1825 application for a British patent for the Danforth frame admitted that another counter-twisting mechanism had been applied previously to drawing machines. Indeed, all that Dyer claimed as original in the Danforth speeder was the presser and the combination of motions. In his famous 1738 spinning patent, Lewis Paul briefly described an alternative method of imparting twist between the drafting operations by passing the thread through a rotating tube. Paul's idea (or John Watt's, as some such as Ure claim it really was) probably was never put to practical use, and it is highly improbable that Danforth ever heard of it. Danforth seems to have independently conceived the tube mechanism. However, it is likely that he
borrowed the peripheral drive of the bobbins from the commonly-used jack-in-the-box. It is safe to conclude that although most of the elements of the Taunton speeder were not new, the combination of these motions was. But then, seldom is any invention truly original. It is either a modification or recombination of earlier ideas, or an independent, unwitting reinvention.  

Owing to its inexpensive simplicity, the Taunton speeder became the most popular speeder in southern New England. Seeking new markets, Charles Richmond introduced it to England during his 1824-1825 trip. While there Richmond arranged for Manchester merchant Joseph Cheseborough Dyer to secure a British patent for the Danforth speeder and to manage its licensing in England. Dyer, a Rhode Islander, made a practice of either representing American inventors in Britain or securing the British rights to their inventions. Among the British patents he held were those for several nail and textile machines from America, including the Whittemore card clothing machine. Dyer eventually convinced the Taunton partners to sell to him the British

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patent rights to the speeder, then made it a success in British coarse-goods mills by greatly improving it. For part of these modifications, Dyer received a British patent in 1829 and an American patent on October 1, 1830. The Dyer frame of the mid-1830's described in detail by Ure was a far more rugged, sophisticated machine than the crude Danforth speeder shown in the patents a decade earlier. A sturdy cast iron frame replaced the built-up wooden frame. In the traverse mechanism, the tubes rather than the bobbins reciprocated to distribute the roving. Danforth's cumbersome mechanism for slowing the traverse was replaced by an escapement mechanism borrowed from contemporary fly frames. An automatic stop motion stopped the speeder when the bobbins were full. As revised, the tube speeder enjoyed some popularity for a while in British mills making coarse yarns (finer than 30s) for uses such as low-priced calico cloth, but never as much as in the small southern New England mills where it reigned for two decades.35

The origins of the Taunton speeder's popularity in southern New England were obvious: it ran two to three times faster than the fly frame and cost far less. When twenty-spindle Waltham double speeders were selling for $2400, a similar sized Taunton speeder sold for only $350 and produced more work. Moreover, the Taunton device did not get out of adjustment as easily. Southern New England mill owners liked its low power consumption. Offsetting these advantages were two limitations. What twist one end of the tube put into the roving, the other end removed, with the result that the roving often broke in later handling. Even if it did not break, Taunton roving was coarse. Any foreign matter in the roving would prevent the roving at that point from untwisting as fully as the rest of the roving, making a hard spot in the yarn. However, the coarse cloth resulting was quite acceptable for the American (and British export) calicoes of the day. Until the perfection of the fly frame in the 1830's, the Taunton frame's advantages sufficiently outweighed its disadvantages to make the Taunton speeder the Brick Mill's most popular product. Danforth assigned the speeder to Taunton Manufacturing, and by late 1824 Crocker, Richmond and Otis were selling the speeder on the company's behalf. When Crocker and
Richmond took over the Brick Mill in 1833 as their share of the Taunton Manufacturing assets, they acquired the patent.  

Two rival counter-twisting speeders, the Eclipse and the plate, were developed by other firms in an effort to circumvent the successful Taunton patent. Both were essentially modifications of the Taunton speeder. Patented in 1829 by Gilbert Brewster of Poughkeepsie, New York, the Eclipse, or Bellows, speeder used belts running in opposite directions in place of the tube for counter-twisting. While the Eclipse took up less space, offered simpler construction, consumed less power, and ran at higher speeds than the Taunton, fly, and plate speeders, it produced more uneven work. The plate speeder, also an American design, produced the counter-twist when the roving passed between

the beveled edges of two round plates rotating in opposite directions. It proved to be slower and more complex than the Eclipse speeder. Plate and Eclipse speeders were used mainly in Paterson, New Jersey, and in a few other Middle Atlantic and Southern mill towns. Both were introduced in Britain about 1835, but never were popular there, even though the prestigious firm of Sharp and Roberts produced an Eclipse speeder superior to the American imports. Coming late, neither the plate nor the Eclipse speeders offered significant advantages over the Taunton since they suffered the same shortcomings. 37

Improvements in the English fly frame by Aza Arnold, Green and Higgins, and Henry Houldsworth in the 1820's soon resulted in a reliable machine which produced a product superior to all other roving frames. In the 1830's Matteawan imported the improved English fly frames (probably to copy in their own shop), and in the late 1840's and 1850's fly frames, generally imported, replaced the Waltham and Taunton speeders in most

37Leigh, Cotton Spinning, 2: 195; Montgomery, Practical Detail, pp. 61-62, 67; Journal of the Franklin Institute 8 (1829): 53. The Eclipse frame was patented Apr. 18, 1829.
American mills. By then those mills too poor to afford fly frames were disappearing. Moreover, southern New England efforts to shift to fine goods in the late 1830's and early 1840's doomed the Taunton speeder and its coarse roving.38

THE MASON SPEEDER

By 1837 Crocker and Richmond must have been aware of the fading popularity of the Taunton speeder since they encouraged William Mason to develop a new type of speeder, which he did, patenting the device in 1838. Coming from the drafting rollers, the roving passed through a hole in the closed end of the tube-like horizontal cap which enclosed the bobbin. Passing inside the cap, the roving was pressed firmly against the bobbin by the short end of centrifugal lever. This cap and the spindle was independently powered by a differential motion. To facilitate doffing and distribution of roving on the bobbins, the bobbins were mounted on a horizontal carriage. Even though this permitted the spindles and bobbins to be withdrawn from

38Leigh, Cotton Spinning, 2: 179; Charnock, Roving Frame, pp. 10-13; English, Textile Industry, p. 170; Montgomery, Practical Detail, p. 66; Navin, Whitin, p. 36.
the caps, the machine still must have been difficult to thread and doff. While fast, Mason's frame provided little challenge to the improved fly frames and was soon forgotten. 39

The experience of the Taunton speeder and its close relatives demonstrates how designs technologically inferior to their rivals can be brought into existence or preserved because of inadequate capital. This experience also illustrates how closely the Taunton shops were tied to the needs of the small southern New England mills. The Taunton speeders and their offspring produced plentiful, though crude rovings for a modest capital investment. For a couple decades these machines coexisted with the otherwise superior fly frame, then vanished in the forties and fifties when the small, underfinanced, southern New England mills were forced to either close or modernize to combat shrinking profit margins and competition from large, modern mills. Likewise, the product shift of American mills in the 1830's from coarse heavy cloth to finer goods rendered the coarse rovings of the Taunton speeder increasingly unacceptable.

THE CROMPTON FANCY LOOM

In 1835-1837, as Crocker and Richmond faced higher cotton prices and lower profit margins, the Brick Mill and School Street shops became the locus of an intensive effort by Richmond to develop new types of textile machines for his own mills and for sale. One result of this effort was William Crompton's fancy loom which was intended to weave complex designs requiring many harnesses to give a wide variety of settings of the warp. William Crompton was born in the noted English weaving community of Preston, Lancashire. Although originally trained as a hand loom weaver, as a young man Crompton learned the machinist's trade. Before age thirty he had charge of a Ramsbottom cotton mill; if a hyperbole-prone family tradition can be believed. In August 1836 William Crompton emigrated


to the United States where he entered the employ of Crocker and Richmond as a machinist under the supervision of William Mason.\textsuperscript{42}

Soon after Crompton's arrival, Richmond asked him to build for the Brick Mill a dozen fancy power looms for cottonades or similar fabrics requiring many harnesses which held those warp threads to be raised during each passage of the shuttle.\textsuperscript{43} A plain loom could operate with two to four harnesses using cams or cranks, however space limitations made operation with more harnesses impractical. Several inventors, particularly in England in the 1820's, had developed mechanisms for fancy looms with many harnesses. One was William Mason prior to his arrival in Taunton. Devices used extensively on English handlooms, but apparently not very much on power looms, anticipated much of the Crompton shedding motion for the setting of

\textsuperscript{42}Crompton, Crompton Loom, p. 29; Hayes, American Textile Machinery, p. 50. Again, family tradition pumps him up into a superintendent, but Hayes, who quite possibly knew William and certainly knew his son George, says he was a mere mechanic.

\textsuperscript{43}Van Slyck, Representatives, 1: 186; Crompton, Crompton Loom, p. 29; Hayes, American Textile Machinery, p. 50.
harnesses for each pick. The tappet wheels of Richard Roberts' 1822 British patent power loom and the jack levers of Robert Bowman's 1821 and John Potter's 1825 British patent power looms seem to have influenced Crompton's design. In fact, little of Crompton's loom seems to have been truly original, except possibly the open shed. The real significance of the Crompton loom was that it was the first commercially successful American loom for the power weaving of fancy goods. Excepting a few scattered fancy power loom experiments, previously American fancy goods had been produced on hand looms, usually in the weavers' homes. 44

In the Crompton loom, an endless pattern chain, which advanced one lag or bar each pick, governed the shed. On each lag were easily changed rollers or pins which engaged a lifting harness jack attached to a jack lever. The jack in turn lifted the outside end of the jack lever, depressing the inside end attached to one of the harnesses. After the pick, a spring returned the harness to the neutral position. In another feature of

the loom, the harness jacks not engaged by rollers were depressed by another bar so that their harnesses were raised. This increased the space open for the passage of the shuttle and decreased the distance the other harnesses had to be depressed, thereby reducing the strain on warp threads. This was half of the famous Crompton open shed motion. The other half, patented in 1858 by William's son George, consisted of keeping in the open position all harnesses which did not need to be shifted for the next pick, again cutting the strain on the warp.\textsuperscript{45}

Crocker and Richmond's bankruptcy in April 1837 prevented them from selling Crompton's new loom. Unable to interest others in his invention because of the recession, William Crompton returned to England in 1838 where he secured a patent in the name of his partner John Rostron and placed many looms in British factories. Late in 1839 Crompton returned to interest Americans in his loom. Having no luck at Lowell, he reentered the employ of Crocker and Richmond, who had partly recovered from their embarrassment. Another trip to Lowell failed to interest the cotton mills, but he

\textsuperscript{45}U. S. Patent 491, Nov. 25, 1837.
did secure an order from Samuel Lawrence, agent of the Middlesex woolen mill, who sought to mass-produce fancy woolens. Crompton spent two years with the Middlesex mill converting their looms to his design, then in 1841 granted Phelps and Bickford, an old Worcester loom builder, the rights to build his pattern. Crompton set up the looms and instructed workers in their operation until he became mentally incapacitated in 1849.46 Although William Crompton lived until May 1, 1891, he never fully recovered. His son George, deciding to exploit his father's loom more fully, secured an extension of the patent and in 1851 with Merrill A. Furbush established Furbush and Crompton to manufacture the loom. After Furbush left in 1859 to form his own firm in Philadelphia, the Crompton Loom Works continued to improve its designs, becoming along with the neighboring Knowles Loom Works one of the two largest fancy loom builders in America. Merged in 1897,

46 Crompton, Crompton Loom, p. 42; also Samuel Lawrence to George Crompton, Nov. 14, 1874, reproduced in Crompton Loom Works, 1881 Catalogue, pp. 3-4; Crompton, Crompton Loom, pp. 37, 78-80; Van Slyck, Representatives, 1: 187; Bishop, American Manufacturers, 3: 365; Great Industries, p. 723; History of Worcester County, Massachusetts, Embracing a Comprehensive History of the County from Its First Settlement to the Present Time..., 2 vols. (Boston, 1879), 2: 664.
Crompton and Knowles still dominates the manufacture of fancy looms today. But for their 1837 failure, it might have been Crocker and Richmond.

WILLIAM MASON

More significant than the inventions of Danforth, Crompton, and the others were the innovations of William Mason. At the recommendation of a mutual customer, Edmund Smith of Uncasville, Connecticut, Charles Richmond hired Mason in February 1836 to run the Taunton shop and, more importantly, to add the Mason ring frame to Taunton's line. Invented by John Thorp after his return from Taunton to Providence, the ring frame had been commercially unsuccessful until William Mason had simplified the design. It was Mason's initial success in marketing this improved ring frame for the creditors of his former employer in Connecticut that had influenced Richmond to bring Mason to Taunton.

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For half of the potential patent royalties, Crocker and Richmond financed Mason's efforts to develop other types of machinery intended to produce finer goods with less labor. It was an ambitious development program, but it was sharply restricted by Crocker and Richmond's 1837 assignment and ended by their deeper financial problems in the early 1840's. At its peak during 1836 and 1837, this innovative quest made the Taunton shop the center of the most intensive development effort in the textile machinery industry since Lowell and Moody's at Waltham and Leonard's at Matteawan.
CHAPTER IV

WILLIAM MASON, THE RING FRAME, AND THE MASON SELF-ACTOR MULES

When they hired William Mason shortly before their failure, Crocker and Richmond made their most important contribution to the development of Taunton's equipment building industry. Within twenty years Mason would bring Taunton national recognition by producing the most elegant locomotives and textile machines in America. After helping to perfect John Thorp's ring frame, he popularized this spinning device and made Taunton the early leader in its production. Although the ring frame was destined to become the standard twentieth century device for spinning fibers, he also developed an alternative, a self-acting mule, in order to satisfy the demands of southern New England mills for a cheaper device for spinning fine filling.

MASON THE MAN

William Mason was a striking person: over six feet tall and lean of frame. Later in life he wore a
magnificently long, romantic beard which reflected both his artistic flair and his penchant for self-proclamation. A nervous, restless, stubborn, laconic man, he could be difficult. When defending his honor or promoting his inventions and inventive skill, he remained, as his Puritan ancestors, righteously sure of the correctness of his position. He obstinately refused to permit compromise or to admit error or defeat.¹

His men were loyal to him for being a fair, kind, considerate employer. Mason never forgot his origins as a mechanic, so his office or mansion were open to an employee with a grievance or problem. Likewise, he did not hesitate to remove his coat to help fix a balky locomotive or machine. Mason's highest compliment for a fellow machine builder could have been applied equally well to himself: "He was a machinist brought up to the vise." He realized that "To manage a machine shop a mechanical man with business qualifications is needed," and he successfully lived up to his

own standard. Not a visionary gambler as Charles Richmond, Mason succeeded because he was a practical, pragmatic mechanic and businessman.

Mason's humor was famous in Taunton. When he opened his new factory in 1845, drinking water had to be carried a block from Mill River. Disdaining the foul stream water, the men went across the street for a beer if they were thirsty. One day one machinist accepted a bet from his fellow journeymen that he could not bring back two beers past the watchful Mason. Soon the man returned demanding that his bettors pay. "We see no beers!" "These two witnesses will testify that they are in my belly." At that point Mason who had been observing grabbed a shovel. "Where are you going?" shouted his men. "To dig a well."³

Mason had such good relations with his workers that he had few labor problems. However, on one occasion his men voted to demand a reduction of the workday from

²William Mason quoted in "The Late William Mason," Railroad Gazette 15 (1883): 342. This interview was almost certainly by M. N. Forney. The fellow machine builder was James S. Brown.

10\(\frac{1}{2}\) to 10 hours. Their spokesman approached Mason with trepidation: "Mr. Mason, we are going to work 10 hours."

"I'm glad of that," replied Mason with the famous twinkle in his eye, "you never have yet." The issue was closed. 4

Perhaps born of a desire to escape rural poverty and anonymity, throughout his life Mason demonstrated a driving desire to express himself and to gain recognition by creating. Coupled with a love of simplicity and natural beauty, this passion led him to become a credible, although not outstanding, painter and violinist. Mason's love of art and hunger for recognition combined in the 1850's to produce what many have argued were the most graceful steam locomotives of the era: "melodies cast and wrought in metal," in the judgment of nineteenth-century inventor-journalist M. N. Forney. 5

Inventor does not describe Mason well. Innovator does. Mason's genius was the modification of inventors' ideas into commercially practical designs. This he accomplished elegantly by making machines simple, balanced, and symmetrical. As we shall see, this approach to design was reflected in his ring spinning frames and American

4Ibid., Henry Copeland speech.

5"The Late William Mason," p. 341.
standard locomotives. "The work which he did," eulogized Forney, "always bore the indication of his consummate skill in the adaptation of the simplest and most appropriate means to the ends arrived at." 6

EARLY LIFE OF WILLIAM MASON

William Mason's early life was commonplace for a mechanic of his era. Indeed, that was its significance. Most great mechanics of the early and mid-nineteenth century were men from farming or working class families who had been "brought up to the vise." 7 Outside of the later historic significance of his innovations, Mason's first thirty-five years differed little from most contemporary mechanics' lives, humble or illustrious.

William Mason was born to an old colonial family near the seaport of Mystic in

6 Ibid., p. 342.

7 Indeed, mechanics institutes did produce a cadre of men familiar with the principles of mechanics, geometry, steam engineering, and related fields, but prior to the 1870's, most machines were designed by trial and error rather than by scientific engineering. See, for example, Monte A. Calvert, The Mechanical Engineer in America, 1830-1910 (Baltimore: Johns Hopkins Press, 1967).
eastern Connecticut. One of his ancestors was the fabled seventeenth-century Indian-killer "Pequot" John Mason. William's father Amos was a farmer and blacksmith—trades less colorful, if more socially productive, than Pequot John's. Mary Holdrege Mason, William's mother, was a sturdy New England woman who raised seven sons, then finished her labors with a lone daughter. William was the third of these children.

In 1811 when William was three, the family moved to a farm on Ram Island in the mouth of the Mystic River. Three years later Amos again took his family to North Stonington fifteen miles away where he

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8 His birthplace is in doubt. Mason always said he was born in Mystic, but Frederick M. Westcott, author of "William Mason: Artist-Inventor-Builder," typescript, ca. 1942, felt that the "town historians" made a better case for Groton on the other side of the Mystic (copies of Westcott are in the hands of this writer, Arthur W. Wallace of Denver, and members of the Mason family). Representative Men and Old Families of Southeastern Massachusetts...(Chicago: J. H. Beers & Co., 1912), pp. 405-408, using information furnished by the family, says Groton. My check of the incomplete birth records in Stonington and Groton town halls failed to turn up any other evidence. However, the matter is minor since consists of a question of on which bank of the Mystic River he was born.

9 Representative Men, pp. 405-408.
smithed and farmed. Here as helpers at their father's anvil, William and his two older brothers were introduced to metalworking. William later boasted that before he was thirteen he had smithed the best skate and sled runners in town and was making and selling jew's-harps and drawings. During the four winter months, he attended a public grammar school of the nearly universal New England type which helped produce much of the literate workforce of the early American industrial revolution.10

When William was fourteen, his family contracted to work in the cotton mill in Packerville in Windham County fifteen miles above North Stonington. The Quinebaug Valley wherein Packerville lay held Connecticut's most important cotton spinning district. Developed by a combination of local and Rhode Island capital, the Quinebaug represented an extension of the Rhode Island cotton industry. Windham County's first mill opened in 1807. When the Masons arrived in 1822, there were two-dozen mills

10Ibid; Livingston, Portraits, pp. 13-17; Van Slyck, Representatives, 2: 430-431; "The Late William Mason," p. 341; Bagnall, "Sketches," 3: 1818; Emery, History of Taunton, pt. 2, p. 43. "The Late William Mason" is based on an interview with Mason while Van Slyck and Livingston are based on either interviews or correspondence with Mason. Unless otherwise cited, these last three works are the principal sources for the following description of William Mason's life prior to coming to Taunton.
operating in the county. The mill in which the family worked was Packerville's oldest, having been built by local investors in 1811 as the Andrus Mill. Welcoming the mill as an alternative to agricultural depression and overpopulation, local citizens cleared the land, dug the cellar, raised the frame, and built the road. Founded under the artificial protection of the Embargo, the Andrus Mill was closed by the post-war flood of inexpensive British goods, but eventually Daniel Packer and Daniel Lester from nearby Preston re-equipped and enlarged the derelict mill. As did most early mill owners, excepting those at Waltham and Lowell, Packer and Lester staffed their mill with farm families attracted by an income higher than they could earn on Connecticut's marginal farms. Amos Mason accordingly contracted in September 1822 with Packer and Lester to employ William Mason at $1.50 per week and to take two younger sons, Edwin and Calvin, for lower wages. Packer and Lester agreed "to furnish free one kitchen for said Mason family and to sell meat, flour, clothing and shoes at as low a

11 For more on factors attracting labor to early mills, see McLane Report, 1: 70, 76, 1046; Hayes, American Textile Machinery, p. 29; Clark, History of Manufactures, 1: 3; Ware, Early Cotton Manufacture, p. 198.
price as any nearby store." They also had "to furnish two boarders at 10 shillings per week to assist in the family support." In turn, the Mason boys were required to be "obedient, industrious," and regular in attendance. Since employment of entire families was the standard mill practice of the 1820's, it is a bit surprising that no other Mason is mentioned. Amos may have worked in the machine shop under separate contract.

The contract clause on William and his brothers' behavior reflects Packer's concern for the morals of his workers and community. When he found that his employees' "Sundays were given over to drinking, horse-racing and kindred amusements," he counterattacked by recruiting a Baptist Home Missionary Society minister to establish the Packerville Baptist Church. Alas, the minister did not convert William, a later owner of race horses. Packer also joined the temperance crusade of the late 1820's, as did many other Windham mill owners, and helped drive out of town a school for Blacks which he feared would bring to town an unwanted race and endow

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12 Quoted by Westcott, "William Mason," p. 8, who cited a newspaper clipping, which gave a contract from Packer and Lester's old contract book. Barbara Tucker, University of California, Davis, who is working on family labor, finds some parts of the contract oddly drawn.
them with dangerous skills and ideas. Besides dictating his community's morals and activities, he proved an able administrator and by 1832 operated 5070 spindles, the state's third largest mill complex.\(^{13}\)

During the six years at Packerville, 1822-1828, William Mason's mechanical skill grew. Fascinated by a traveling musician's lute-like hurdy-gurdy, he made one with five strings stopped by wooden pegs and a resinated wheel to play the strings. He also developed such a reputation for keeping the balky wooden thrrostle frames running that he was loaned to a neighboring thread mill in Lisbon to keep one cantankerous machine running. Hearing of the young cotton spinner's ability, Noah Bulkley, partner in a mill near Packerville, borrowed the fifteen-year old Mason from Packer in 1823-1824 to

start the spinning frames of his new Union Company Mill in East Haddam, 30 miles to the southwest.\textsuperscript{14}

Mason's skills were sufficiently impressive to encourage Packer and Lester to apprentice him as a machinist in 1825. After three years apprenticeship in the mill-basement machine shop, Mason took a job as a mill machinist in New Hartford in the Utica mill district of upstate New York. After spending six months there, he received a letter from Packer asking him to check a rumor that Utica mills used power looms to make diapers (a twill that made a diamond shape requiring a minimum of three harnesses but commonly using six or eight). When Mason replied that he knew of no such looms, but was certain he could build them, Packer invited him to try. Returning to Packerville, Mason built what he claimed were the first American power diaper looms, an assertion which is impossible to prove and should be regarded with some suspicion. In the absence of a surviving description, one is led to guess that Mason used a crank or cam mechanism derived from the Scotch or Waltham looms, with which he would have been familiar, rather than a dobby head, which would have been unknown to him. Cams or cranks would have limited Mason to a few harnesses, yet so good were the looms that some

\textsuperscript{14}McLane Report, 1: 984-989; Livingston, Portraits, pp. 14-15; Van Slyck, Representatives, 2: 431.
were still running in 1853. Next Mason built for Packer a power damask loom to weave tablecloth with figures interwoven into both the middle and the border. However, it proved too complicated and was stored in the mill loft. Later, while being removed, the tackle broke, smashing both the loom and the young inventor's hopes. Soon afterwards Packer and Lester failed in the depression of 1829. Out of a job and back pay, Mason turned to painting oil portraits and making violins. Although this interlude lasted but three years, it helped to endow him with a concern for the aesthetics of locomotive and machinery design. Likewise, he continued a lifelong love of art. Indeed, one of the few publications he bought later in life was a monthly art journal.¹⁵

While Mason the artist's popularity rose, his mechanical skills were not forgotten. In 1832 John Hyde, owner of a mill in Mason's native Mystic, contracted with the twenty-four year old artist-mechanic for some

¹⁵Livingston, Portraits, pp. 15-16; Van Slyck, Representatives, 2: 431; Freedly, Leading Pursuits, p. 193; Emery, History of Taunton, pt. 2, p. 43; William Mason's Private Account Book, Box 62, Old Colony Historical Society, Taunton. I thank Joyce Messer, formerly of the Merrimack Valley Textile Museum, for explaining the early nineteenth-century meaning of damask and diaper. Ware, Early Cotton Manufacture, p. 211, cites cases of boys Mason's age and younger supervising mills or starting up their machinery.
diaper looms similar to Packer's. Needing a shop, Mason sub-contracted the frames and other parts not requiring his close attention to a machine shop in Willimantic, a mill center in western Windham County. He also arranged for an assistant and himself to make the loom mechanism in the same shop. The Hyde order changed Mason's life: a ten-dollar-a-day profit convinced him to be a machinist rather than an artist, and John Hyde was so pleased with his looms that he recommended Mason to Asahel M. Lanpher in 1833.  

Lanpher operated the upper machine shop at Killingly Center in east-central Windham County, selling in New England and the Middle Atlantic states a full line of cotton machinery from card to spinning frame. Mason, age twenty-five was put to work on Lanpher's pet project of designing a commercially successful ring frame. When Lanpher failed in 1834, Mason was asked to run the shop

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16 Livingston, Portraits, p. 16; Van Slyck, Representatives, 2: 431; Bagnall, "Sketches," 3: 1818; McLane Report, 1: 984-985 (The identity of the shop is unknown, although it could have been the mill shop of Appleton Walker who carried on a textile machinery business manufacturing 2000 spindles worth of machinery in 1831, McLane Report, 1: 988-989); Larned, History of Windham County, 2: 403, 431-433, 539; Charles E. Fisher, "William Mason," Railroad and Locomotive Historical Society Bulletin 15 (1927): 20. Lanpher has been variously spelled--the form I give is from his signature in the Killingly Deedbook.
for the creditors, receiving a percentage of the business. Demonstrating his business acumen, he sold ring frames to doubting mill owners by promising to remove the machines without charge if they failed to satisfy. In February 1836 when Mason called on Uncasville, Connecticut, mill owner Edmund Smith about installing ring frames, Smith recommended Mason to Crocker and Richmond, who had already told Smith of their interest in ring spinning. Mason was promptly hired by Crocker and Richmond as a foreman. As occurred repeatedly in the nineteenth century, a new design had been acquired by hiring a workman. For the next year Mason supervised the improvement and production of the ring frame for a comfortable $1000 annual salary.17

WITH LEACH AND KEITH

When Crocker and Richmond's 1837 failure closed the shop, Mason returned to portrait painting and on the

side developed and patented a tube speeder (see Chapter III). The following year Crocker and Richmond placed their machinery business in the hands of two Taunton machinists, James Leach and his nephew Edwin Keith, with the proviso that William Mason would be agent of the new firm with supervision of sales and of development of new machinery. For the next four years Leach and Keith employed fifty to seventy hands at building textile machinery in the School Street and Brick Mill shops. Typical of the independent southern New England textile machine shops of this period, their sales ranged from Petersburg, Virginia, to Somersworth, New Hampshire. Some large orders were filled, including two Mason mule shipments, each of about 11,000 spindles, to New Hampshire's Great Falls Mills and Newburyport's Bartlett Mills. Products included Mason's improved carding machines and drawing frames, dead-spindle frames, Mason's new tube speeders, Taunton speeders, Mason's self-actor mules, Mason's ring frames, and dressing frames. Quite likely Leach and Keith rounded out a complete card-to-loom line by also selling looms and warpers. They seem also to have made shafting and gearing. As did many other shops of the period, Leach and Keith occasionally
designed and equipped entire mills, purchasing from other shops the few types of machinery not in the Taunton shop's line. William Mason later recalled that as agent for Leach and Keith he had gone to Petersburg, Virginia, "designed a mill [probably the Etterick in 1838], and staked it out and took a contract for machinery . . . ."\textsuperscript{18}

Instead of being Leach and Keith's employee, Mason was under contract to Crocker and Richmond. For his work as agent and inventor, he was to receive $1000 annually; in return Crocker and Richmond were to get half of Mason's 25-cent-per-spindle royalty for each of his self-actor mules built by Leach and Keith. Leach and Keith were repaid for mule development costs and were able to use Mason's outstanding machinery designs. This complicated arrangement seemed to promise something for

\textsuperscript{18}Quote from "The Late William Mason," p. 341. Also used: Van Slyck, Representatives, p. 432; Westcott, "William Mason," p. 15; Livingston, Portraits, p. 17; Emery, History of Taunton, pt. 1, pp. 646, 658, pt. 2, p. 51; Trustees Letters and Bills, Samuel Crocker Collection, New York Public Library; unidentified typescript /George Boswell?/, ca. 1900, VB 37 Ind T, Old Colony Historical Society /the writer was a teenager in 1840's and had a very accurate memory/; "Mason's Claim against Leach and Keith," referee's summary, M 381 W, no. 6, Old Colony Historical Society; William Mason, Job Expense Book, Box 62, Old Colony Historical Society; U. S. Patent 1801, October 8, 1840. Of the two mills built in Petersburg during the existence of Leach and Keith, the Etterick is more likely than the Mechanics since William Mason and Company had reorders from the former in the 1840's, "Machinery Records: Mason's Machine Works," Old Colony Historical Society; Kathleen Bruce, Virginia Iron Manufacture in the Slave Era, (1931; reprint ed., New York: Augustus M. Kelley, 1968), p. 125.
everyone, but it left Leach and Keith in the awkward position of not being masters of their own business. Just how awkward it was was illustrated by their experience with the Newburyport, Massachusetts, Steam Cotton Company. In late 1840 and early 1841, Mason acting as Leach and Keith agent contracted to supply Newburyport Steam Cotton with fourteen self-actor mules of Mason's revised style. The Newburyport company probably had these mules with their 11,340 total spindles installed in their second Bartlett Mill. Leach and Keith, although obligated to produce and start the mules, were not consulted about the contract. When Mason took a year longer than anticipated to complete revisions to his mules, the Newburyport shareholders grew restless. Mason offered to supply his older pattern self-actor, but the mill agent insisted on the revised pattern. When the mules finally began arriving in the fall of 1841, Mason was too ill to journey to Newburyport to supervise their installation. They worked poorly until March 1842 when he had recovered enough to go to adjust them properly. The cotton mill sued Leach and Keith for compensation for business lost during the delay and collected. Leach and Keith retaliated against Mason for getting them in this predicament by demanding compensation
and by withholding the royalty fee due Mason and Crocker and Richmond. When Mason sued for his royalty, a court referee held both claims valid, meaning that Leach and Keith owed Mason only an offsetting balance of $159.19

In 1841 Crocker and Richmond's assets were returned to their trustees, leaving Mason once again unpaid. Then, in June 1842, the textile depression caused Leach and Keith to fail for want of business.20

Profits of the large northern mills dropped to 22 percent of 1836, their dividends nearly vanished, and their spending on equipment fell to 28 percent of 1840, a fairly dull year. Textile machinery orders of the large mills were at their lowest ebb in the period 1840-1886.21 Even harder hit were the smaller, fine-goods mills, the Taunton shop's major customers. Tariff rates reached


their lowest point on June 30, 1842, confronting the fine-goods mills with intense British competition.\textsuperscript{22}

With Leach and Keith closed, William Mason faced a major turning point in his life. Disdaining an offer to go to the Locks and Canals shop in Lowell, he, with the aid of a Boston dry goods commission merchant, James K. Mills, bought the Leach and Keith shop.\textsuperscript{23} Quickly Mills' money and Mason's mechanical and business abilities made William Mason and Company one of the nation's leading shops.

MASON'S CAREER EVALUATED

Mason's career was in many respects typical of leading American machinists of his era. An examination of the lives of ten important machine designers or builders\textsuperscript{24}

\textsuperscript{22}Ware, *Early Cotton Manufacture*, pp. 88, 101-108.

\textsuperscript{23}"Mason's Claim;" Livingston, *Portraits*, p. 17; "The Late William Mason," p. 341.

\textsuperscript{24}The ten men are: Mathias W. Baldwin, foremost American locomotive manufacturer; Andrew Campbell, a leading designer of printing presses, many of which were manufactured by Mason; William Crompton, designer of the Crompton loom; Charles Danforth, inventor of the cap frame and a leading locomotive and cotton machinery manufacturer; Saul White Eddy, Mason's superintendent; Willard Walcott Fairbanks, co-founder of Fairbanks, Bancroft and Company and of Taunton Locomotive Manufacturing Company; Parley Ide Perrin, Taunton Locomotive's mechanical head and agent; Thomas Rogers, leading American locomotive designer and manufacturer; William Sellers, foremost American machine tool builder; John Thorp, inventor of the ring frame. From knowledge of the lives of many similar men, I would say the expansion of the list would have a very limited effect on the results.
in fields in which Mason was involved reveals many parallels with Mason's experience.\textsuperscript{25} With no more than two exceptions,\textsuperscript{26} the ten came from humble origins, as did Mason, and all were Americans but one,\textsuperscript{27} highlighting the home-grown quality of American machine design and innovation in the first two-thirds of the nineteenth century. These machinists' educations were humble and practical. Most had, as Mason, a common-school grammar


\textsuperscript{26}Sellers, and possibly Fairbanks.

\textsuperscript{27}Crompton was English.
education of typically three years and an apprenticeship, but only two appear to have had any additional formal education in which they would have learned in any organized fashion the principles of mechanical engineering. Mason and the other eight were practical mechanics who developed their designs by the trial-and-error method, yet Mason and six of these eight became recognized as being among the leading American locomotive, textile machinery, or printing press designers of the first two-thirds of the century. Working in the shops and mills, practically trained men such as these produced the most useful inventions in these three industries prior to the 1870's. This clashes with Monte Calvert's suggestion that inventors were "independent entrepreneurs" who "rarely worked under any sort of contract with manufacturing industry." To the contrary, our ten machinists and Mason worked for manufacturing firms.

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28 Five--Baldwin, Campbell, Perrin, Rogers, and Sellers--are known to have had a formal apprenticeship, as did Mason, and almost certainly Crompton and Eddy did too. All except possibly Baldwin, Campbell, and Crompton had grammar school, and all were literate.

29 Sellers and Perrin.

Furthermore, their inventions were designed to meet the specific requests of industry.

Most of the ten became highly successful innovators and businessmen, and four became, as Mason, extremely wealthy machinery builders. If one can call these men mechanical engineers, and they are within Calvert's definition, then one must seriously question Calvert's assertion that, "upward mobility was not the primary operating factor in reaching the top levels of the mechanical occupations." Calvert greatly overestimates the importance of a "shop aristocracy" which placed the sons of the upper class in the mechanical engineering posts after only a short, planned practical shop experience. William Sellers was an exception, not a rule. Calvert might be a little closer to the truth if he defined mechanical

31 Thorp, Campbell, and Crompton were poor businessmen, and Eddy and Perrin were managers rather than entrepreneurs.

32 Baldwin, Danforth, Rogers, Sellers.

33 Calvert, Mechanical Engineer, xvi.

34 Ibid., p. 8.

35 Ibid., pp. 8-17.
engineers as those with a sound knowledge of the science of mechanics. However, prior to the 1870's, most mechanical engineers, as Calvert defines them, rose through the rags-to-riches route Gutman recognized in Paterson, New Jersey. This was so because, as in the case of Mason, practical experience, and inventive, mechanical, and business ability—not class origins—were the touchstones to success in the early machinery industry. Late in the nineteenth century as the science of mechanics came to play a significant role in the design of machinery, the well-educated professional mechanical engineer became important. Since at that time education was largely the prerogative of the upper and middle classes, the late-nineteenth century professional mechanical engineer was far less likely to have come from humble circumstances.

36 It is Sellers who stands in so many respects as the exception among the ten men, yet Sellers is the outstanding example Calvert uses to make his case.

The itinerant phase of Mason's career, up to 1836, is typical of his profession. Only three of the ten men in our sample came from trades other than machine building. Before he settled down, Mason worked for ten employers in four different centers; the ten other machinists worked for an average of 5.5 employers in 4.2 different centers, sharply illustrating the geographic mobility associated with the occupation. One man had thirteen different employers in eleven different towns, while four had only three, the lowest number of employers for any of the ten. Only one never left his city for a job elsewhere. This high degree of geographic mobility, characteristic of the machine trade, served an important function: the transfer of technology from one center

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38 Rogers was trained as a carpenter, Campbell as a smith and wagon-maker, Baldwin as a jeweler. Rogers was hired to build cotton machine frames, and Baldwin to make a model of a locomotive.

39 Windham County, Connecticut, was considered one center, as was northern Rhode Island. A return to a center was not considered employment at a new center. Being self-employed was considered as one employer. Any employer was counted only once, even if the man had been employed by that party on more than one occasion.

40 Campbell, perhaps reflecting his instability.

41 Baldwin, Fairbanks, Sellers, Thorp. Quite possibly these are understated.

42 Baldwin.
to another. Most often, these men were hired for their general skills, but several were brought in by employers seeking to acquire a machine or refine a process, much as Richmond hired Mason to acquire the ring frame.\textsuperscript{43} Through the constant flow of men from center to center and from shop to shop, technological transfer in the machinery industries proceeded rapidly.

\textbf{THE EARLY TEXTILE INVENTIONS OF WILLIAM MASON}

Invention is rarely a discrete or spectacular event. Normally it is a cumulative process in which many persons contribute minor modifications to an evolving design. Often the final alterations to a device are as important to its commercial success as was the original conception of that invention. If one distinguishes inventors—those who first conceive of a new machine or process—from innovators—those who modify it—then William Mason must be classed as an innovator. He demonstrated a shrewd businessman's ability to recognize

\textsuperscript{43}Crompton was hired by Richmond for a knowledge of English looms; Danforth was brought to Paterson by Godwin, Rogers and Clarke to acquire the cap frame; Thorp was brought in by Shepard to borrow ideas from the Thorp loom.
promising designs and knack for making them practical. This he usually accomplished by making the machines he redesigned elegantly simple and balanced, as will be seen in the following section.

THE DEVELOPMENT OF THE RING FRAME

None of Mason's inventions more clearly illustrate his proclivity for simple designs than his version of the ring frame. Briefly, the ring frame was a cotton spinning machine invented by John Thorp, needlessly complicated by Thorp and others, and finally simplified and made commercially practical by Addison and Stevens and by William Mason. So practical were Mason's improvements that today, almost a century and a half later, virtually all cotton, wool, and spun synthetic fibers are spun on ring frames.

Reasons for the Ring Frame's Development

The ring frame originated in an effort to discover a spinning device which could run faster than the old Arkwright throttle flyer. Resembling an inverted-U, the stiff wire Arkwright flyer was suspended from the top of the spindle. A loop at the bottom of one of the flyer's legs guided the thread onto the bobbin.
A slight difference of speed between the flyer and bobbin induced the twist needed to hold the thread together.

When American mills attempted to speed up their flyer throwstles in the 1820's, they discovered that about 5,000 rpm was the fastest that flyers could be run without the flyers spreading their legs or wobbling. Large northern New England mills with adequate water power prevented the spread and wobble by supporting the flyers in the frame at the top and by attaching the bottom of the flyer legs to a whorl at their bottoms. However, this dead spindle or Montgomery frame (as it was called respectively in New England and Great Britain) consumed 20 percent more power than the conventional Arkwright frames, making it unappealing to the power-poor mills of southern New England and the Middle Atlantic states. Therefore, the smaller mills began searching for a low-power, high-speed substitute for the Arkwright and dead-spindle flyers. Because of the loss of pre-1836 patents, nobody can be sure how many flyer substitutes were attempted prior to the 1828 patents issued to the Thorp ring frames and its sister, the Danforth cap frame. One attempt, albeit an unsuccessful one, to circumvent the traditional flyer's problems was the August 28, 1824,
trumpet flyer of Oliver G. and Nathan Rogers of Whitestown, near Utica, New York. The March 13, 1822, patent of John Sharp of same town may have been the result of a similar attempt, but no descriptions remain. One wishes fruitlessly for a detailed description of the bobbin tube for spinning for which a patent was issued December 13, 1824, to Job Manchester of Warwick, Rhode Island. In 1827, Niles' Register claimed that the Manchester frame permitted a 25 percent increase in spindle speed. Whatever the relative merits of the Manchester frame, the small mills finally found a successful solution to the flyer problem in the ring frame and the cap frame, which initially increased speed and productivity 25 to 50 percent over the unsteady flyer throstles. The ring frame also cut doffing time 80 percent because no flyer had to be removed to gain access to the bobbin. 44

It is significant that these efforts to raise spinning speeds took place in the southern New England

and Middle Atlantic region in the twenties and early thirties. This quest for faster spinning was a response to the competitive pressures the smaller, less efficient mills of this region faced, both from the larger, more economical mills north of the Boston-Springfield line and from the lower-labor-cost British mills. Emphasizing this search for speed, John Thorp stated that the object of his various flyerless spinning devices was to:

obtain greater speed than the arms of the flyer, and common operations of the bobbins will allow of, and to increase the length of the bobbins, so that a greater quantity of yarn can be spun before they require shifting, and to produce a more constant, even, and tensive draft on the yarn, than is produced in the common mode of spinning, and to render the trembling of the spindle, occasioned by wear, less injurious.45

In a revealing contrast, Britisher James Montgomery first praised the ring frame because "it requires much less power" before he mentioned the advantages of higher speed and better quality yarn than were possible on the conventional flyer frame.46 Montgomery listed the

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45 U. S. Patent, Nov. 20, 1828, John Thorp, reprinted in *Journal of the Franklin Institute* 8 (1829): 63-64. With minor modifications, the same objects were stated in a letter to the U. S. Secretary of State, Mar. 21, 1828, also reprinted in the *Journal* 9 (1830): 41-42. See McLane Report, 1: 961-962, for more on the problems of the fine-goods and calico industries.

46 Montgomery, *Practical Detail*, p. 70.
qualities in the order of importance he, a Britisher, attached to them. As he observed, American spindles were driven faster than British because of cheaper power and dearer labor in the United States. \(^{47}\) Expensive fuel and cotton led the British to prefer fuel-saving and cotton-saving machinery designs. Accordingly, the power-saving lightweight Gore spindle and the less breakage-prone Danforth cap frame gained some popularity in England in the 1830's, but British acceptance of the ring frame came much more slowly. \(^{48}\)

Besides being the result of the smaller mills' quest for a high speed, low power, fine goods spindle, the development of the ring and cap frames was also part of an inventive spurt in the late 1820's. Cotton and wool patents, I find, followed the business cycle by a one-year lag. Prior to 1810 few textile manufacturing patents had been issued, but as a result of the wartime mill boom, patents for cotton and wool manufacture rose to an average of 27 per year during the five year period.

\(^{47}\)Ibid., p. 71.

1811-1815. In the next two quinquennial periods, reflecting the postwar textile depression, average annual patents declined to 16 and 18 respectively. Late in the 1820-1825 period, patents began a sharp rise that continued through the 1826-1830 quinquennium, in which patents averaged 31 annually. During this period ring and cap spinning frames first appeared. Slowly falling prices and profits did not create a depression among the small mills of New England until the early 1830's, but increased competitive pressures and costs seem to have spurred the search for higher-speed spinning devices.  

The Danforth Frame: Cousin to the Ring Frame

The discovery of the principle upon which the ring frame operates is one of many examples of simultaneous, independent invention. John Thorp and Charles Danforth, both recognized that the end of the flyer through which the thread ran traced a circle around the spindle. Faster spinning would be possible if this circle became a rigid track. All that was needed was some means of guiding the thread onto the bobbin and of providing friction that would induce twist by making

\(^{49}\)Calculated from Ellsworth, Digest of Patents.
the thread tend to lag behind the spindle. John Thorp first announced inventions based on this principle in a March 21, 1828, letter to the Secretary of State, who supervised the Patent Office, however Thorp was a bit slower in filing his formal patent applications than was Danforth. The Patent Office of the time was none too careful about duplicating claims, so on September 2, 1828, Charles Danforth received the first patent based on the concept. Then, between November 20, 1828, and November 11, 1830, John Thorp received patents for eight different designs adhering to this principle, one of which was identical to Danforth's cap frame.

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50 Reprinted in *Journal of the Franklin Institute* 9 (1830): 41-42.

51 U. S. Patent, Sept. 2, 1828, Charles Danforth, reprinted in *Journal of the Franklin Institute* 10 (1830): 1-2; British Patent A.D. 1829 No. 5822. Given the destruction of the U. S. Patent Office, our sources for pre-1836 patents must be the *Journal*’s descriptions, the 1836 reconstructed patents (when reconstructed, and if not too modified), and the British patents (often under another name—John Hutchinson in the case of the Danforth frame).

Charles Danforth, inventor of the Danforth cap frame, was the brother of George, creator of the Taunton speeder. Charles was born in eastern Norton, just north of Taunton, on August 30, 1797. In 1811 at age fourteen he went to work as a spinner's assistant in the new cotton mill next to his father's fulling mill. Ten years later after military service, school teaching, and mill labor, he moved to the progressive Matteawan Company at Fishkill Landing, New York. In 1825, after four years as a foreman in Matteawan, Danforth went to a mill at Sloatsburg in Ramapo, New York, just north of New Jersey. Here he developed his cap frame in 1828. That year Danforth returned to Taunton and Norton to spend some time with his brother George and possibly to interest the Taunton Manufacturing Company in building his cap frames. After receiving his patent while at Norton, Charles made arrangements with Godwin, Clark and Company of Paterson, New Jersey to manufacture the cap frame. Shortly after, in early 1830 Danforth went to England for two years where he demonstrated his business skills in his promotion of his cap frame. Danforth's journeys provide another illustration of the role played by itinerant mechanics in transfer of new technology.
Danforth finally settled down on his return to Paterson in late 1831, becoming a partner in Godwin, Clark and Company. In the 1840's he took over ownership of the shop and mill and built the firm into an important competitor of William Mason and Company. In the late 1830's Danforth frames operated in a few Paterson and Rhode Island mills and many English mills, and by the start of 1854 Danforth had installed 200,000 cap frame spindles in the United States.  

Simplicity and speed were the virtues of the Danforth cap frame. In his initial model, Danforth cut the loops off the legs of a conventional flyer, then attached a horizontal ring to the legs. In later versions, he supported from the spindle top a metal cap resembling an inverted drinking glass. In either version, the bobbin was driven by a whorl that spun loosely about a dead spindle. The thread coming from rollers above the cup was fed outside the cap, thence against the underside of the cap or ring before being wound on

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the spindle. The drag necessary for twisting the thread was produced by air resistance on the balloon of thread from the rollers to the cap, and by the friction of the thread and the bottom edge of the cap. To develop sufficient air resistance for twisting, the Danforth frame had to be run at high speeds, typically 6000 to 7000 rpm. Guidance of the thread onto the bobbin was obtained by vertical movement of the bobbin bolster (support) rail.\(^{54}\)

Danforth frames saved labor cost by running much faster than the commonly used throstle frames. In the mid 1830's White found that Danforth frames ran 40 percent faster than throstle frames in America, while Ure reported that they ran 33 percent faster in England. Ure also cited some special cases where Danforths ran as much as 107 percent faster.\(^{55}\) Because the thread did not have to drag a flyer around, less breakage occurred.

\(^{54}\)U. S. Patents, Sept. 2, 1828, Apr. 1, 1830, Charles Danforth, reconstructed drawings; Journal of the Franklin Institute 10 (1830): 1-2; British Patent A.D. 1829 No. 5822; Montgomery, Practical Detail, p. 70; White, Memoir, pp. 330-331; Ure, Cotton Manufacture, 2: 135-142; Leigh, Cotton Spinning, 2: 208-210. It is interesting that the Journal of the Franklin Institute honored Danforth's request that they not publish his patent until he could secure European patents, lest some overseas reader might beat him to a patent.

\(^{55}\)White, Memoir, p. 330; Ure, Cotton Manufacture, 2: 141-142.
despite the Danforth's greater speed. Cap-spun yarn was softer and less wiry than throstle yarn making it desirable as a filling thread. Being softly spun, a given weight of cotton spun on a cap frame could fill more warp, a feature appreciated by the cotton-thrifty British. However, several drawbacks eventually limited the Danforth's use to a few products, notably inexpensive British calicos and woolen worsteds. The lightness of twist imparted to cap-spun yarn proved the Danforth's most serious failing. Because of its light texture, cap yarn could not be used interchangeably with throstle or ring yarn. Therefore, cap yarn commanded a much lower price, a significant barrier to wider acceptance in England where spinning mills which sold only thread were still common. Moreover, most weavers found cap yarn too weak for warp. Since small bobbins were used with early cap frames, the subsequent rewinding of the weak yarn into larger cops led to considerable breakage and waste. Acceptance of the Danforth frame was also inhibited by its temperamentality, since to twist evenly and to wind without snarls, it had to be run at uniformly high speed. Because the cap had to be

56 Niles' Weekly Register 39 (1830): 139.
removed, doffing bobbins and piecing broken thread took 50 percent longer on than throstle frames, negating much of the labor savings of the high speed operation. Although the Danforth used less power than American throstle frames, higher operating speeds caused it to use more power than the better-made British throstle frames, a serious deficiency in fuel-conscious Britain, and led to much wear of the machinery. Producing a tougher yarn, the ring frame proved a stronger challenger to the throstle frame than the Danforth.

John Thorp and the Ring Frame

John Thorp of Providence and Taunton, whose life has been treated in Chapter II, investigated flyerless spinning devices in a far more thorough manner than Danforth. Considering that Thorp's ring frame remains the standard spinning device today, it is ironic that his inventive effort was half-forgotten until Charles H. Clark's 1928 rediscovery of Thorp (see Chapter II). A few earlier textile historians, starting with J. G. Dudley in 1854, had attributed to


58 Clark, "John Thorp," pp. 72-95.

Thorp the invention of the ring frame, but many other writers credited one of the Jenks of Pawtucket's Fales and Jenks, a Jencks of Pawtucket, a Jenks of Philadelphia, or a Sharp.

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60 Samuel Webber told Zachariah Allen on May 12, 1876, "I have always heard that Mr. Jenks had something to do with it," Heirs Misc., Allen Collection, Rhode Island Historical Society, Providence.

61 Leigh, Cotton Spinning, 2: 224.

62 Melvin Thomas Copeland, The Cotton Manufacturing Industry of the United States, Harvard Economic Studies, vol. 8 (1912; reprinted, New York: Augustus M. Kelley, 1966), p. 9. Neither the U. S. Secretary of State's annual lists of patents issued nor the 1830 Ellsworth list of patents show spinning patents by a Jenks or Jencks. The Jenks family was prominent in the early textile machinery firms of Fales and Jenks in Providence and Bridesburg Manufacturing Company in Philadelphia. One W. Jenks of Manchester, N. H., received a patent on a spinning ring on August 25, 1863, later assigned to G. Draper and Sons, reissued December 23, 1873. B. H. Jenks of Bridesburg received many ring spinning patents in the late sixties and early seventies. Any of these might explain the use of the name Jenks. More likely the crediting of the ring frame to Jenks came from James Leander Bishop's ambiguous remark in his historical sketch of Fales and Jenks: "The first Ring Spinning Frames were made by them in 1845..." (American Manufactures, 3: 400). I assume Bishop intended to say that the first Fales and Jenks ring frame was built in 1845. It is certain that other shops were building ring frames prior to 1845.

63 Batchelder, Introduction, p. 86, probably a typesetter's misreading of S for T and a for o, an error perpetuated unknowingly by many later writers. However, a John Sharp of Whitestown, N. Y., patented a device for spinning wool and yarn, March 13, 1822. I know of no surviving description, but doubt that this was the man or device Batchelder had in mind.
The magnitude of John Thorp's inventive effort during the late 1820's becomes manifest when one realizes that he secured eight of the fifty-six patents issued for cotton and woolen manufacture in 1828-1829, not counting one reissue of an earlier Thorp patent. Six of these eight were for spinning devices. What led Thorp to search for a flyer substitute is unknown, but the answer probably lies somewhere in his association in the 1820's with Thomas and William Fletcher, Providence braid manufacturers. Attesting to this association were Thorp's only patents between 1820 and 1827, both were braiding machines. Since the Fletchers were partners in Thorp's first effort to market his spinning frame improvement, quite likely it was they who encouraged Thorp to undertake his program to develop a flyerless spinning frame.

64 Calculated from Ellsworth, Digest of Patents; and U. S., Secretary of State, Annual Report on Patents Issued, 1828 and 1829.


66 U. S., Secretary of State, Annual Report on Patents Issued, 1821 and 1826. These patents were dated Aug. 10, 1821, and July 10, 1826.

Particularly noteworthy is Thorp's attempt to patent all possible ways which he could conceive of replacing the flyer. If it were not for his failure to protect his patents in the 1830's and 1840's, it would appear that he was attempting to prevent competition by controlling the alternative ways of accomplishing the same end, much as the Drapers did with automatic looms sixty years later. Thorp's first action to protect his inventions was to send to the Secretary of State on March 21, 1828, a letter claiming invention of the ring groove spinner and the cap spinner. Late in the year, just after Danforth secured letters patent, Thorp entered his formal patent applications.

Thorp's first spinning patent was granted on November 20, 1828, for two different designs. The first and historically most significant was the rotary ring and revolving hook frame. In place of the flyers of a conventional throstle frame, there were two concentric rings which described the path the flyer legs followed around the bobbin. The inner ring was firmly attached to a rail and was flanged to retain the loose outer ring. Thorp fed the thread between the two

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68 *Journal of the Franklin Institute* 9 (1830): 41-42.
rings and thence to the live-spindle bobbin. The friction of the thread against the two rings imparted a twist to the thread. If a greater twist was desired, a notch could be cut in the outer ring so that the thread lodging in the notch would drag the ring around the inner, stationary ring, thereby increasing friction. In a variation, Thorp attached to the outer ring a hook, which served the same function as the notch. Alternatively, the revolving hook could be made of a loop of wire, the ends of which were bent so as to join each other, simultaneously forming the hook. Although Thorp went on to patent several other flyerless spindles, clearly the ring and hook frame was the one he attempted to sell to the mills.

At no time in the late twenties did Thorp indicate that he had conceived the modern ring frame by replacing the complex rotating ring and hook with a traveler—a loose-fitting clip retained by the flanges of the upper edges of the stationary ring. In the drawing he submitted in 1837 for the reconstruction of his patent

following the patent office fire, he did not take advantage of the situation to slip in modifications, as did other inventors such as Woodworth. This suggests that Thorp had not yet perceived that the ring frame could be simplified to a ring and traveler. By the 1840's the ring traveler had become well known in New England, so when Thorp recorded his patent anew on January 28, 1843, he added an optional wire piece (marked G on the patent drawings) which somewhat resembled a simple traveler. He also moved the ring and hook inside the stationary ring, something he had been doing in manufacturing practice since at least 1830. Finally, on September 27 of the following year, Thorp received U. S. patent 3766 for a spinning ring and traveler resembling those already in common use, except that the traveler clipped around the inside of the ring rather than the top. Unfortunately, these last two patents have mislead some unwary historians to the conclusion

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Ibid.; U. S. Patent, Nov. 20, 1828, recorded anew Jan. 28, 1843; U. S. Patent 3766, Sept. 27, 1844; Silsbee, "Cotton Manufacture," p. 97. For those unable to distinguish between the reconstruction and renewal drawings, the renewal drawing is the one witnessed by Angall and Humphreys. The Journal's plate and the British patent drawing are the most nearly original left, given the destruction of the original drawings in the patent office fire.
that Thorp also invented the simplified ring and traveler in 1844.\textsuperscript{71}

Thorp's November 20, 1828, patent claimed other variations on the rotary ring and revolving hook frame. In all of his spinning frames described so far, the thread was distributed over the bobbin by the up-and-down movement of the ring rail. He alternatively suggested distributing the yarn by attaching the ring to the spindle or to a stationary rail and making the bobbin rise and fall. More complex was the dead-spindle, powered-ring frame described in the same patent. Mounted on a rail were double-flanged, vertical-axis friction pulleys, one more in number than rings. There was only one ring per spindle, and it was supported only by the pressure of its drive belt pulling it tightly against two of the friction pulleys. The flanges of the friction pulleys fit into grooves in the ring, preventing its vertical dislocation, and likewise kept the drive band in place. Each spindle shared its friction pulleys with the adjacent spindles. A notch or hook at the upper edge of the ring received the yarn

and dragged the bobbin around, much as did the dead-spindle flyer. One wonders if a prototype of this complicated dead-spindle ring frame was ever placed in practical operation.

Five days later, November 25, 1828, Thorp received a patent for his can spinner, which was essentially identical to the Danforth cap frame. As in the Danforth device, a powered bobbin dragged the thread against the polished bottom of a cap suspended from the top of a dead spindle. The up-and-down motion of the bobbin rail distributed the yarn. Annoyed at the laxity of the Patent Office procedures, the editor of The Journal of the Franklin Institute remarked that,

The patent obtained by Mr. Danforth, in September, 1828, was for an improvement bearing a strong resemblance to that . . . by Mr. Thorp . . . . The question of who was the first inventor is one which we are not prepared to discuss, as it belongs to another tribunal.

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72 Journal of the Franklin Institute 8 (1829): 63, plate I, fig. 2; Reconstructed U. S. Patent, Nov. 20, 1828; British Patent A.D. 1829, No. 5787.


Although Danforth's patent preceded Thorp's by almost two months, Thorp's letter of March 21, 1828, to the Secretary of State claiming the invention of the cap spinner would seem to accord his frame priority. However, the British patent office granted the cap frame patent to Danforth's agent Hutchison rather than to Thorp's agent Lee. The possibility remains that Thorp may not have attempted to secure a British patent for the cap frame, so Danforth's British patent may not strengthen his claim.

A month later Thorp received a patent for the ring groove spinner, essentially a modification of the first ring frame patent, except that the loose ring fit inside the stationary flanged ring. The thread was dragged between the two rings by the powered bobbin and spindle with the resulting friction giving the yarn its twist. An ingenious spring under the bobbin made piecing broken threads easier because the bobbin could be depressed out of the way of the rings. Thorp envisioned his invention as both a warp and filling frame because

75Ibid., 9 (1830): 41-42.
76British Patent A.D. 1829, No. 5822.
it was designed to accept either warp or shuttle bobbins. His efforts to make conical cops suitable for shuttles led him to design a can frame cam building motion in which a wheel with many cams, each smaller than its predecessor, govern the rise and fall of the bobbin during winding. As the bobbin became fuller, it was not depressed as far so that it would wind the yarn less high on the bobbin.

Thorp's cap frame, patented January 13, 1829, was a cross between the ring groove spinner and the can (cap) frame. A cap similar to the cap of the can frame was inside a stationary ring of the type used in the ring and groove spinner. The thread, pulled by the live spindle and bobbin, rubbed against the cap and ring, producing the twist. A notched, circular plate attached to the top of the spindle kept the yarn far enough from the bobbin and assisted twisting by increasing friction.

More modifications of the can frame were patented by Thorp in 1829. The first of these was his separator,

79 Journal of the Franklin Institute 8 (1829): 68-69, plate I, fig. 5.
a sheet metal piece which encircled the cap of the can frame, thereby preventing the thread from becoming entangled with the thread of the adjacent spindle. This saved space—an important consideration with many mill owners—by permitting closer spindle placement. One limitation of the can frame was the weak twist it gave the yarn, so Thorp lined his separator with cloth against which the thread would rub, increasing the drag and twist.  

His second effort to improve the can frame was the running cap spinner patented June 13, 1829. Both the cap and bobbin were attached to the spindle so that they revolved with it. To obtain the drag for twisting, the roving passed between the cap and a cloth-covered ring held against the cap by a spring. The most unusual feature of the machine was the way in which the cop was formed and the yarn was compressed tightly: a movable flange at the base of the bobbin was forced downward by the yarn as it was wound on the bobbin.  

Thorp's final invention of this fecund period was the bobbin flyer and spindle patented November 11, 1830. In this device a ring was attached to the legs of a powered flyer, as in Danforth's original conception of the cap frame. Inside this rotating flyer and ring was a stationary ring segment with notches or hooks, intended to increase the light twist caps imparted. The greater twist came from the rubbing of the thread as it was dragged by the powered bobbin around the underside of the rotating ring and then against the hook on the stationary ring.\textsuperscript{82}

Thorp set out to commercially exploit his inventions in 1829 and 1830. In need of capital, he took on as partners his old employers, braid manufacturers Thomas and William Fletcher and Jeremiah Whipple. An advertisement dated March 9, 1829, in the \textit{Manufacturer's and Farmer's Journal} announced that "Orders (post paid) for these improvements . . . or for the right to use them in any section of the country, will be punctually attended . . . ." Clearly this willingness to license these innovations demonstrated that Thorp and his partners

\textsuperscript{82}Reconstructed U. S. Patent, Nov. 11, 1830; Thorp Advertisement in \textit{Manufacturer's and Farmer's Journal}, Oct. 6, 1830, Clark, "John Thorp," p. 86.
had limited manufacturing facilities and therefore intended to exploit the ring frame mainly by licensing rights, a procedure requiring little capital. For those customers desiring to observe the operation, the advertisement noted, the ring frame, cap frame (Thorp now used Danforth's term cap in preference to can), and cam cop builder motion were on display near Mill Bridge. Since the Fletcher braid mill was near Mill Bridge on Ormsbee Avenue in North Providence, that was probably where Thorp's machines were running. Aging memories of contemporaries later recalled that Thorp's prototypes ran in a horse-powered mill in Providence or in a mill on Dean Street.

At the same time as this advertisement, a Mr. Brown of Providence (he could have been any one of several local Browns prominent in the textile industry) appeared in New York City claiming to have the Western and Southern rights to the ring and hook spinner (the first design

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83 Clark, "John Thorp," p. 85. According to the McLane Report, 1: 974, Whipple and the Fletchers were partners in a 1828 mill of 700 spindles.

84 Hayes, American Textile Machinery, p. 39.

Thorpe patented). An observer claimed that the demonstrator that Brown brought with him ran at 12,000 rpm without breaking the yarn. The following year Thorp exhibited a hand-driven, six-spindle ring and hook frame the same as the original patent, except that the rotary ring and hook were inside the stationary flanged ring, as in the 1843 patent renewal. Afterwards Thorp built full-sized ring and hook frames, but they were not very successful commercially.

Ironically, Thorp never seems to have made much profit from his inventions, for his estate was modest. This was in part because his lack of capital limited his ability to exploit his innovations by manufacturing them and in part the result of his failure to protect his rights in court. Another cause was his failure to simplify the ring frame to a stationary ring and traveller, a final step left to Addison and Stevens and to William Mason.

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86 Niles’ Weekly Register 35 (1829): 116-117. The communication nowhere mentions Thorp, but uses Thorp's language to describe a ring and hook flyer. Indeed, one is left with the suspicion that the writer might be one of Thorp’s partners.


The Evolution of the Ring Frame

Although sound in principle, Thorp frames had deficiencies. The first four years of experimentation with ring spinning saw modifications develop unsuccessfully from simple to increasingly complex designs.

Oddly, the first modification of the ring frame by other inventors was the penultimate simplification, the ring and traveler of George Addison and Samuel H. Stevens of New York City, patented October 10, 1829. Addison and Stevens used stationary rings similar to those in Thorp's ring and hook frames, and made these rings

very true, and smooth, and in such a form that a light piece of metal may clip round their edges, by means of small projection or wires, attached to them for that purpose, this latter piece is called a traveller; it passes freely round the ring, being carried by the thread as it is spun; there is an opening, or eye, in the traveller, through which the thread passes.

Their "traveler"--a term they originated--was more complicated than the simple wire or plastic clip used today, but the concept was essentially the same. Unlike Thorp and Danforth, Addison and Stevens considered the major advantages of their frame to be savings in the weight and size of the frames, hence in the building space required to hold them.\(^{89}\) The same month they

\(^{89}\) *Journal of the Franklin Institute* 9 (1830): 27-28.
received their patent, Addison and Stevens won a prize for their ring frame at New York's American Institute trade fair. 90

What effect the Addison and Stevens ring and traveler had is difficult to assess. Almost no further mention of it is made after 1829, leading one to wonder if the New England textile industry was influenced by it or was even familiar with it. No contemporaries seem to have credited Addison and Stevens with the idea of the ring and traveler, and the modern ring frame would appear from known testimony to have derived from Connecticut inventors' efforts to make the Thorp ring and hook frame work. Yet, two bits of evidence argue the contrary. First, New York's annual American Institute fair, being the premier American industrial exposition of the period, was well attended by industrialists and even machinists from New England, several of whom must have observed Addison and Steven's device and could have taken the concept or even a prototype back to New England. Second, there is philological evidence that the later ring frame was influenced by Addison and Stevens: their name traveler survived as the

90 Niles' Weekly Review 37 (1829): 142.
standard term. Excepting for the writings Samuel Webber in 1879,\textsuperscript{91} someone at Draper in the late 1880's,\textsuperscript{92} and Harold Catling in 1970,\textsuperscript{93} Addison and Steven's invention of the ring traveler has been forgotten.

November 1829 brought two more ring spinning patents, both more complex than Thorp's or Addison and Steven's. Samuel Elydenburg of New York patented a spinning ring which ran loosely in three or four grooved friction pulleys, not unlike Thorp's friction pulley design.\textsuperscript{94} A few days later Henry Ruggles, also of New York, patented a wheel which rode on a track encircling the spindle. The yarn was fed through a hook at the axis of this wheel.\textsuperscript{95} Since the Addison and Stevens, Elydenburg, and Ruggles devices were patented by New Yorkers in the autumn following Brown's New York demonstration of Thorp's ring and hook spinner, the

\textsuperscript{91}Webber, Manual, 2nd pagination, p. 47.

\textsuperscript{92}Fibre and Fabric 7 (1888): 99. Possibly this was William F. Draper.

\textsuperscript{93}Catling, Mule, p. 184. English, Textile Industry, p. 166, credits them with the word traveler, but not the invention.

\textsuperscript{94}Journal of the Franklin Institute 9 (1830): 130.

\textsuperscript{95}Ibid., p. 137.
surmise is inescapable that these inventions were inspired by that demonstration. Manhattan has never been noted as a center for cotton spinning machinery innovation.

In the early 1830's the locus of flyerless spinning experiments shifted to Killingly in Windham County, Connecticut, where limited water power and deteriorating profit margins encouraged a search for fast, power-saving machinery for fine-goods manufacture. On January 17, 1834, an inverted-cap frame was patented by Samuel F. Mason. Samuel, no known relationship to William, held patents for many other textile innovations, including highly respected whippers and loom temples. Samuel's up-side-down cap was powered and had a notch or pin on the top which pulled the thread around the spindle, while the spindle and attached bobbin rose and fell inside the cap to distribute the yarn over the length of the bobbin. Unfortunately for Samuel, his design was doomed because at this very time in another part of Killingly Asahel W. Lanpher and William Mason were about to render the ring frame practical.

96 Ibid., 18 (1834): 114-115. For more on Samuel P. Mason, see Ibid., 10 (1830): 231; 11 (1831): 256; 19 (1835): 95; 25 (1838): 272; Montgomery, Practical Detail, pp. 26-28, plate II.
Asahel K. Lanpher has left no known descriptions of his ring frame modifications, but his March 19, 1834, speeder patent gives a hint of what his reforms consisted. That speeder was an improbable hybrid of George Danforth's Taunton speeder, of Thorp's friction-wheel ring speeder, and of Addison and Steven's ring traveler. In order to hold the roving together between the rollers and the traveler, Lanpher employed one of George Danforth's counter-twisting tubes to impart a transitory twist. The spinning ring was held in place by three friction wheels, much in the manner of Thorp's and Elydenburg's friction wheel frames. A ring traveler running on that ring imparted a slight twist into the roving, thereby rectifying the weakness of the Taunton speeder product: the lack of twist which caused excessive breakage in later handling. A differential motion compensated for the changing peripheral speeds of the bobbin as it filled. Of particular interest was Lanpher's description of the ring and traveler: "I make the rings, usually, of wrought iron, and case harden them, or of steel." Lanpher went on to describe a ring which was double flanged at the top to retain the traveler.
The traveler may be made of iron or steel wire, and should be hardened. The wire may be cut into lengths of about three-fourths of an inch, and so bent that the ends shall be about three-sixteenths of an inch apart.  

The ring and traveler Lanpher was describing was essentially identical to the modern ring and traveler, even if it was mounted on an unusual speeder. Who had so simplified the traveler from its more complex Addison and Stevens design? Mason or Lanpher? William Mason, not noted for his modesty, always claimed that it was he, and nobody disputed him. Because Lanpher patented no other inventions, but Mason many, and because Lanpher's lone patent displayed a propensity to greater complexity, whereas Mason's later designs were characterized by simplicity, I believe Mason rather than Lanpher probably reduced the traveler to its uncomplicated essence. There remains an unresolved question as to whether Mason (or Lanpher) started with the Addison and Stevens ring and traveler or with the Thorp frames, for Lanpher in his patent describes his design as an improvement on the Thorp frames, making no mention of Addison and Stevens even though he uses their term, "traveller." 

Lanpher was manufacturing rings, travelers, and spinning frames in Killingly as early as 1833. It is uncertain, however, whether he used a simple ring and traveler of the modern pattern, or made the spinning frame more complicated by adding friction wheels, as he did to the speeder. 98 William Mason gives a clue when he says that Lanpher was "engaged on what was called the 'ring-traveler' . . . ." A further hint lies in Mason's observation that the trouble with Lanpher's machine was that its travelers were made by hand, leading, he implies, to irregular performance. Mason reformed the ring frame by devising a machine to make the traveler and by refining various elements of the frame's design. These recollections suggest that Lanpher's ring spinning frame had no friction wheels since Mason hardly would have remarked on the irregularity of the travelers while not commenting on greater deficiencies of the friction wheels. 99

98 Killingly Deedbooks 28: 161-162; 29: 30-33, in which an Apr. 19, 1834, inventory and a July 9, 1834, mortgage show spinning frame orders and ring and traveler inventories; and William Mason's letter to Webber, Manual, 2d pagination, p. 47.

99 Mason to Livingston, Portraits, p. 16. The quote is from Livingston, but clearly he was paraphrasing Mason.
Mason later claimed that he made the first of his simplified ring and traveler frames in 1833, adding, with his fine sense of irony, that one of that year's ring frames had gone to his future competitor, P. Whitin and Sons.\textsuperscript{100} After Lanpher failed the following year, Mason operated the shop for a year and a half for the creditors. He continued improving and marketing the ring frames, offering to remove without charge any which failed to satisfy the customer.\textsuperscript{101} Whatever Mason had done to refine the ring frame, his most important role in its development was what he did at this time to make it a commercial success. When Mason was hired by Crocker and Richmond in early 1836, it was to bring his ring frame to Taunton where for the first time it could be produced on a large scale in a major textile machinery shop.

Several characteristics of the inventive process are illustrated by the ring frame's development. First, the invention of the ring frame is a classic example of the

\textsuperscript{100} William Mason to M. N. Forney, \textit{Railroad Gazette} 15 (1883): 341.
gradual evolution of a design through the successive modifications of several inventors. Invention is most often a cumulative process rather than a discrete event, therefore Thorp, Addison and Stevens, Mason and possibly Lanpher all may be rightfully considered the inventors of the ring frame. Mason's role in refining, popularizing, and commercializing the ring frame is no less important than Thorp's function as the original inventor. Second, the contemporaneous invention of the Danforth cap and Thorp can was an example of the commonplace phenomenon of simultaneous invention. Third, the spate of inventions after Thorp's and Danforth's patents has been repeated often with other inventions as mechanics have attempted to get onto the band wagon by developing a slight variation on a theme to enable them to avoid interference with the original inventor's patent. This process of patent circumvention is often the vehicle for improvement of the original design, as it was with the example of Addison and Stevens' and Mason's designs.

Acceptance of the Ring Frame

The suggestion has been made by Thomas R. Navin and echoed by Paul Strassmann that the ring frame's acceptance was slowed when William Mason, after selling
some in 1835, "neglected his lead in the ring frame field and devoted his attention to the self-acting mule . . . ." This badly overstates the case. Mason did spend much of his time between 1837 and 1843 developing his self-actor mules, but he did not neglect the ring frame. As he told Samuel Webber:

I built quite a number of ring frames in Killingly, but moved to Taunton with all my patterns in the spring of 1836. All the successful ring-frames that were built were made by me up to about 1840, when P. Whitin & Sons commenced to build them.

Furthermore, Mason's job expense book reveals that he supervised the construction of ring frames in 1839, 1840, and 1842 while agent of the shop of Leach and Keith. William Mason and Company built ring frames from its inception in late 1842. Although in its first twenty years, 1842-1861, Mason and Company shipped mules totaling 550,760 spindles, it also sent out ring frames totaling 199,812 spindles. In four of these years, ring frame shipments exceeded mule shipments (measured in spindles), and only ring frames were sold to Ohio Valley,


103 Quoted in Webber, Manual, 2d pagination, p. 47.

104 William Mason, Job Expense Book, Box 62, Old Colony Historical Society, Taunton.
Southern, and foreign mills. In reality, the greater sales of mules reflected customer preference and the popularity of the Mason mule rather than a lack of effort by Mason to sell his ring frame. Mason's neglect of the development of the ring frame came not in the forties, but in the late sixties and early seventies when he frittered away much of his firm's developmental energies on his vanity, the Fairlie locomotive, permitting Whitin and Draper to gain the lead in ring frame production and patents.

Modern writers often have underestimated the speed of acceptance of the ring frame. This is largely because they are most familiar with the large northern New England mills and machine shops where the throstle frame survived longest due to adequate power and, probably, conservatism. By the late 1830's the ring frame was in operation in various Connecticut,


106 The Whitin orderbooks in Baker Library show that prior to the Civil War Whitin concentrated on a picker-to-drawing-frame line, making ring frames on a much smaller scale.

107 See for example Gibb, Saco-Lowell, pp. 192, 757.
Rhode Island, and southern Massachusetts mills. Many shops began producing ring frames in the 1840's, thus testifying to its rising popularity in warp spinning (at this time the self-actor mule came to dominate filling spinning in the southern New England mills). In 1845 Fales and Jenks of Providence began ring frame manufacture, and the Springfield Canal Company of Chicopee, Massachusetts, contracted to build a large number of ring frames for the Conestoga Steam Mills of Lancaster, Pennsylvania. Franklin Foundry and Machine of Providence was producing ring frames by 1848, and Whitin to the north in Whitinsville, Massachusetts, made them by 1849. Even Lowell Machine Shop issued a lithograph of a ring frame in the late 1840's, suggesting that it too had entered the market. One industry observer declared in 1854 that

108 Montgomery, Practical Detail, p. 70.

109 Bishop, American Manufactures, 3: 400; Contract, Box M0-0, Dwight Manufacturing Company Collection, Baker Library, Harvard.


the ring frame had "now gone into extensive use," and
another asserted that by 1860 there were more ring flyers
than throstle spindles operating in the United States.\textsuperscript{112}

The demise of the flyer throstle was a bit slower. Lowell Machine Shop, responding to the demands of the
large, conservative, northern New England mills, continued
flyer throstle manufacture into the late 1860's, and many
mills kept their flyer throstles until they wore out
twenty or thirty years later.\textsuperscript{113} Even slower was the
British acceptance of the ring frame, the first being
manufactured there in 1867, according to one account.\textsuperscript{114}
In the last two decades of the nineteenth century, the
ring frame, which did not require skilled labor, began
to replace the mule in cotton filling manufacture, and
in 1909 Mason Machine Works built its last cotton mules--
probably the last built in America.\textsuperscript{115} The ring frame

\begin{enumerate}
\item[\textsuperscript{112}]Dudley, "Growth," p. 5; Draper, "Spindles," p. 21.
\item[\textsuperscript{113}]Gibb, Saco-Lowell, p. 757.
\item[\textsuperscript{114}]Fibre and Fabric 7 (1888): 99.
\item[\textsuperscript{115}]"Machinery Records, Masons Machine Works," Old
Colony Historical Society. See also Lars G. Sandberg,
"American Rings and English Mules: The Role of Economic
costs were offset by lower cotton costs when spinning
finer yarns, suggesting that labor problems led to the
earlier replacement of the mule by the ring frame in
the United States; p. 43.
completed its domination in the mid-twentieth century by replacing the cotton mule in Britain and the woolen mule in wool and synthetics spinning.

Advantages and Disadvantages of the Ring Frame

The ring frame enjoyed such success because it was faster, simpler, and cheaper. The significance of these advantages as well as the importance of the ring frame in cotton manufacture becomes clearer when one realizes that in the mid-nineteenth century spinning frames constituted almost half the cost of all mill machinery. Even in the 1940's spinning machinery represented over a fourth of the final capital expense of a mill's machinery. ¹¹⁶

As early as 1840 James Montgomery, a leading British observer of the contemporary American cotton textile industry, recognized the key advantages of the ring frame: "It requires much less power, and may be driven at a much higher speed, and at the same time it makes a better quality of yarn."¹¹⁷ To Montgomery,

¹¹⁶Bishop, American Manufactures, 2: 400; Navin, Whitin, pp. 91-92.

¹¹⁷Montgomery, Practical Detail, p. 70.
the only peer of the ring frame was the Gore throstle, a live-flyer English frame which, with its high, bobbin-enclosed bolster, automatic oiling, low spindle weight and reduced wobble, anticipated the 1870's light-weight ring spindles.118

A 25-percent increase in speed by the ring frame over the flyer throstle was typical in 1840, and by 1885 ring frames were found by one study to be 38 percent faster than throstles. What is more, the ring frame had no flyer or cap to remove when doffing the bobbin, saving as much as 30 minutes of down-time per day.119 Doffing time was also reduced because ring frames permitted the use of longer bobbins than could be used on flyer frames where spreading and wobble restricted the length of flyer legs. The advantages of the ring frame expanded even more in the 1870's and 1880's with the adoption of chambered bobbins, high bolsters, and light-weight, self-centering spindles, which cut spindle wobble and top-heaviness, thereby permitting the use of longer spindles and bobbins.

118 Ibid., pp. 71, 74; British Patent A.D. 1831, No. 6201; Ure, Cotton Manufacture, 2: 142-143; Leigh, Cotton Spinning, 2: 210-211.

119 Montgomery, Practical Detail, p. 77; Fibre and Fabric 1 (1885): 41-42.
Equally important to the mills of southern New England was the ring frame's power savings. In 1852 a ring frame in normal use consumed 8 percent less power per spindle than the most efficient flyer throstle and far less than most others. Samuel Hayes estimated that the ring frame used more than 50 percent less power than the Waltham dead-spindle frame. Lubrication oil consumption was similarly lowered.

Against these advantages were some deficiencies which slowed acceptance of the ring frame, but they were eventually offset by design improvements and by growing pressures to cut labor costs. Flyer yarn was smoother, hardier, and stronger than ring yarn, and mule yarn, more regular because, mule partisans claimed, the ring frame's twist changed as the bobbin filled and its peripheral speed rose. Also the ring frame could not duplicate the soft, fuzzy filling yarn of the mule. Alas, labor costs won over taste, and mules were replaced by ring frames.

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121 *Fibre and Fabric* 1 (1885): 41-42.

WILLIAM MASON AND THE SELF-ACTING MULE

Ultimately Mason's commercialization of the ring frame was his most important textile contribution, but ironically for many years he and Taunton were best known for his self-actor mules.

For over a century two types of spinning coexisted in the cotton industry: continuous and discontinuous. Flyer throstles, ring frames, and cap frames— the descendants of Richard Arkwright's water frame— exemplified continuous spinning, in which drafting, spinning, and winding were carried on simultaneously and were uninterrupted except for repairs and doffing. Mules, jacks, billies, and jennies represented the discontinuous process in which drafting, spinning, and winding were separate, successive steps.

The mule, true to its name, was a hybrid which inherited from the jenny the discontinuous concept and from the Arkwright frame the drafting rollers. In the jenny, only the clove that gripped the roving was mounted on a moving carriage, whereas the spindles and bobbins of roving were set in stationary frames. In the mule it was the spindles which were mounted on the carriage while the bobbins of roving and the rollers (which drafted and gripped the roving) were at the rear of the mule on a
stationary frame, much as in spinning frames. The yarn was fed from the rollers directly to spindles mounted on the carriage. Normally a mule had two of these carriages placed end-to-end with the controlling head between them. With several hundred spindles gauged 1\(\frac{1}{4}\) inches apart, these carriages were impressively long. The longer carriages of Mason's 1088-spindle mules built in the 1850's for Hadley Falls and Atlantic DeLaine were over 60 feet long (One of the two carriages of a mule was normally a couple feet longer than the other so that the controlling head between the two carriages would be offset from the facing mule's head).^{123}

Starting near the drafting rollers at the back of the mule, the carriage moved out about 5 feet on its rails on what was called the stretch (or draw or running-out), stopped for twisting-at-the-head and back-off, then ran-in to the rollers again. The entire process was repeated about four times a minute. In the first step, the stretch, the roving was drafted by three pairs of rollers, each pair of which turned faster than the previous pair, thereby stretching the roving between the pairs. As the front rollers played out the roving,

the carriage retreated 5 feet at a slightly greater rate than the speed at which the rollers delivered the roving, stretching the roving a bit more. At the same time, the spindles turned, twisting the roving lightly. Reaching the end of the track farthest from the rollers, the carriage stopped, but the spindles continued turning for a moment to twist more tightly the yarn, a step called twisting-at-the-head. Since a few turns of yarn had become wound around the bare tops of the spindles, those turns were backed-off by briefly reversing the spindles.

Now came the run-in, the most difficult step, which made invention of a self-acting (automatic) mule so vexing.

Superficially, the task of the run-in seemed simple: to wind the yarn onto the spindle while returning the carriage to the back of the mule so that the next stretch could take place. However, the first perplexity a self-actor designer faced was how to rapidly reverse the spindles from the back-off and to quickly accelerate them to winding speed, all without letting the yarn become too tightly stretched or too loose. At the same time, a faller wire had to depress the yarn to the point at which the yarn was to wind onto the bobbin. What complicated this step to the point of near-impossibility
for the self-actor designer was the need to build a proper cop. A cop was the package of yarn spun on the bare spindle, and since it was to go into a loom shuttle, the cop had to unwind freely from its end. This meant that the cop had to be built with a round bottom and tapered top. The bottom was formed first and had to be firm enough to hold together after the bobbinless cops were doffed. To start the bottom, the spindles maintained a constant speed while the first few winds were put on the new cop. Next, to round the bottom and start a tapered top, the spindles had to start slowly at the beginning of the winding of each new layer, then accelerate to complete that layer. On each successive wind, the number of turns made by the spindles had to decrease to compensate for the increasing cop diameter which took up the thread more rapidly. After the bottom was formed, the succeeding layers were wound on the tapered upper end of the cap at a uniformly accelerating rate of speed since the cop now grew longer at the top, but no larger in diameter. Since each successive wind went a little higher on the spindle, the faller wire had to stop a little higher on each successive wind. To keep the fine-pitched spirals of windings of yarn from becoming entangled, a steeply pitched layer of yarn was
laid between each gradual-pitch layer by dropping the faller wire quickly at the start of the run-in. During the rest of the carriage run-in, the faller rose slowly, guiding in place the gradual-pitch layer. If these were not enough complications, the spindle speeds also had to be compensated for the acceleration and deceleration of the carriage to maintain an even winding tension. Beyond this were many further refinements as self-actors became adapted to increasingly finer goods. 124

Since these operations were so complex, they defied several attempts to fully automate the mule. Stretching, twisting-at-the-head, and backing-off were mechanized fairly early, but until the 1830's mule spinners had to manipulate the complex running-in operations. Because quite a bit of muscle was required, employers would only consider men for the job. Great skill was needed to

124 These actions over the years became even more refined. For more detailed descriptions the reader should see Ure, Cotton Manufacture, 2: 174-193; John Platt, "On Machinery for the Preparing and Spinning of Cotton," Proceedings of the Institution of Master Mechanics (1866), pp. 227-240, plates 77-82; British Patent A.D. 1830, No. 5949; U. S. Patent 2305; English, Textile Industry, pp. 173-178 (the most lucid brief explanation of how a self-actor works); D. A. Tompkins, Cotton Mill Processes and Calculations (Charlotte, N. C., 1899), pp. 165-169 (also brief and simple to understand).
built an acceptable cop, so mule-spinners commanded a high wage and could shut down a mill if they walked out—which managements felt they did all too quickly. The evidence suggests that in Britain the primary motive for developing the self-actor was replacement of this "troublesome class of labour" with a machine simple enough to be run by women and children. Repeal of Combinations Laws in 1824 was quickly followed by a long mule-spinners strike in Staleybridge, which led the mill owners to ask Richard Roberts to develop a self-actor capable of building the cops automatically.  

In New England, the motive for automation of the mule seems to have been to save costs as well as replacing some of the scarce, unmanageable mule spinners. Citing the advantages of Ira Gay's self-actor, the Nashua Manufacturing Company annual report for 1827 observed that "in this country the expense of employing mule spinners and the extreme difficulty of obtaining good + faithful ones have caused the mule to fall into general disuse in the larger Factories."  

126 AB-1, pp. 57-58, Nashua Manufacturing Collection, Baker Library.
mule spinners in 1817 were six times as great as those for other mill operatives, and in the early 1840's they were still two to three times other mill wages. 127 Depending on the type of yarn spun, self-actors cut mule spinning costs 16 to 50 percent by producing 8 to 20 percent more yarn and by allowing one man to run two mules rather than one hand mule. 128 Other advantages of a self-actor over the hand mule were better quality yarn, firmer cops more evenly wound, and more even drafting. 129

After many early experimental self-actors failed because they could not satisfactorily handle the run-in, many mill owners attempted to replace mules with throstle, cap, or ring spinning frames, which could be tended by unskilled women and children. Previously spinning frame yarn had been commonly used for the tough warp threads which had to withstand shuttle passages and harness sheds, but frame-spun yarn had been less popular as filling where a softer yarn made a better texture cloth. Paul Moody's

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127 Gibb, Saco-Lowell, p. 54; Gregg, Essays, p. 61; Montgomery, Practical Detail, pp. 78-81.

128 Montgomery, Practical Detail, pp. 78-81; Hayes, American Textile Machinery, pp. 31-32; Gregg, Essays, p. 61.

129 Montgomery, Practical Detail, p. 78; Ure, Cotton Manufacture, 2: 199.
1819 filling frame and its descendents were widely-used skilled labor saving devices in the large northern New England mills where smooth, wiry filling was acceptable for their coarse product. Cop-building motions on these frames eventually eliminated the need to rewind the bobbins into packages suitable for shuttles. However, in the fine-goods mills of southern New England, frame-spun yarn was considered an unacceptable substitute for soft mule filling. As the directors of Nashua Manufacturing Company (a northern mill with some southern characteristics) put it, "It is universally known that better + softer Cloth is made from yarn spun on mules than can be from the yarn of the Throstle: and in fabricating the finer Cloths the mule is indispensable . . . ." Also, mules were more economical of power and were less expensive to install than spinning frames, important considerations in the small southern New England mills.

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130 AB-1, p. 578, Nashua Collection.

131 See for example Ware, Early Cotton Manufacture, pp. 77, 86; Hayes, American Textile Machinery, pp. 31-32; Montgomery, Practical Detail, pp. 69-70; v. AB-1, p. 47, Nashua Collection.
Early British Self-actors

Only twelve years after Samuel Crompton made public his mule, William Kelly of Lanark, Scotland, received the first patent for a self-actor mule. Kelly's 1792 self-actor illustrates the problems and limited success of early machines of that type: the lowering of the faller was too slow, so a child had to be hired to lower it. However, when longer mules with more spindles were introduced in an effort to cut unit costs, stronger adult male mule spinners had to be reemployed to work the heavier machine. Since the mule spinners were back, Kelly's Lanark Mills let them again control the winding operation, disconnecting the most important portion of Kelly's invention.\(^{132}\)

One suspects from this that the cop-building motion was primitive and did not compensate for the changing shapes and diameters of a proper cop.

Kelly's self-actor may not have been the first such ill-fated effort (William Strutt is alleged to have made a self-actor prior to 1790), and it was certainly not the last. A far more sophisticated and complex

mule was patented June 18, 1818, by William Eaton of Manchester, and several were installed in Manchester, in Derbyshire, and in France. No match for the Roberts or Smith mules, only four remained in operation in 1836. On the same day as Roberts received his first mule patent, March 29, 1825, Maurice De Jongh of Warrington also received a British mule patent, followed by others on December 18, 1826, and on December 4, 1827. After some of the features of Roberts' 1825 patent were added, De Jongh's machines were used in his Warrington mill with some success, but seem to have had no outside market. A similar experience involving infringement of parts of Roberts' mule patents forced the 1831 patent mule of Thomas Knowles of Manchester to be confined to Knowles' own mill. In the 1830's other self-actors were invented to emulate the success of the 1830 Roberts mule, including the Buchanan, Potter, and Smith mules.

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135 Ure, Cotton Manufacture, 2: 196, 198.
Early Self-actors in the United States

Gilbert Brewster, that inventive creator of the Eclipse speeder, often has been credited with building the first American self-actor. Paul Strassmann has asserted that the Brewster mule "in many ways anticipated Roberts' self-acting mule."

This is an uninformed remark since the Brewster was really an upended self-acting wool jenny in which the spindles were mounted horizontally on a stationary frame. The jenny cloves (clasps) rode on a vertically rather than horizontally moving carriage.

Even though in 1824 Brewster claimed over $20,000 worth of orders for his machines at $2700 a pair, "somewhat clumsy construction" limited their success.

The best claimant for the honor of putting America's first self-actor in active use was Ira Gay.

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136 Strassmann, Risk, p. 87.
137 Montgomery, Practical Detail, p. 81.
138 Eagnall, "Sketches," 2: 1515-1516; also Niles' Weekly Review 26 (1824): 363; James S. Brown to Zachariah Allen June 2, 1876, Heirs Misc., Allen Collection. Exactly which, if any, of Brewster's patents covered the self-actor is unclear. His patents for spinning machines were received Jan. 16, 1812; Feb. 27, 1824; Mar. 13, 1824. Brewster's known residences were Barre, Vt., in 1812; Norwich, Ct., in 1824, and Poughkeepsie, N. Y., in 1827, 1829, 1831. In 1834 he was presumably dead since Lewis Brewster, as his administrator, received a patent.
Gay worked as a partner in Pitcher and Gay of Pawtucket until 1824 when he became resident agent of the Nashua Manufacturing Company in New Hampshire. He was also a founder of the outstanding machine shop of Gay, Silver and Company near Lowell, Massachusetts.\footnote{139} As early as 1823 or 1824, Pitcher and Gay installed a Gay self-actor in the mill next to their Pawtucket shop. After Ira Gay went to Nashua, he continued improving his mule by simplifying it—an unusual way to redesign a mule since the successful self-actors, which came later, were refined by adding increasingly complex motions to make even finer cops.\footnote{140} By late 1827, the machine was sufficiently developed for Nashua Manufacturing to command $125 per head plus 25 cents royalty per spindle.\footnote{141} Between early 1827 and mid-1828, Nashua installed twenty-two mules totaling 4864 spindles in its own mills plus


\footnote{140}Thomas J. Hill to Zachariah Allen, Heirs Misc., Allen Collection; 1827 Directors Report, AB-1, p. 57, and Ira Gay to J. Keating, Dec. 17, 1827, Letterbook GB-1, Nashua Collection.

\footnote{141}Ira Gay to Caleb Stark, Dec. 29, 1827, Letterbook GB-1, Nashua Collection. It is my assumption that the 25 cents is a royalty.
nine more heads in other mills in New Hampshire, Rhode Island, and New York. The firm also received inquiries from as far away as Philadelphia. Indeed, Nashua became so busy in 1828 building mules and other textile machinery that it authorized Oliver and Nathan Rogers of Whitestown, New York (the patentees of the 1824 trumpet flyer), to build Gay self-actors. Again in 1830 and 1831 Nashua had to refuse orders, this time because its shop was tied up building the machinery for the Jackson Mill. During the late 1820's, Pitcher and Brown (successors to Pitcher and Gay) were licenced for a twenty-cent per spindle royalty to build and sell the improved model Gay, and at least two Rhode Island mills were so equipped by them. For unknown reasons, a patent application was delayed in the Patent Office until Nashua shareholder Daniel Webster interceded with Secretary

142 Ira Gay to Amos Briggs, Jan. 27, 1828, and to J. Keating, June, 1828, Letterbook GB-1, Nashua Collection.


of State Henry Clay. It was issued April 10, 1829, to Ira and A. Gay.¹⁴⁵

No detailed description of the Gay self-actor survives, but it did have an automatic running-in and winding mechanism, which Ira claimed, "lessens the expense of labor in spinning one third. . . ."¹⁴⁶ He chased that never attained chimera of self-actor designers: a machine so simple that, "the mule spinner is wholly dispensed with--and Girls + Boys can tend the mules as easily as they can the frames."¹⁴⁷ Although Gay boasted that he had accomplished this, Montgomery found in 1840 that only the Nashua Manufacturing Company mules were still running, and that Gay self-actor had a reputation for being a "very imperfect and complex" machine not "equal to the common hand mule." Nobody could keep the tin bobbins straight. Since these bobbins had wood bases and tin rings to keep the yarn from sliding

¹⁴⁵Ira Gay to Daniel Webster, Feb. 9, 1829, and George and Thomas Searle to Henry Clay, Feb. 27, 1829, GC-1, Nashua Collection.

¹⁴⁶Gay to Keating, June 1828, GB-1.

¹⁴⁷Directors Report, 1827, AB-1, pp. 57-58, Nashua Collection.
off, it is safe to surmise that the cops were neither tightly wound nor well formed.\textsuperscript{148} There were other attempted American self-actors prior to Mason's, including Benjamin Lapham's, which was patented September 25, 1840, but none enjoyed even the very limited acceptance of Gay's.\textsuperscript{149} All failed for want of an adequate cop-winding mechanism. It remained for William Mason to turn out the first mechanically and commercially successful American-designed self-actor able to stand with Britain's Roberts and Smith mules.

Richard Robert's Self-actor

In the 1830's two British inventors, James Smith of Deanston, Scotland, and Richard Roberts of Manchester finally produced successful self-actors. Welsh-born Richard Roberts was an alumnus of Maudslay's shop and one of England's leading machine-tool builders.\textsuperscript{150} In reply to repeated mill-owner requests during an 1824

\textsuperscript{148} Montgomery, Practical Detail, pp. 81-82; also William A. Burke to Samuel Webber, in Webber, \textit{Manual}, 2d pagination, p. 52.

\textsuperscript{149} Journal of the Franklin Institute 32 (1841): 345.

\textsuperscript{150} Smiles, \textit{Industrial Biography}, pp. 265-266.
strike, Roberts' partner in Sharp, Roberts and Company, finally persuaded the reluctant Roberts to develop a self-acting mule, for which he received a patent in 1825. Fallers, spindles, and carriages were synchronized by using the rim shaft to lower the fallers and by driving the spindles off the carriage motion. A profiled copping rail, which shifted after each wind, guided the faller which directed the yarn onto the cop. However, this mule did not solve the old problem of loosely wound cops, so Roberts developed the quadrant motion, which he patented in 1830.

The genius of Richard Roberts was displayed by his use of the quadrant and nut to provide the variable speeds required for building the rounded cop bottoms. He drove his spindles by a drum. As the carriage and the drum moved towards the back of the mule, a chain, attached at the front of the mule on one end and wrapped around the retreating drum on the other, was forced to unwind from the drum, thereby turning the drum and spindles at a velocity governed by the speed of the carriage. However, the speed of the drum and spindles had to be

additionally varied to build the round bottom and conical top of the cop. The outer end of the chain was not attached to a fixed point on the frame, but to a nut which moved rapidly towards the rear of the mule as the carriage began its retreat to the rear, then slowed as the carriage continued its run-in, thereby unwinding the chain from the drum slowly at first, then ever more rapidly as the run-in progressed. The movement of this nut holding the chain's outer end was generated by placing the nut at the outer end of a quadrant arm which swung through a 90-degree arc towards the retreating drum. At the start of this swing, the arc was tangent to the direction in which the drum moved, and at the end, perpendicular. This accelerating winding motion was necessary during each run-in because the winding of that layer of yarn progressed from the large diameter of the cop which took up the yarn quickly to the small diameter which took it up slowly.

To produce the rounded cop bottoms, Roberts began the nut not at the swinging end of the quadrant arm, as just described, but next to the axis of the arm. Since the nut, when it was near the axis, barely moved on each downward sweep of the arm, the first layers of yarn were wound tightly on the bare spindle at an even
speed, but as the nut advanced slightly towards the outer end of the arm on each successive cutout of the carriage, the accelerating effect of the nut began, permitting the building of a cop base with a rounded bottom and a conical top. When the cop base was completed, the nut had reached the end of the quadrant arm where it remained during the rest of the building of the cop, as described in the previous paragraph. Hundreds of winds later, as the cop grew near the top of the tapering spindle, a nosing peg came out and struck the chain near the end of each wind, forcing the drum to unwind chain a bit faster. This slowed the spindles a bit, compensating for the reduced diameter at top of the spindle.152

The quadrant nut was a masterful invention which made such firm cops that the Roberts mule quickly became the first commercially successful self-actor. By late 1834 when Roberts patented further improvements, over 300,000 spindles were powered by his self-acting heads.153

Imitation is the highest form of flattery, and Roberts

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153 Ure, Cotton Manufacture, 2: 198.
was so honored when virtually all other self-actors--Mason's excepted--adopted the quadrant motion.

Smith's Scotch Mule

James Smith's Scotch mule was Robert's and Mason's strongest early competitor, and the first truly successful mule adopted in the United States. It was this mule that Mason attempted to best when he brought out his 1840 self-actor. Its inventor, James Smith of Deanston, Scotland, developed his mule in the early 1830's, with an assist from John Robertson of Renfrew, and received a British patent in 1834.154

The best-known characteristic of the Smith mule was its mangle wheel, which controlled the movements of the carriage. A pinion geared to an irregularly cardioid-shaped (a circle folded back into itself) track on the inside of the mangle wheel replaced Roberts' more complicated belt-shipping mechanism. A shaper performed the functions of a copping rail, and the back-off was avoided by using John Robertson's (actually previously used by William Kelley in 1792) stripping motion in which

154 Platt, "On Machinary," p. 239; Ure, Cotton Manufacture, 1: 317-318. Robertson received a British patent Sept. 21, 1833; Smith Feb. 20, 1834.
the yarn deposited on the spindle tips during the wind was removed before winding by raising the under-faller. Smith compensated for the growing peripheral speed of the cop as its circumference increased, and for the changing amounts of wind needed at various stages of cop building, by borrowing the differential motion from the fly frame and by using a pulley restrained in differing degrees by the application of varying amounts of weight to a friction band. It was an ingenious solution, but as soon as Roberts' patents expired, builders replaced the friction wind with a quadrant motion. Another interesting innovation by Smith was the synchronization of two facing mules so that their opposing carriages could alternately run over the same space. With each carriage drawing four times per minute, the spinners, who stood between the mules, had to be extremely lively to keep from being run over. Mercifully this space-saving innovation never became popular.¹⁵⁵

Because of its simplicity, the Smith mule was 12 to 15 percent cheaper to install than the Roberts

mule as well as faster and more productive. As did the Mason and Roberts mechanisms, the Smith made it possible for one spinner to tend two mules rather than one. Fewer moving parts also made the Smith easier to maintain than the Roberts. However, the yarn irregularities caused by stripping and the poorly wound cops rendered the Smith mule unsatisfactory for fine goods, confining its use to coarse goods.\textsuperscript{156} American coarse-goods manufacturers adopted the Smith in the 1830's and 1840's, but the mule never gained popularity in southern New England.\textsuperscript{157}

The American Search for a Self-actor, 1837-1840

By 1837 conditions were ripe for the introduction into America of a self-actor with an adequate cop-building mechanism. Generally smaller and less efficient, the Rhode Island, Connecticut, and southern Massachusetts cotton mills were being squeezed between British mills.

\textsuperscript{156} Montgomery, \textit{Practical Detail}, p. 76; John Chase to James A. Mills and Company, June 25, 1843, Box MO-2, Dwight Manufacturing Collection, Baker Library, Harvard.

and large northern New England mills. The coarse-goods market belonged to the large Lowell-type mills because of their efficiency and low power and raw materials costs, leaving only the fine-goods trade to the Rhode Island-type mills. A cheaper, more skilled workforce enabled British manufacturers to overcome higher transportation and power costs so that they could compete in the American fine-goods market. Slowly the competitive advantage was tilted in favor of the British by the phased tariff reductions decreed by the Compromise Tariff of 1833. In the 1830's the British mills further improved their cost advantage by converting on a large scale to the Roberts and Smith self-actors while the American mills continued to use hand mules. Hand-mule spinners in America seem to have been largely Britishers who, complained early mill owners, were a troublesome, quarrelsome lot with high absence and wage rates. Conversion to flyer throistles or ring frames in order to avoid these labor costs was unacceptable in southern New England because frame yarn was considered 158 Especially Woodbury Report, pp. 47-48; see also Navin, Whitin, pp. 488-489; Ware, Early Cotton Manufacture, pp. 88, 101-108; Ure, Cotton Manufacture, 1: xli-xlxi.
too hard to be a substitute for soft, fluffy filling yarn from mules.\(^ {159} \)

As was often the case in this period, it was Matteawan which first acquired the new technology from Britain. In 1838 William B. Leonard, agent for the progressive New York shop, sent his son William A. overseas to secure a self-actor. While in Scotland young William obtained a model of the Smith mule small enough to fit in a steamer trunk. Since the export of machines or plans from Britain was still forbidden, a sham fight with the ship's captain diverted the customs officer's attention while the crew smuggled the trunk on board. Meanwhile, the elder Leonard back in the United States secured for James Smith an American patent on June 27, 1838, antedated to February 20, 1834, the date of Smith's British patent. It was an expensive operation, and the rewards were soon limited by the introduction into

\(^ {159} \)Ware, Early Cotton Manufacture, pp. 209, 243; Montgomery, Practical Detail, pp. 75-81; Gregg, Essays, p. 61; Hayes, American Textile Machinery, pp. 31-32; 1827 Directors Report, AE-1, pp. 57-58, Nashua Collection. One would be wise not to conclude that avoiding costly or scarce labor was the sole cause for adoption of machines; the desire for precision, quality, uniformity, and an end to labor troubles were important causes. There were some tasks manual labor could not perform, and there were many persons who preferred mechanical devices on general principles.
the early 1840's, apparently demand for the Smith mule in the northern coarse goods mills outran the capacity of the Matteawan shop to produce the heads, so the Lowell and Amoskeag shops were licensed to produce the Smith mule, generally splitting a 24-cent royalty three ways between Smith, Matteawan, and the builder.  

Since the Smith mule was not suited to fine-goods manufacture, the southern New England mill owners began to seek a better self-actor. In 1838 and 1839 William C. Davol, a former Fall River mill superintendent, and his uncle, Fall River mill-owner Bradford Durfee, toured Europe in search of new cotton machinery. A bargain was struck in early 1839 with Sharp, Roberts and Company, who were anxious to follow Smith's example so that they could reap patent royalties for their Roberts Mule. Sharp, Roberts and Company would furnish six prototypes while Durfee and Davol were responsible for smuggling the machine out of England and for acting as Roberts'  


agents in securing and administering a United States patent. Davol and Durfee retained the services of a professional smuggler in Liverpool, then returned to America to await the prototypes. A year passed; no mules came. Then there arrived from France long, thin cases marked "small metal-ware." Upon opening the cases, Durfee and Davol discovered to their horror that six of the most complex machines in existence had been hacksawed into thousands of small, jumbled pieces in order to deceive customs. Slowly the huge jig-saw puzzle was reassembled and set up in the Annawan Mill in Fall River. Durfee obtained a United States patent on behalf of Richard Roberts, while the partnership of Hawes, Marvel and Davol was formed to manufacture Roberts mules. So many orders flooded in that before 1840 ended, Pitcher and Brown was licensed to make Roberts mules. Fifteen miles away in Taunton, William Mason discovered that his new design of self-actor was suddenly obsolete. By 1847 Hawes, Marvel and Davol's Roberts self-actors powered 180,000 spindles. An improved Roberts mule, brought out by them in 1847 to

answer the competition of the 1846-patent Mason mule, powered 100,000 spindles by 1854.\textsuperscript{163}

In both the case of the Roberts mule and of the Smith mule, British manufacturers prohibited from selling to America were forced to abet the unlawful export of designs so as to at least enjoy American patent royalties. The potential of the overseas machinery market and the obvious failure of the export prohibitions led to repeal of those laws soon after. Once the British export restrictions were repealed, Americans imported a second generation of British self-actors, embodying refinements of the Roberts motion. The Parr mule was imported in 1844 and manufactured by the Franklin Foundry of Providence starting in 1845. Beginning in 1845 Potter mules were introduced to America, and in 1853 the Franklin Foundry—soon joined by Saco Water Power Company in Maine—began making Higgins mules. So good were the British mules and Mason's mule that American efforts to develop new designs of self-actors seems to have waned.

In 1853 Taunton's Wanton Rouse did introduce a mule with an eccentric cam controlling the building of the cop, but its success was limited. By the late 1870's, the Roberts, Mason, Parr, and Platt mules dominated the American market, the others being long departed. Against this extensive field, William Mason's self-acting mule held its own as the finest American self-actor: distinctive, elegantly designed, and thrifty of power.

**William Mason's Mules**

After Crocker and Richmond failed in early 1837, they sought to recover part of their fortunes by financing William Mason's inventive efforts. They had long been interested in self-actor mules and knew first-hand the small, southern New England mills' mounting desire for a good self-actor. Therefore, in the fall of 1837 they instructed Mason to design one. Shortly afterwards Leach and Keith began operating Crocker and Richmond's shop under instructions to furnish at Crocker and Richmond's expense all materials Mason needed for

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164 Webber, *Manual*, 2d pagination, p. 54; and examination of a large number of lists of mill equipments in *Fibre and Fabric*; Peck and Earl, *Fall River*. 
developing the new mule. After two years work, he brought out and patented his self-actor in 1840. 165

Mason's highly original 1840 self-actor was characterized by extensive application of gears and chains, and by sparing use of bands. Instead of a scroll band, the carriage was powered by an endless chain. His 1840 mule was an effective rival of the Smith self-actor, then the only one available in the United States; therefore to satisfy the rush of orders Mason licensed both Leach and Keith and the Providence Machine Works of Thomas J. Hill to build the machines. Hill secured a prestigious order for the mules from the new Wessacumcon (Bartlett) Steam Mill in Newburyport, Massachusetts, one of the pioneer coastal steam mills, which began the shift of locus of large-scale mills from inland to coastal New England. This order was also significant because it brought Mason into contact with the consulting engineer that equipped this mill, Charles T. James, who would soon become the most important customer of William Mason and Company. The mill also

won so many trade-fair prizes for the quality of its goods that Mason began to receive attention from other mill owners. Just as prospects appeared fairest for him, Durfee and Davol's Roberts mule arrived in America. With its crude cop-building mechanism, the Mason was a poor match for the Roberts. 166

So great was the respect that Mason's first mule generated that the Newburyport Steam Cotton Company ordered for the new Bartlet Mill an improved mule which Mason had not yet even designed. He commenced work in October 1840, imprudently promising his customer that he would deliver the new design by January 1841. To answer the Roberts mule, the new mechanism was extremely complex compared to the old design. This, illness, and the fact that Mason had to fashion the prototype with his own tools delayed completion of the 11,000-spindle order until November 1841. Not until the spring of 1842 was he well enough to journey to Newburyport to make the adjustments needed to make the mules function properly. Even though the Newburyport Company sued

166U. S. Patent 1801, Oct. 8, 1840; "Mason's Claim;" Charles T. James, Letters on the Culture and Manufacture of Cotton (New York, 1850), pp. 22-23; Thomas J. Hill to Zachariah Allen, June 1, 1876, Heirs Misc., Allen Collection. According to Hill the spelling of the mill was Wisacumeon.
because of the delay, the yarn from his mules won so many awards that other mills soon ordered Mason mules. During the difficult year of 1842 when Leach and Keith failed and William Mason and Company was formed, Mason continued improving his mule, delivering the final version to the Essex Mill in Newburyport in 1843. This was, according to Mason, essentially the design patented in October 1846.167

Mason's 1843 Mule

No self-actor mule, Mason's included, was a completely new machine since many of its elements came from hand mules or earlier self-actors. Mason's 1843 faller copping-rail motion and his main and idler pullies were not essentially different from other self-actors, while his fallers, spindles, carriages, rollers, creels, and general sequence of operations dated back to the early days of the hand mule. Unlike most earlier self-actors--the Roberts excluded--the Mason had a back-off motion.

Less power was used by the Mason than by other mules because chains, gears, cogs, and racks replaced most ropes and belts, which were prone to slippage and higher friction. To further conserve power, Mason powered part of the actions by the machine's momentum with the power briefly disconnected. Belt shipping was accomplished with a minimal expenditure of power by allowing gravity to pull a balance weight to one side or the other. Riding on a rocker arm above the rest of the mule head, the circular balance weight bearing the Mason name and the date of manufacture provided a note of functional, eye-arresting elegance characteristic of its designer.

The most original feature of Mason's 1843 mule was its winding motion, which was governed by the relative speeds of the two reciprocating racks at the mulehead's bottom, the lower of which governed the carriage motion, and the upper, the spindles. The upper rack on its outward move caused the spindles to back-off the yarn deposited on their tips during spinning, then the upper rack, on its return during run-in, powered the spindles' winding. These sliding racks were reminiscent of the reciprocating-bed motions of planers and of revolving-cylinder presses, both of which were devices with which American mechanics had become familiar shortly before
Mason had redesigned his mule. Quite possibly his racks were inspired by these earlier inventions. As in some later presses, a crank rod powered the racks.

A chain, fixed to the upper rack, ran around a wheel on the lower rack and ended on a scroll cam also attached to the lower rack. If the scroll cam was held stationary, the upper rack would move at the same rate as the lower, but if the scroll cam turned, it would take up the chain at an ever-increasing rate, thereby reducing the length of chain between the two racks and in turn accelerating the upper rack and spindles at a rate faster than the lower rack and carriage. This accelerating motion was used to build the rounded bottoms and conical tops of the cop.

The method of building the base was similar in principle to that used by Roberts, yet enough different to avoid patent infringement. The first turns of a new cop were wound at a rate proportional to the carriage speed, then, as the rounded base of the cop was built, the spindles were accelerated by a screw in a vibrating arm analogous to the Roberts quadrant and nut. In this mechanism a wheel was attached to the scroll cam so that when the wheel turned, the cam turned, taking up the chain connecting the two racks, causing the upper rack...
to accelerate the spindles at an increasingly faster rate. The wheel driving the scroll cam was activated by unwinding a second chain, one end of which was wrapped around the wheel and the other of which was fastened to a nut attached to the screw in the oscillating arm. The oscillating arm was pivoted at its far end, and at its nearer end it was attached to a second arm of equal length. The second arm pivoted about the axle of the scroll cam so that as the rack to which the axle was attached moved back and forth, these two vibrating arms alternately folded and unfolded. At the start of base building, the nut was next to the joint of the two vibrating arms, thus no chain unwound. At each run-in during base-building, the nut was drawn a bit further up the screw in the more distant arm, much as was Roberts' quadrant nut. This caused one end of the chain to move a shorter distance than the other end, thereby unwinding chain from the wheel and causing the scroll cam to rotate. In turn, this accelerated the top rack and the spindles that it activated. As in the Roberts quadrant-nut motion, at the end of cop-building the Mason nut reached the outer end of the vibrating arm and remained stationary, keeping a constant rate of acceleration.
This acceleration was required as each layer of yarn, after the fast down-stroke of the faller, was wound from the bottom to top of the cone of the cop. 168

The Mason mule evolved slowly over the following fifty years, but the basic motion remained essentially the same. Unlike other mules, it was not modified with the Roberts quadrant until 1893 when the traditional Mason mechanism was completely replaced with a fine-goods Roberts-type mechanism with quadrant, nosing peg, rope drive, Roberts-style belt shipping, and long levers. This change reflected the fact that new mule purchases in the 1890's were confined to fine-goods mules. 169

The 1843-1893 Masons were classed among the finest of mules. Designed and built to William Mason's elegant standards, they turned out a good product at 44 to 53 percent less power than Roberts-type mules. 170 This was just what the small mills of southern New England wanted, so demand exceeded the capacity of Mason and Company's small shops until construction of the large

169 Various Mason catalogs and advertisements, 1876-1898.
When Locks and Canals' shop officials approached Mason in January 1844 with a request for rights to build the Mason self-actor, William replied: "I should be glad to have my mule built at your shop and introduced to the notice of the manufacturers in your vicinity under the sanction of your approbation."

Mason went on to demand that the price be equal to what Locks and Canals charged for Smith mules until the mills learned of the "superiority of mine." Mason and Company sent a pattern mule to the Lowell shop and promised to sell to Locks and Canals the required castings, however the cramped old Taunton shops were so busy that Mason could only supply six sets of castings per month, greatly annoying William Boott at Lowell. Once the 1845 factory was completed, Mason was able to supply the demand except in boom periods such as 1866-1873. The Mason mule was widely used in southern New England, although it faced stiff competition from English-style mules built in the United States or imported from England. Late in the nineteenth century, American mule manufacturers capitulated to the ring frame, leaving Mason with a monopoly of a declining market. Ironically, the firm sold its third highest annual total of mule spindles in 1899 on the eve of the mule's demise.
Thereafter the decline was swift, and the last Mason mule was built in 1909.\footnote{William Mason to William Boott, Jan. 31, 1844, Letterbook A-33, Locks and Canals Collection, Baker Library (source of quote), and a stream of correspondence in the same Letterbook; "Machinery Records: Masons Machine Works."}

The 1843 Mason mule was an example of the unnecessary, duplicating invention—a category which must cover a substantial majority of all inventions. The Mason was unnecessary precisely because it merely attempted to duplicate what the Roberts mule did quite well. Many late nineteenth century American mule spinners considered the Mason to be without peer, however the claim was questionable since the British never adopted the Mason. The 1843 Mason is better viewed as the product of an inventor's refusal to be defeated and of an effort to remain competitive by circumventing the patent of another firm. These causes for duplicating inventions occurred frequently.

When William Mason and Company took over the Taunton shops in 1842-1843, it already had an outstanding line of textile machinery: the superior spinning frame, one of the two finest mule designs available, and a suitable set of patterns to round out an entire card-to-loom
product line. What Mason now needed was capital and customers. Two men in particular provided these: James K. Mills and Charles T. James.
CHAPTER V

MASSON AND MILLS:
William Mason and Company and the Industrial Empire
of Mills and Company: 1842-1857

FORMATION OF MASON AND COMPANY

William Mason and Company, Taunton’s most important shop, began as part of Boston merchant James Kellogg Mills’ industrial empire. After Leach and Keith’s 1842 failure, a Taunton acquaintance convinced Mills to purchase the Taunton shops and to install William Mason as the proprietor.\(^1\) Mills was investing in the mechanical skills of William Mason since he already controlled a machine shop in Chicopee, Massachusetts, adequate to supply his many cotton factories with machinery. Mechanics and artisans, such as Mason or Chicopee’s Ames Brothers, who were able to develop new commercially desirable products were appealing investments to Mills. His past role in the Taunton Manufacturing Company and control of the Whittenton Mill must have

\(^1\)Livingston, Portraits, p. 17; William Mason to Mathias N. Forney, quoted in "Late William Mason," p. 341. My guess is that the friend who recommended Mason to Mills was, in descending order of probability, either Willard Lovering, Samuel Crocker, or Charles Richmond.

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further disposed him to invest in the shop. Mason thus became the managing partner of William Mason and Company. As his share of the new firm's capital, he contributed his lucrative patents and mechanical and business skill, while the other partners, the firm of James K. Mills and Company and Willard Lovering, agent for Mills and Company's Whittenton Mills, provided the firm its physical plant and working capital.\(^2\)

Mason and Company's partnership of an inventor-mechanic and merchant-capitalists was common to many antebellum machine shops.\(^3\) Of 59 pre-1870 machine and locomotive builders examined, 29 percent followed this pattern of partnership between mechanic and capitalist. Mechanics alone owned another 34 percent; waterpower companies, textile mills, and railroads owned 17 percent, independent corporations formed 12 percent;


\(^3\)See Glenn Porter and Harold C. Livesay, Merchants and Manufacturers: Studies in Nineteenth-Century Marketing (Baltimore and London: Johns Hopkins Press, c. 1971), Chapter 4, for one explanation of the origin of this pattern.
and small-time local capitalists owned 8 percent. This frequency of mechanic ownership reflected the importance of invention and mechanical knowledge to success in the machinery industry, as the experience of Mason and Company would testify. Most of the owner mechanics in this group, William Mason included, were from farm or

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4 This sample consists of all companies for which I had adequate information. Standard sources provided the necessary data: Dun; Dictionary of American Biography; industrial histories such as Freedley, Bishop, Van Slyck or Trumbull; county and town histories; Bulletins of the Railway and Locomotive Historical Society; and histories of Amoskeag, Saco-Lowell, Baldwin, and Whitin. The sample included 29 New England shops, 19 Middle Atlantic, 8 Midwestern, and 3 Southern. Although most of the 59 firms made more than one product, 18 specialized in textile machinery as their primary product, 32 in locomotives, 6 in stationary and marine engines, and 3 in general machine shop business too broad to permit more precise description. Firms in the sample were: Amoskeag; Manchester Locomotive; Nashua Mfg.; Portland Co.; Locks & Canals; Essex Co.; Springfield Car & Engine; Blanchard, Averill & Co.; Ames Mfg.; Springfield Canal; Hadley Falls; Furbush & Crompton; Knowles Loom; Whitin; Draper; Taunton Mfg; Mason; Hinkley & Drury; Globe Locomotive; Jabez Coney; Union Iron Works (Seth Wilmarth); McKay & Aldus; Hawes, Marvel & Davol; E. C. Kilburn; Taunton Locomotive; Pitcher & Brown; Fairbanks, Bancroft & Co. (Corliss, Nightengale & Co.); Fales & Jenks; Rhode Island Locomotive; Rogers, Ketchum & Grosvenor; Charles Danforth; Swinburne & Smith (N. J. Locomotive); William Swinburne; Eleeze & Kneeland; Vancleve & McKean; Matteawan; Schenectady Locomotive; Brooks; Pittsburg Locomotive & Car; Smith & Porter; Dawson & Baily; Mt. Savage; Ross Winans; N. A. Furbush; Alfred Jenks; Norris Bros.; Lancaster Locomotive; Baldwin & Colton; Cincinnati Locomotive; Niles & Co.; Cuyahoga Locomotive; Charles Cooper; Detroit Locomotive; Menominee Locomotive; H. H. Scoville & Sons; Smith & Perkins; Anderson, Souther & Pickering; Tanner, Ehbets & Delany.
working-class families and used their mechanical skills as vehicles for riding the rags-to-riches route identified by Herbert Gutman in his Paterson study.\(^5\)

The formation of Mason and Company represented for Taunton the final stage of divorce of textile machinery manufacture from the cotton mills, a process culminating throughout the cotton equipment industry in the 1840's. One contemporary writer concluded that the machine shops' independence brought greater specialization, which in turn led to improved technology, increased competition, and lower prices.\(^6\) However, the scanty evidence at hand suggests no significant long-term decline in textile machinery prices after the mid-1830's, excepting ring frame

\(^5\)"The Reality of the Rags-to-Riches 'Myth': The Case of the Paterson, New Jersey, Locomotive, Iron, and Machinery Manufacturers, 1830-1880," Stephen Thernstrom and Richard Sennett, eds., Nineteenth Century Cities: Essays in the New Urban History (New Haven, 1969), pp. 199-128. I question Gutman's suggestion that inter-regional variations explain the differences between Gutman's findings on Paterson and the results of the earlier studies, which found that few leaders of business rose from poverty. More likely the high incidence of the obscurity-to-wealth pattern in Paterson stems from the fact that most of its industrial leaders made their fortunes in the machinery and metalworking industries where skill counted almost as much as wealth. Also, Gutman's results are biased because he neglects the New York merchant-capitalists that were partners and owners, such as the Grants, Ketchams, and Grosvenors.

\(^6\)Hayes, American Textile Machinery, p. 30.
prices which fell rapidly in the 1850's. The latter probably resulted from increased competition and economies of scale resulting from expanded production as firms switched from throstle to ring frame manufacture. The divorce of mill and shop was incited sometimes by a desire to rationalize a company's operations, as in the case of Lowell. Other times it was motivated by a mechanic's desire to enjoy the profits of his inventions, since the typical mechanic was employed under an agreement that made his inventions the property of his employer. While William Mason was luckier than many mechanics in that he received half of the royalties from his patents, by establishing his own shop he would thereafter share in the manufacturing profits as well.

Patent rights were an important asset of textile machinery shops, whether they or one of their mechanics owned the patent. Whitin built his success through sales of his patent picker, and the same held for Katteawan with its rights to the railway head, Smith mule, and Woodworth planer. Similarly, Crompton's fancy loom patents and Locks and Canals' large portfolio of patents and patent

7 Ware, Early Cotton Manufacture, pp. 26, 261.
8 "Mason's Claim Against Leach & Keith," M 381 W, No. 6, Old Colony Historical Society, Taunton.
rights helped bring these companies success.\textsuperscript{9} Mason and Company's most important asset, besides the business and mechanical skill of William Mason, was his patents. A contemporary reported that Mason's mule patent "of itself brings him in a good deal."\textsuperscript{10} If Mason was able to retain the entire patent royalty of 25 cents per mule spindle (Crocker and Richmond probably never collected their half-share because of nonpayment of wages), then he made over $137,000 between 1843 and 1861 in royalties from the sale of his mules by William Mason and Company.\textsuperscript{11}

MILLS AND COMPANY

Mason and Company possessed one other valuable asset: the financial, managerial, and marketing resources of Mills and Company. The firm, one of five great Boston drygoods commission houses, was, for twenty years following the failure of Crocker and Richmond, the leading industrial

\textsuperscript{9}This observation is hardly unique. See, for example Clark, \textit{History of Manufactures}, l: 520.

\textsuperscript{10}Mass. vol. 9, p. 556, Dun.

\textsuperscript{11}"Mason's Claim;" "Machinery Records: Masons Machine Works;" both Old Colony Historical Society, Taunton; Bristol County, Mass., probate records for Charles Richmond, Samuel Crocker and Elizabeth Crocker show no patent rights, nor do the Samuel Crocker papers in New York Public Library.
developer of Taunton. Founded in 1822 as James K. Mills and Company, and renamed Charles H. Mills and Company at the start of 1853, the firm played a central role in the establishment and management of the water power, mill, and shop complexes at Chicopee and Holyoke, as well as individual factories elsewhere in New England. Edmund Dwight, one of the founders of the Taunton Manufacturing Company, and James Kellog Mills were the original partners. Over the years they were joined by their relative Charles Henry Mills, by Dwight’s son Edmund, by another Dwight in-law and Taunton Manufacturing Company founder, Samuel Atkins Eliot, and by Patrick Tracy Jackson, Jr. ¹²

James Kellog Mills (1798-1863) and Charles Henry Mills (1812-1872) came from a section of far-western Massachusetts only a generation removed from the frontier. Their grandfather, Benjamin Mills (1739-1785) had come in 1764 from Killingly, Connecticut

(where Mason would later perfect the ring frame), to serve as the minister at Chesterfield, Massachusetts, fourteen miles west of the Connecticut River town of Northampton. While there, Benjamin sat on various state and local revolutionary bodies and represented Chesterfield in the state legislature in 1781. Benjamin had two sons who lived to maturity: Josiah Mills, the father of James K. Mills, and Elijah Hunt Mills, the father of Charles H. Mills. After graduating from Williams College in 1797, Elijah Mills became a leading Northampton lawyer and ran a law school good enough to turn out a future president, Franklin Pierce. Elijah's political career as speaker of the state house (1820), congressman (1815-1819), United States senator (1820-1827) and Federalist leader made him a close political associate of Federalists Fisher Ames, Harrison Gray Otis, and Daniel Webster. These connections provided important contacts for son Charles and nephew James when they came to Boston in the 1820's. Reflecting his position, Elijah married a Boston merchant's daughter, Harriette Blake, and saw most of his children marry into important Boston and Cambridge families. Charles Henry Mills, our co-subject, was Elijah's second son. Except that Charles was born
in September 1812, nothing else is known of his life, until his marriage to partner Edmund Dwight's daughter Anna Cabot Lowell. 13

Josiah Mills, older brother of Elijah and father of James K., was born in Chesterfield in 1771. Unlike his father and brother, Josiah seems neither to have been educated for a profession nor to have had a calling other than farmer and politician. Sometime between 1796 and 1808 he moved to a farm in neighboring Worthington, a rural town settled but two years before

his father had arrived in Chesterfield. As Worthington's representative to the lower house of the state legislature in 1814, 1815, 1822, 1829, and 1835, Josiah likely made friendships useful to his son James' early business career in Boston. Josiah's marriage to Esther Strong of Chesterfield produced a daughter, Mary, and three sons who lived to maturity, Josiah, Jr., Benjamin, and James Kellog. Josiah, Jr., died at twenty-five, but Benjamin became a lawyer, as did his son, General James Mills, who in the 1850's tended the Connecticut Valley legal and business interests of his merchant uncle and namesake, James K. Mills.14

James Kellog Mills, cofounder of Mills and Company, was born to Josiah and Esther Mills, April 18, 1798, probably in Chesterfield, but possibly in

Worthington where he was raised. Nothing is known of the upbringing of either James K. or his cousin and partner Charles H. Neither seems to have gone to college, their fathers' political connections in Boston being enough to secure their needed entree into the Boston business community. In the throes of the depopulation that led brother Benjamin to move to Illinois, Worthington was an uninviting place for an ambitious young man in the late 1810's, so James K. Mills moved to Boston. In 1822 he and another western Massachusetts man, Edmund Dwight, began selling textiles for cotton mills.

Both Mills cousins, Charles even more than James, were exceedingly private men, so little is known of their non-business lives and personalities. While fellow merchant princes resided in Beacon Hill's Bulfinch mansions, the Mills cousins lived in high-class boarding houses.

15 National Cyclopaedia of American Biography, 10: 505; History and Genealogy of Chesterfield, p. 254; Vital Records of Worthington, p. 48. Both the 1850 U. S. Census and the obituary in the Boston Courier, Nov. 30, 1863, imply that he was born a year later.

16 Neither Amherst, Williams, Yale, nor Harvard list James or Charles among their graduates.

Both belonged to the Athenaeum, the Boston elite's private library, and the Somerset Club, the city's most exclusive, but neither man seems to have been much involved in the literary and social life of the city. This is hardly surprising since they lacked the Harvard preparation that was virtually de rigueur. Other than a few small gifts to the Boston Athenaeum and Harvard, support for expanded free education for the masses, and possible involvement in the Prison Discipline Society and the Emigrant Aid Company, their public benefaction was either very limited or, more likely, anonymous. In short, James' and Charles' lives were almost completely tied to business. Little wonder in the case of James K. Mills; he not only managed Mills and Company's affairs, but also attended to minute details of the operation of the several textile mills and machine shops of which he was treasurer. Both men were widely respected by businessmen as capable and honest, if a bit speculation-prone. James appears in his letters to have been the model of the sage, frugal Yankee merchant who carefully watched his investments.
and regularly sent his subordinates stern homilies.\(^\text{18}\) He was not without a salty sense of humor: when the key to Mills and Company's Holyoke project, the great Connecticut River dam, collapsed, James telegraphed his partners back in Boston, "Dam gone to Hell by way of Willimanset."\(^\text{19}\)

James K. Mills remained the senior partner of Mills and Company from its inception until 1853 when he partially withdrew, possibly because of age, health, and the pressure of his treasurer's duties. Charles H. Mills joined the firm in the 1830's and became the senior partner after James assumed a lesser role in 1853. Following Mills and Company's failure in the Panic of 1857, James joined a new Baltimore dry goods commission partnership of Mills, Mahew and Company. When the war dried up business, James withdrew in 1862 and moved


\(^\text{19}\)Green, Holyoke, p. 28.
to New York City where he died November 25, 1863. Possibly a bachelor, and probably childless, James' funeral was held in Charles' house. Charles' life after 1857 was even less fortunate: he recovered little of his lost wealth in a small commission business, but did manage to send his two sons to Harvard, only to have one killed in action a few days before the end of the Civil War. Death came to Charles, himself, April 18, 1872.  

Edmund Dwight (1780-1849) was the cofounder of Mills and Company and remained a vital force in the firm until his death in 1849. As did Mills, Dwight came from western Massachusetts. Josiah Dwight, Edmund's grandfather, started a general store in the 1750's in Springfield, Massachusetts, in the Connecticut Valley. In the hands of Edmund's father, Jonathan, and uncle, Thomas, the store grew into western Massachusetts' largest mercantile empire with branch stores in several other Connecticut Valley towns and with a line of boats connecting the Connecticut River towns with New York.

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20 Mass. vol. 68, pp. 224, 459; Md. vol. 8, 421, Dun; Boston Daily Advertiser, Nov. 28, 1863; Daily Evening Transcript (Boston), Nov. 27, 1863; Boston Courier, Nov. 30, 1863; Jarves, "Charles James Mills," 2: 133-141; Will and Probate, Charles H. Mills, 2d Series, 7645, Middlesex County, Massachusetts.
and Boston. Thomas Dwight, Edmund's uncle, established the family's Boston connections while serving in the state senate (1796-1803, 1813) on the governor's council (1808-1809), and also in Congress (1803-1805). Both Edmund and his brother Jonathan, Jr., continued the family role in the legislature. After graduation from Yale in 1799, Edmund Dwight studied law with Uncle Thomas' brother-in-law and Federalist leader, Fisher Ames of Dedham. From 1804 to 1819 Edmund helped run the family business empire in the Connecticut Valley, with time out to serve in the legislature in 1810-1813 and 1815. Marriage in 1809 to the daughter of Samuel Eliot cemented Edmund's ties to Boston mercantile society. The same agricultural depression and depopulation in western Massachusetts which sent the Mills cousins to Boston also led Dwight to move to Boston in 1819 and join in Mills and Company in 1822. It was Dwight, with Mills, that sold the other Boston merchant-capitalists on the idea of investing in the great Connecticut Valley mill projects at Chicopee and Holyoke. In his later years Dwight became a leader of the movement for improved public
education, serving as a member of the state Board of Education.  

Edmund Dwight as the oldest partner brought to Mills and Company important connections and considerable skill and experience in business. Both Mills' and Dwight's personalities seem to have been quite similar. Dwight was outwardly "cold and reserved," according to Francis Bowen. Despite his courteous manners, he seemed to Theophilus Parsons to "distrust most persons" and crave privacy. Many of his gifts to charity were silent.

At Edmund Dwight's death in 1849, Edmund, Jr., and Samuel Atkins Eliot took the senior Dwight's place in the firm. All but one of the partners were now relatives: Samuel A. Eliot's sister was the elder Dwight's widow, Charles H. Mills was the late Dwight's


23Ibid., p. 20.

24Ibid., pp. 19, 22.
son-in-law, and Edmund, Jr., his son. James K. Mills, cousin of Charles, completed the tightly knit family. Eliot seems to have had a limited role in the actual operations of the firm, although he did serve as the treasurer of Whittenton Mills of Taunton, a Mills and Company enterprise. Of all the partners, Eliot was the only member of the cultured Beacon Hill aristocracy.

Edmund Dwight, Jr. (1824-1900), joined the firm following the usual Harvard education, Class of 1844. Taking an active role, he became treasurer of Mills and Company's Chicopee Manufacturing Company. Unlike the Mills cousins and Eliot, young Dwight built a successful second career after Mills and Company's 1857 failure, serving as treasurer of several major mills.25

Only Patrick Tracy Jackson, Jr. (1818-1891), was unrelated to the other partners. Joining the firm the year after his 1838 degree from Harvard, Jackson came from one of the most illustrious families in American industrial history. His father, the elder Patrick Tracy Jackson, and his uncle, Francis Cabot Lowell, had

25Boston Daily Advertiser, June 7, 1900, and Boston Evening Transcript, June 8, 1900, in Biographical File, Edmund Dwight, 1844, Harvard University Archives (Cambridge); Dwight, Descendants of John Dwight, 2: 900. See Chapter II for more on Eliot.
established the landmark Waltham mill of the Boston Manufacturing Company. Patrick, Jr., was a working partner in Mills and Company who joined to learn the trade. As did Edmund Dwight, Jr., he made a new career after the 1857 failure of Mills and Company, first as a commission merchant, then as a cotton broker.  

COMMISSION HOUSES AND EARLY MANUFACTURING

To understand the relationship between William Mason and Company and Mills and Company, one must be familiar with the great dry goods commission houses' central role in New England manufacturing during the four antebellum decades. Most large northern waterpower companies, mills, and cotton machinery shops were tied to one of five Boston cotton goods commission houses: Mills and Company, A. and A. Lawrence and Company, Lawrence, Stone and Company, J. W. Paige and Company, or Francis Skinner and Company. These houses


and their partners performed key entrepreneurial, financial, supply, sales, and managerial functions in the development of the great mill centers. They conceived most of the great waterpower projects and factories in New England, they subscribed to much of the stock, they furnished part of the credit, particularly when credit was unavailable elsewhere, they purchased raw materials for the mills, they sold the finished products, they helped promote and finance the railroads carrying these goods, and they had a powerful voice in the general policies and daily management of the mills and shops.

Louis Hacker divided nineteenth-century capitalists into merchant-capitalists and industrial-capitalists. In Hacker's classification, merchant-capitalists were those who made fortunes in trade and tended to invest as silent partners in public works, transportation, real estate, banking, and insurance, while industrial-capitalists were those who rose after the Civil War from the yeoman class to be the entrepreneurs of the new industries.28 Yet, Mills

and Company and its sister Boston commission houses exhibit characteristics of both merchant-capitalists and industrial-capitalists. They also manifest antecedents of the vertical integration of manufacturing and marketing.\textsuperscript{29} Mills was an antebellum merchant and industrialist who was hardly silent in his control and management of his factories. He became a merchant-industrialist precisely because, as a merchant, he had to control a dependable supply of goods to sell. Likewise, as a commission merchant, Mills was able to meet the textile mills' large capital and marketing requirements. His central direction of his selling house, mills, and shops anticipated the multiunit corporations of the late nineteenth century, but lacked their integration, middle management, permanence, and lasting effect; as Alfred D. Chandler, Jr., has pointed out.\textsuperscript{30}

\textsuperscript{29}Glenn Porter and Harold Livesay in Merchants and Manufacturers, pp. ix, 2-3, argue that the antecedents of vertical integration occurred earlier than Hacker thought.

MILLS' EMPIRE

William Mason and Company was but one unit in Mills and Company's industrial empire. James K. Mills and Edmund Dwight helped conceive and finance the mills and shops of two of the largest northern New England textile centers: Chicopee, just north of Springfield, and Holyoke a few miles further up the Connecticut River. A few scattered mills such as the Whittenton in Taunton rounded out their holdings. Although Mills and Company's partners were generally among the key organizers of these companies and held some of their stock, their control of these factories stemmed more from their handling of the firms' sales, provision of credit, and active involvement in management.

Facing the usual problem of new commission merchants, landing accounts, James K. Mills and Edmund Dwight in 1822 decided to build a textile mill which would give them its business after completion. Dwight had been fascinated with the waterpower potential of the falls of the Chicopee River just north of his native Springfield. In 1822 he and brother Jonathan bought the land and water rights at Chicopee and in the following year began the
Boston and Springfield Manufacturing Company. The investors were mostly the same people who were involved in setting up at the same time the Taunton Manufacturing Company. A power canal, dam, shop, bleachery, and four mills were built in quick succession with the company doing its own construction and machine building. By 1852 the Chicopee Manufacturing Company, as it was renamed in 1828, had over 20,000 spindles and 700 looms.31

With the upper waterpower site at Chicopee Falls filled, in 1831 the same group of Boston investors, with the Mills and Company partners at the fore again, incorporated the Springfield Canal Company to build a dam, canal, and machine shop further down the Chicopee River in the Cabotville section of Chicopee. Mostly the same investors, including Mills and Company, organized the Cabot Manufacturing Company (1832), the Perkins Mills (1836), and the Dwight Manufacturing Company (1841) to build the Cabotville mills. After mergers in 1852 and 1856 forming an enlarged Dwight Manufacturing Company, these mills employed over 1600 hands working about 59,000 and 1600 looms, a significant antebellum industrial establishment for which Mills and Company sold the cloth, 31

and over which Mills partners presided as treasurers guiding the major and minor affairs.\textsuperscript{32}

The Springfield Canal Company operated both the canal and the machine shop, producing the textile and other machinery for the Cabot Manufacturing Company. Then, inexplicably, the Chicopee Manufacturing Company received the contract to build the Perkins Mills' machinery, so, the Springfield Canal Company shop turned elsewhere for customers. In 1838 treasurer James K. Mills contracted for the Canal shop to furnish all the machinery for the Stark Mills in Manchester, New Hampshire. During the next several years the shop subsisted on small orders from throughout New England and the Middle Atlantic states until Mills personally journied to Lancaster, Pennsylvania, in 1845 to secure a large contract for the machinery for the important Conestoga Mills. At this juncture the Springfield Canal

Company shop was sold to the Ames Manufacturing Company, another Mills company.\textsuperscript{33}

The Ames Manufacturing Company's predecessor began in 1829 when Edmund Dwight encouraged Nathan P. and James T. Ames to move their cutlery shop from the Lowell area to leased space in the Chicopee Manufacturing Company machine shop. Besides cutlery, in the early 1830's Ames manufactured paper mill knives, cotton spindles, and repair parts for the local factories. By 1831 Mills and Dwight had used their connections in Washington to secure a government sword contract for Ames. Two years later the firm moved to a new shop at Cabotville and was incorporated as the Ames Manufacturing Company in 1834 with, as usual, the same Boston investors taking most of the stock. Mills and Company and its partners held almost a third of the stock and through the treasurership of James K. Mills dominated Ames even more than they did Mason and Company. Mills and Dwight expanded Ames rapidly, adding in the late 1830's plated-ware manufacture and a foundry to cast bronze cannon.

bells, and, later, statuary such as the great equestrian Washington which presides over Commonwealth Avenue from Boston's Public Gardens. Ames Manufacturing acquired the Chicopee Falls Company hardware and firearms shop in 1841, then absorbed the much larger Springfield Canal Company shop in 1845 in an apparent effort of Mills and the other Boston investors to eliminate the inefficiency of operating multiple machine shops in the same town. From the Springfield Canal Company Ames acquired a textile machinery business which put it in competition with Mills and Company's two other textile machine shops, Mason and Company and the Hadley Falls Company.

After completing the Conestoga order in 1846, James K. Mills took a large order for Ames from E. R. Mudge of Boston to equip for the Saratoga Victory Mill in Upstate New York, followed by a similar order in 1848 for the Glasgow Manufacturing Company of nearby South Hadley. Cotton machinery manufacture for mills in all parts of the country continued at least as late as 1857, and flyer and spindle orders were accepted as late as 1860. Soon after, if not then, Ames vacated the cotton machinery business. Other product lines Ames added in the 1840's, partly through the acquisition of the other two shops, included saws, naval yard machinery,
lathes and planers for general shops, gunstocking lathes and other gun-making tools, bolt cutters, and turbines. During the Mexican and Civil Wars Ames made large profits with its arms business, but the 1850's and late 1860's were lean times which highlighted Ames' most fundamental problem: unlike Mason its product line was too diffuse. Only in the sword and presentation sword lines did Ames occupy a significant place in one of its industries. For this and other reasons, the Ames Manufacturing Company slowly withered after the Civil War. 34

With the mill sites in Chicopee filled, Mills and Dwight and their friends George W. Lyman and Thomas H. Perkins conceived an even bolder project. Instead of damming merely a tributary of the Connecticut, they proposed in 1847 to dam the Connecticut itself at the

Falls at South Hadley. The task was almost too great, for the 1018-foot long dam failed when filled in 1848. A second succeeded the next year. Besides building the dam and canal, the Hadley Falls Company laid out the new town of Holyoke, built a large machine shop to make the machinery for the mills, and constructed two mills containing 50,000 spindles. Following the normal pattern, the Lyman Mills were incorporated in 1854 to take over the two mills, the Hadley Falls Company thereafter being merely a waterpower and machine-building company. James K. Mills was the treasurer of both companies and the usual Boston investors owned most of the stock. In 1852 Mills and Company partner Patrick Tracy Jackson, Jr., contracted with the Hadley Falls Company to construct and equip a fancy goods mill, but thereafter paper mills and other types of factories were built at Holyoke rather than textile mills.

Holyoke failed to fulfill its promise, as did the great machine shop of the Hadley Falls Company. After filling Jackson's Hampden Mill in 1854, the shop scraped together some fairly small orders of textile machinery, built paper mill machinery, and scrounged some general machine shop jobs making turbines, shafting, and other odd items. The 1857 failures of it, Mason and Company,
Mills and Company, and the Lawrence Machine Shop marked the end of the era of the great commission merchants in the machinery building industry.\(^{35}\)

Besides the Chicopee and Holyoke factories and Mason and Company, Mills and Company owned most of Taunton's 5,000-spindle Whittenton Mill, which they had received as their share of the Taunton Manufacturing Company. The remaining interest was held by Willard Lovering, mill agent and a partner in Mason and Company.\(^{36}\)

At the north end of the Massachusetts Connecticut Valley, Mills and Company owned a half interest in the small woolen mill of the Greenfield Manufacturing Company.\(^{37}\)

The Mills partners also held 72 shares of stock in the Indiana Cotton Mill at Cannelton on the Ohio River. James K. Mills' friend Charles T. James and Elisha Mills Huntington, probably Mills' first cousin, appear to have interested Mills in the Indiana mill. Although a


Louisville house sold the cloth, Mills supplied parts, oil, and labor, while William Mason and Company built the mill's spinning machinery. Finally, James K. Mills served in the early 1830's as treasurer of the Nashua Manufacturing Company, but without lasting effect on his firm.

James K. Mills and Edmund Dwight, as were most merchants, were vitally interested in reducing transportation costs, thereby expanding their markets. This motive led Mills and Dwight to be key investors and officers in the Western Railroad, which tied Springfield to Boston and Albany, in the Taunton Branch Railroad which linked Taunton to Boston and Providence, and in the Connecticut Valley Railroad and its predecessors which served Mills' Connecticut Valley factories. While the Mills partners held stock in many other railroads about the country, these holdings were purely for the

38 Property Schedules, In the Case of Charles H. Mills & Co.; Lists of Incorporators, and Letters for 1854-1855, Indiana Cotton Mills Collection, Lilly Library, Indiana University, Bloomington; Letterbook v. PW-3, pp. 93, 122, Lyman Collection.

investment worth of the securities or to aid Mason and Company in disgorging securities it had received in payment for locomotives. In none of these other companies did Mills and Company partners serve as officers. The partners' other important investments were also supportive of their mercantile and manufacturing empire. James K. Mills, Charles H. Mills, and Edmund Dwight were directors and important stockholders of the Massachusetts Hospital Life Insurance Company, the American Insurance Company, the Merchants Bank of Boston, the Columbian Bank of Boston, and the Machinists' National Bank of Taunton, all of which lent heavily to Mills and Company, its

partners, and its mills and factories and discounted commercial paper for the Mills group.  

MARKETING BY MILLS AND COMPANY

Commission merchants were largely a creature of the early industrial revolution. Its flood of goods required merchants with a more specialized knowledge of complex, distant markets and transportation than was possessed by the manufacturer. Thus, a commission merchant was characterized by his specialization in one product, as well as by his selling both for others and on his own account. In the domestic cotton textile trade, the goods he sold came directly from the manufacturer and were bought by jobbers (wholesalers), who in turn resold to other jobbers and to retailers. If the goods the commission merchant marketed were sold for the mill's account rather than his own, a commission of generally 5 percent plus shipping costs was charged.

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41 Shlakman, Factory Town, pp. 244-254; White, Massachusetts Hospital Life, pp. 173-175; Massachusetts Register, 1823; Taunton and the Machinists' National Bank; High Lights in the History of the City and a Record of the Bank (Boston: Walton Advertising and Printing Company, 1928), p. 157; Property and Debt Schedules, In the Case of Charles H. Mills & Co.

42 Porter and Livesay, Merchants, p. 5, for this definition.
to the mill. By the 1840's mills and commission houses were entering into contracts which gave the merchant exclusive rights to sell the mill's product. Yet, not all of Mills and Company's sales were commission sales, since textile mills with which it had no exclusive contract still consigned a fair amount of goods which Mills sold on its own account.

In a three-year contract typical of the 1840's and 1850's, the commission merchant agreed to sell virtually all of the mill's cotton goods for a 5 percent commission plus shipping costs. The merchant was to absorb all storage charges and commissions to merchants in other cities and to guarantee all sales and payments, excepting the soundness of the currency taken in payment. Certain restrictions were placed on cash discounts and on prices

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43 Ware, Early Cotton Manufacture, p. 183. Porter and Livesay, Merchants, p. 76, find the 5 percent commission in the iron trade, and Cole, American Wool Manufacture, 1: 208-214, observes it in the woolen business. There were some commissions as low as 3 percent and as high as 6½ percent, but 5 percent was the most common. These are, of course, guarantee commissions in which the merchant guarantees the sale and the customer's payment and paper. A straight (unguaranteed) commission was generally 1 percent. These figures are for the 1840's and 1850's, since the guarantee agreements seem to have been brought in by the 1837-1842 failures. See Gregory, Nathan Appleton, pp. 222, 230, 242, 245, 248-251, 258-259.

44 See especially Ware, Early Cotton Manufacture, pp. 178-179.
for sales south and west of New York. Also, the merchant agreed to buy all coal and cotton for the client mill, keeping a year's supply on hand. By accepting the drafts of the mill, the merchant was to provide the money needed by the mill to operate. The mill reimbursed the merchant for the interest charges incurred from acceptance. These drafts were to be accepted up to the expected market value of the goods plus the cost of the cotton in the hands of the merchant. The arrangements of Mills and Company and of other Boston houses in the 1840's and 1850's generally were similar to this contract. In short, Boston commission merchants, in return for a monopoly on the sales of a mill's product and for a 5 percent commission, agreed to supply their market, transportation, and financial knowledge, to protect against customer default, to pay marketing costs, and to provide raw materials and credit. This division of

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45 This contract was between the Naumkeag Steam Cotton Company and Francis Skinner and Company, December 30, 1850, Directors Record Book, 1845-1863, v. AB-1, Naumkeag Collection, Baker Library, Harvard. Another arrangement—in my opinion, not very common in the 1840's and 1850's—the commission house charged 1 percent, with the mill absorbing the shipping and storage and collecting the jobbers' notes. See Evelyn H. Knowlton, Pepperell's Progress: History of a Cotton Textile Company 1844-1945 (Cambridge: Harvard University Press, 1948), p. 78, for a description of such a contract between Pepperell and Skinner. That the Naumkeag contract was fairly standard for the 1840's and 1850's is attested to by Ware, Early Cotton Manufacture, pp. 180-183; and Cole, American Wool Manufacture, 1: 208-214.
labor left the mill agent free to concentrate his attention on his specialty, production. However, to protect their substantial interest in the mills and shops, James K. Mills and other commission merchants repeatedly intruded into the realm of the factory management.

The market to which Mills and Company sold textiles was paradoxically at once concentrated and widely dispersed. New York, most importantly, and Philadelphia and Boston were the largest markets, accounting for at least three-quarters of Mills' shipments in any given period. The remainder of the textiles were sold to widely scattered jobbers in the lesser New England and New York cities, in Baltimore, and in the important Southern and Western cities.46

46 Mills and Company's records are lost, excepting a letterbook which somehow ended in Baker Library's Lyman Mills papers. This section is based on Mills' records of notes discounted for Lyman Mills, July-Dec., 1855, v. PW-3, Lyman Collection, and on the list of Mills and Company's notes receivable in mid-1858 in In the Case of Charles H. Mills & Co. In the former, New York accounted for 41 percent of the notes, Philadelphia 33, Boston about 18, and Baltimore 5. Shipments of Dwight cloth by Mills in 1848 and 1849 shows the dominance of New York and Philadelphia, Letterbook MA-1, Dwight Manufacturing Collection, Baker Library, Harvard.
Other than Mills' lack of a New Orleans market, its sales were similar to other Boston commission houses.  

Most of the cloth sent to New York and Philadelphia went to commission merchants trading on their own account. These houses then resold much to smaller-city jobbers on their annual or semiannual buying trip to the big city. The jobbers, in turn sold to retailers. While there were many exceptions, this was the common pattern of the two antebellum decades. Knowing the demands of Philadelphia and New York commission houses, James K. Mills usually specified the type of goods and labeling to be made by the textile mills. Marketing, pricing, and styling no longer remained the manufacturer's prerogative.

47 In 1852, 54.2 percent of Francis Skinner and Company's 240 Pepperell customers were New York firms and 21.2 percent Boston houses, Porter and Livesay, Merchants, p. 28. Earlier Mason and Lawrence carried the accounts of 105 New York firms, as well as 16 in Philadelphia, 15 in New Orleans, and a few in other cities, Ware, Early Cotton Manufacture, p. 186.


49 Letterbooks MA-1, BG-1, Dwight Manufacturing Collection. See also Ware, Early Cotton Manufacture, p. 184; Knowlton, Pepperell, p. 81, for similar practices by competitors.
Machine Shop Marketing

Mills and Company's five machine shops sold machinery and locomotives directly to the customer. While textiles were relatively simple, mass produced standardized goods which required the marketing skill of a commission merchant, machines were sold to a comparatively few, easily located customers. Indeed, very often the customers sought out the capital goods manufacturer. Customers generally had to have direct contact with the shop because machinery was technologically complex and was designed partly to customer specifications. Therefore, excepting a very few antebellum commission sales of locomotives, the manufacture and sale of these products was vertically integrated from virtually the inception of the American capital good industry.\(^{50}\)

Although his firm did not sell the machine shops' products, James K. Mills with his customary attention to detail set the marketing policies of the five shops in which he had such a large financial interest. William Mason was bombarded with letters from Mills. On one occasion, Mills asked Mason, "Did you find proper Connections with the Michigan Central or the N Y

\(^{50}\) Much the same conclusion is reached by Porter and Livesay, *Merchants*, pp. 3-4.
Central road? And were you able to obtain any orders for Engines?" Two days later Mills repeated his question. A month later, as if addressing a mere errand boy, he informed Mason that the New York Central superintendant was coming to Boston to order locomotives: "I will give you notice by Telegraph + you must come up . . . Please be on hand to await him or My message." On other occasions Mills forwarded to Mason drawings from master mechanics and requests for drawings of Mason engines.

As the most important investor in several competing textile machinery shops, James K. Mills assigned market areas to each to prevent competition. When Mills learned that the Glasgow Mill was soliciting bids from both the Hadley Falls Company, he warned Mason:

Where as the competition will be entirely between your shop and ours at Holyoke---probably---as as we can do it cheaper than you can, and as it is better that the machinery be made where they can have access to the patterns, it will be obvious to you that no good will come of naming low prices.\footnote{James K. Mills to William Mason, Sept. 15, 17, Oct. 16, 1855, Letterbook v. PW-3, Lyman Collection.}

\footnote{Mills to Mason, Aug. 14, 1855. Gregory, Nathan Appleton, p. 242, suggests that Appleton stimulated competition between his factories. I suggest that Appleton probably allowed competition only when it was not destructive, but served as a stimulant of managerial efficiency.}
In his capacity as treasurer of all his shops except Mason and Company, Mills' task of preventing competition was simplified. He requested his shop agents to make cost estimates, then as shop treasurer he submitted textile machinery bids to the mills. As did the other large northern shops, Mills' Chicopee and Holyoke shops held the local mills as captive customers. When the Hadley Falls shop received an order for mules, Mills ordered William Mason to supply Hadley Falls with patent rights, patterns, and technical advice. All Mason received was a patent royalty. Conversely, Mills saw that Mason received the orders of Taunton's Whittenton Mills, previously a steady Springfield Canal Company customer.

Whenever the demand for machinery for the mills in Taunton, Chicopee, and Holyoke slackened James K. Mills directed his shops to new markets. For the Springfield Canal shop he cultivated customers in northern Massachusetts, in New York, and in Pennsylvania. Later, he guided the Hadley Falls shop to the same market and,

53See for example Mills to Otis Holmes, Dec. 22, 1855.

54Mills to Mason, Nov. 17, 1855.

finding business too light, switched the shop to specialty machines for textile mills and to paper mill machinery. With his connections to Southern and Midwestern merchant-industrialists, Mills was able to steer several machinery orders from those regions to Mason or Ames: notably the Graniteville, South Carolina, mill order from Mason and the Shelbyville, Tennessee, mill order from Ames. Mason also received orders from Ohio Valley mills at Wheeling, Steubenville, Pittsburgh, Cincinnati, and (with Hadley Falls) Cannelton, Indiana. Mills and his partners had a substantial interest in the latter mill, so it was not surprising that Mason sold to it.

Because Mason and Company lacked a significant captive market—Mills' Whittenton Mill had but 5,000 spindles, and the few other local mills were even smaller—Mason had to scramble harder than Mills' other shops

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56 Letterbook v. PW-3 and AB-7, Box 6, Lyman Collection.


58 Letterbook v. PW-3, p. 150, Lyman Collection; "Machinery Records;" Indiana Cotton Mills Collection, Indiana University; In the Case of Charles H. Mills & Co.
for customers. But, in having to struggle more, Mason improved his marketing skills and technology, with the result that his was the only one of Mills' three shops able to survive as a textile machinery builder after the troubles brought by the Panic of 1857 and the Civil War.

FINANCIAL RELATIONS OF MILLS AND COMPANY, 1840-1857

Merchants, particularly commission merchants, provided the fixed capital for most large antebellum New England mills. One reason that merchants provided capital was that they were by nature risk-takers who abhorred idle funds and low rates of return. Furthermore, to obtain the lucrative exclusive contracts to market a mill's production, a commission merchant generally had to subscribe to that mill's stock or to promote the sale of that stock.  

But, if mills and shops had comparatively little trouble finding fixed capital, they struggled to feed an insatiable appetite for working capital. Taxes,

59 See for example Knowlton, Pepperell, pp. 76-77.

transportation, and payrolls had to be paid in cash, yet weeks passed before cash could be realized from the sale of the goods.61 Cash flow problems were exacerbated by banks' and insurance companies' unwillingness to lend to manufacturers unless the loan was secured by real estate, United States bonds or bank stock. Accounts receivable and inventories were generally unsatisfactory collateral for banks or insurance companies.62 Massachusetts Hospital Life Insurance Company stood out as an exception, but its willingness to lend to mills and shops could be easily explained by the circumstance that its founders, major shareholders, and corporate officers were the Boston, mill-owning elite.63

Because of the difficulty of getting loans on receivables and inventories, a mill relied on its commission merchant for advances on unsold goods. Moreover, the commission merchant was a mill's lender of last resort. When in 1854-1857 banks shortened the maturities they would accept, due to rising interest rates, the commission merchants took the intermediate-term paper formerly taken

61 Porter and Livesay, Merchants, pp. 25-26, stress this point.
62 Ibid., pp. 26, 64, 71.
63 White, Massachusetts Hospital Life, pp. 90-95.
by the banks. Commission houses also attempted to fill the void left by the closing of banks' loan windows in panics such as 1857. In twenty years of borrowing by eight large northern mills (four of which were Mills and Company mills) studied by Lance Davis, only 7.3 percent of these mills' loans were furnished by commission houses. Yet, 20.5 percent of the loans of thirty days or less were made by the commission merchants. In the high interest rate and panic year of 1857, their share of the six-months-to-one-year lending rose to 35 percent contrasted to an average 13.2 percent for the twenty-year period.\textsuperscript{64} The commission merchants were able to serve as a lender of last resort in part because they could charge a higher interest rate than the legal rate binding on banks. Indeed, the commission houses' interest rates were the highest of any group lending to the mills.\textsuperscript{65}

The most common way in the 1840's and 1850's in which commission merchants lent to mills and shops was by accepting the drafts of the mill upon the

\textsuperscript{64}Davis, "Capital Markets," pp. 5, 7. See also Ware, Early Cotton Manufacture, p. 180; Porter and Livesay, Merchants, p. 26.

commission house. Mills and Company frequently accepted drafts of William Mason and Company and the other factories of the Mills empire. Whereas banks were disinclined to take manufacturer's notes on inventories or accounts receivable, banks willingly accepted credit instruments bearing leading mercantile houses' names. Therein was the advantage of the acceptance: it permitted the factory to borrow against unsold goods or even against raw materials by using the more credit-worthy name of the merchant. Although the acceptance created a contingent liability upon the commission merchant, it normally neither tied up his capital nor forced him to borrow.

An acceptance began with a factory treasurer drafting a note promising to pay the amount of the note for value received at a given time and place to the order of Mills and Company. Generally these were six-months bills. Alternatively, drafts were made in the form of a bill of exchange or by a separate letter of guarantee by Mills and Company. After writing the draft, the treasurer presented it to Mills and Company which accepted it by endorsing it. Since most treasurers of

66 In the Case of Charles H. Mills & Co.
the Mills-related factories were partners of Mills and Company, they simply wrote the draft in their function as treasurer, then changed hats and accepted the draft in their dual role as a member of Mills and Company. Following acceptance, the note was returned to the factory treasurer, who then discounted the note for cash, usually at a bank. Since a note represented a transaction and bore the endorsement of a respected merchant, banks readily took the notes, except in financial crises. Upon maturity, a note was presented by the bank or other holder to Mills and Company. If Mills sold the goods against which the draft had been earlier accepted, then Mills merely deducted the amount of the draft from the proceeds of the sale before turning over the proceeds to the mill's treasurer. However, in the case of Mason and Company in which Mills did not sell the goods, the amount of the matured draft was charged against Mason's account with Mills.67 Besides accepting

67This description is based on the notes in In the Case of Charles H. Mills & Co., especially items 8½, 16, 32, 36, 37, and 42. Freedley, Leading Pursuits, p. 198; Klein, "Development," pp. 528, 601-602, provide good descriptions of accepting. Acceptances originally developed out of inland bills of exchange, but soon the distinction became forgotten and both came to be called acceptances.
Mason's drafts, Mills and Company assisted Mason and Company by acting as sureties of Mason's bank loans.\textsuperscript{68}

Mills also extended credit to its customers. The commission merchants in New York, Philadelphia, Baltimore, Boston, and outlying cities kept accounts with Mills, which they settled at months end with six-month or, less commonly, three-month notes. Mills in turn discounted these for cash at Boston and New York banks or with merchants with idle funds. However Mills and Company's endorsements left them liable in the event of a customer's failure since the textile mills were guaranteed by Mills' 5-percent contract against such failure.\textsuperscript{69}

Although not Mason and Company's selling agent, Mills and Company often assisted the Taunton shop by taking the securities and notes tendered by the shop's customers. Railroads were as a group more impecunious.

\textsuperscript{68}Bristol County Savings Bank v. James K. Mills & Co., Case 352, 1856-1867 Docket, Court of Insolvency, Suffolk County, Massachusetts. Items 485, 518, In the Case of Charles H. Mills & Co., show that Mills did the same for other companies when it was not the selling agent.

\textsuperscript{69}Notes in In the Case of Charles H. Mills & Co. and many letters in Mills' Letterbook v. PW-3, Lyman Mills Collection. See also Klein, "Development," pp. 527, 528, 530; Porter and Livesay, Merchants, p. 74.
than textile mills, so locomotive shops in the 1850's were forced to extend credit. The six famous 1857 locomotives Mason built for the Baltimore and Ohio Railroad were paid for in part by six $5,300 notes, which Mason discounted with Mills and Company. Likewise, in 1857 the cash-starved Cleveland and Pittsburgh Railroad paid for four engines with a combination of cash, $3300 in notes, 80 shares of stock, and $960 in bonds. Because virtually no market for Midwestern railroad securities and notes existed in the late summer of 1857, Mills and Company discounted the notes and Charles H. Mills personally took the stock and bonds off Mason's hands. This case soon demonstrated the dangers Charles Mills faced in taking subsidiary companies' customer paper and securities. He was unable to find a buyer for the securities before the Cleveland and Pittsburgh sent their regrets and "warm sympathy" that they had joined the many Midwestern roads which failed in the

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month following the 1857 Panic. Three years later Baldwin Locomotive Works was still trying to collect a similar debt from the Cleveland and Pittsburgh, and so would have Mills if the failure of the railroad and many of Mills' companies' other customers had not precipitated Mills' own bankruptcy.

Because the commission merchant trade required little capital, it offered large profits, particularly after merchants began to guarantee sales in return for an increase in commission from 1 percent to 5 percent.

In addition to his share of his firm's selling commission, James K. Mills earned salaries as both agent and treasurer of most of the mills with which his company was connected. He also received dividends from his mill stocks and expenses for his frequent business trips to the Connecticut Valley. No record of Mills and Company's

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71 The quote is from the letter of the Cleveland and Pittsburgh superintendent to M. W. Baldwin and Company, Sept. 12, 1857, Incoming Letterbook, 1857, Baldwin Collection. Also, Cleveland Morning Leader, Oct. 21, 1857, on railroad failures.


73 Ware, Early Cotton Manufacture, p. 185.

or its senior partners' full earnings survives, but competitor Francis Skinner and Company earned $60,000 alone in 1-percent commissions in 1865.75

What capital was required was often borrowed by commission merchants. From 1853 to 1856 Harvard College treasurer Samuel A. Eliot lent $10,000 in college funds to Mills and Company, of which he just happened to be a partner.76 Mills and Company's most important source of credit seems to have been its own drafts accepted by New York's largest commission house, Morton and Grinnell. Because the whole process of shipping, selling, and discounting often took longer than the term of textile-mill drafts Mills had accepted, Mills made drafts upon other commission merchants, particularly Morton and Grinnell, who sold some of Mills' goods for a 1-percent commission.77 Even these sources proved inadequate in the Panic of 1857, so Mills partner Edmund Dwight, Jr.,

75Knowlton, Pepperell, p. 77.


in his capacity as treasurer of the Chicopee Manufacturing Company lent Mills and Company cash by taking on behalf of Chicopee various drygoods merchants' notes held by Mills. In return Dwight gave Mills and Company the notes of Chicopee, which Mills discounted for cash. With the failure of Mills and Company and of many of the merchants who had issued the notes Mills had given to Chicopee, Chicopee was left with a substantial loss. Chicopee sued for violation of the guarantee clause of their contract with Mills and for misfeasance and conflict of interest by their treasurer, Dwight, but settled out of court with the Mills assignees. It was experiences such as this which gave commission houses and guarantee contracts a bad reputation and led Mills to cease making exclusive and guarantee contracts with commission merchants in the 1860's.

Besides the funds borrowed in the Mills houses' name, principal partners, James K. Mills, Charles H. Mills, and Edmund Dwight, also borrowed $132,000 in their own names from the Massachusetts Hospital Life Insurance

78 Suit of Chicopee Manufacturing Company, In the Case of Charles H. Mills & Co.
Company in 1856-1857, presenting as collateral their own mill, shop, and railroad securities, and James K. Mills borrowed over $48,000 in 1857 from the Merchants Bank. Not by coincidence Charles H. Mills was a director of the former and James K. Mills of the latter.79

High risk was the price of the high profits and extensive borrowing of the commission drygoods business. The principal sources of risk lie in drafts and defaulted discounts. Since contracts and court decisions dictated that a commission merchant could reimburse himself for a mill's drafts only out of the proceeds of the sale of goods upon which those drafts were issued, a commission house could get in trouble if the goods could not be sold until long after the draft matured and was presented to the commission house for repayment. Also, if the goods fetched a lower price than the amount commission merchant had advanced the mill, the commission house lost the difference. Both of these risks became serious problems in panics, as Mills and Company

79 Property and Creditor Schedules, In the Case of Charles H. Mills & Co.; White, Massachusetts Hospital Life, pp. 96, 173-175; Shlakman, Factory Town, p. 244.
discovered in 1857. General panics such as 1857 also led to widespread default of commission merchants and jobbers. Since Mills and Company had received and discounted the notes of many of these firms, it became liable for these notes. In 1857, twenty-one purchasers of Chicopee cloth, for example, defaulted, leaving Mills responsible for their notes, since by the contract guarantee, these defaults could not be passed on to Chicopee. Finally, because it endorsed the promissory notes of Mason and Company, Hadley Falls Company, Whittenton Mills, and the Northampton Woolen Mill, Mills and Company was also hurt by their failure, as these notes then became Mills' responsibility. Since all of these risks materialized in the Panic of 1857, Mills and Company, Mason, and the other two firms went down as drowning swimmers locked in fatal embrace. It was no wonder that commission merchants became reluctant to guarantee sales and notes after 1857 and

80 A very fine description of this problem is in Freedley, Leading Pursuits, p. 198. See also Ware, Early Cotton Manufacture, p. 184.

81 In the Case of Charles H. Mills & Co.

82 Ibid., especially Item 485; Bristol County Savings Bank v. James K. Mills & Co.
were willing to accept mill requests that they return
to the straight 1 percent sales commission.\(^3\)

MILLS AND COMPANY'S ROLE IN THE
MANAGEMENT OF ITS FACTORIES

Besides financing and selling his client
factories' goods and assigning market areas to his machine
shops, James K. Mills purchased their raw materials and
supervised their daily operations as treasurer, commission
merchant, and investor. Mills purchased Lehigh Valley
coal in bulk lots and distributed it among his clients,
thereby reducing ordering costs and using the size of
his orders to beat down prices and shipping rates.\(^4\) By
1835 he was buying cotton and by 1850 starch, dyed yarn,
and oil.\(^5\) For his machine shops he secured pig and
wrought iron, steel, lead, copper, tin, coal, oil, and
files, although Mason did part of his own metal purchasing.
Cotton-mill agents sent requests for raw materials to Mills,
and he regularly queried them about their needs. In most

\(^3\)Klein, "Development," p. 528.

\(^4\) Many letters of Mills, Letterbook v. PW-3,
Lyman Collection, refer to this practice.

\(^5\) Cabot Mills Letterbook MO-1, Dwight Manufacturing
Company Letterbooks BG-1, MA-1 through MA-5, Dwight
Collection, Baker Library, Harvard.
cases, he merely issued the notes of the firms he controlled to pay for these materials, but in the case of Mason and Company, he wrote William Mason for authorization to issue the firm's notes. 86

One wonders if the centralization of ordering did not engender inefficiencies partially offsetting its efficiencies; witness, the Dwight mills agent's repeated requests for lubricating oil which end with a desperate plea: "We are entirely out of machinery oil. Will you please send us some at once and so oblige?" 87 Were 59,000 spindles idle for want of lubricating oil? Central purchasing also may have suffered from James K. Mills' love of a bargain: after purchasing 100 tons of Number 1 iron, Mills indicated his uncertainty of his shops' needs by asking their managers, "When shall you require iron of this kind?" He admitted that, "I have purchased it because I think it a good bargain." 88


87 Sylvanus Adams to J. K. Mills, Sept. 27, 1848, Letterbook MA-1, Dwight Collection.

Although Mills had reason to suspect his shops might eventually need the iron, the action seems a bit imprudent, particularly considering the high carrying costs of inventories in the 1850's.

Mills' block purchases of raw materials for his factories and large shipments of finished products gave him considerable leverage in bargaining for special freight rates from transportation companies. First, he secured low rates from the river and coastal shipowners by sending large quantities of goods to fill their partly loaded ships just before sailing time. Using this low rate and his large traffic to bargain, he next obtained from the New Haven railroad special rates for coal and pig iron shipments to Mills' mill companies and machine shops in the Connecticut Valley.90

Mills was also active in securing labor for his mills, particularly the scarce, skilled weavers and mule spinners. In the late 1840's he and his Dwight mill agent carried on an extensive correspondence with a labor agent in Glasgow in an effort to find Scots girls

89 Kistler, Rise of Railroads, p. 209.
experienced with power looms. Later he imported about seventy more, plus Irish women, to work the new mills at Holyoke. Mills also played an active role in setting wages and boarding house rates as well as in handling labor problems. Believing that educated workers would earn more and not engage in idle pastimes, he and Edmund Dwight campaigned for public education expansion.

With such a large interest in his mills' and shops' success, James K. Mills was actively involved in the management of these enterprises through his weekly visits and endless letters. Control was facilitated by his role as treasurer of the Ames, Dwight, Perkins, Cabot, Springfield Canal, Lyman, and Hadley Falls establishments. The Dwights, Senior and Junior, were treasurers of Chicopee, Samuel A. Eliot of Whittenton, and Patrick Tracy Jackson, Jr., of Hampden. Only in the case of Mason and Company, which was a partnership without need of a

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92 Letterbooks MA-1 to MA-5, Dwight Collection; Green, Holyoke, pp. 30-31, 56-57.
corporate treasurer, did Mills and Company lack this key office. While the resident agent managed the daily operation of the factory, the treasurer not only controlled the purse strings, but also set policies supervised their implementation. He even called for the annual corporate meetings to be held on the same day in the counting rooms of Mills and Company and at these meetings he voted the proxies of the Mills and Company partners, further cementing his control.93

James K. Mills paid closer attention to the affairs of his textile mills than to those of his machine shops, mainly because his company sold the mills' goods. Besides finances, quality, character of goods, raw materials, labor, and marketing, he was concerned with the details of production and of plant repair and maintenance. Imperfections in cloth were of utmost concern, as were experiments with various machines, processes, cloth patterns, and styles. Mills also paid close attention to anything governing production costs. On one occasion he upbraided the Perkins agent for using more lubricating oil than English mills—rather an unfair complaint considering that English mills used power-saving.

93Various Material, Box MO-1, Dwight Collection.
low-friction machinery more carefully constructed than American equipment. He demanded and carefully checked regular mill-agent reports giving on a room-by-room basis information on raw materials used, production, and costs. And, he ordered machinery—from his own shops when possible.  

Nor did Mills spare his machine shops from his close supervision. He pressured James T. Ames to improve his collection of accounts receivable and attempted to straighten out Ames Manufacturing's lackluster management. Over James T. Ames' vigorous protests, Mills' dictated a dividend rate Ames felt too high. Even Ames' choice of products was subject to Mills' scrutiny. In his correspondence with Otis Holmes, Hadley Falls agent, Mills even told Holmes where to buy raw materials not already purchased. Likewise, Holmes was instructed where to bid for machinery orders, although Mills left the estimating to Holmes. The two men discussed advertising, shipping, freight rates, and

94 Letterbooks MA-1 through MA-11, BG-1, Dwight Collection; Letterbook v. PW-3, Lyman Collection.

95 Various letters, Mills to Ames, particularly Jan. 7, 1856, Letterbook v. PW-3, Lyman Collection; Shlakman, Factory Town, pp. 83, 87-88.
raw materials acquisition, while banking and financial affairs were largely handled by Mills. Because of William Mason's managerial skills and half-ownership of Mason and Company, Mills did not exercise nearly as much control over Mason. Still, Mills tried to influence the strong-willed William Mason. "I saw your name on the hotel book of Springfield Yesterday," Mills upbraided Mason on one occasion. "Beyond that, you did not take advantage of \[\text{the opportunity}\] there to go up to Holyoke to look at the Mule I mentioned to you . . . . When will you look into it."\(^{97}\)

One fascinating aspect of James K. Mills' involvement in his shops' affairs was his interest in technological development. This interest helps explain why Mills and Dwight were willing to set up in business three bright mechanics, Nathan and James Ames and William Mason. Frequently Mills requested his shop operators to examine or try new machines or to share technology with

\(^{96}\)Mills letters to Holmes, July-Dec., 1855, Letterbook v. PW-3, Lyman Collection.

\(^{97}\)Mills to Mason, Dec. 15, 1855, Letterbook v. PW-3, Lyman Collection. Commas are supplied, abbreviations filled out.
other Mills firms. Keeping abreast of his competitors, he exhorted his agents to do likewise. Reports of James B. Francis' Locks and Canals hydraulic experiments were obtained by Mills, as was an improved loom which he had spirited out of England in 1843. The loom was acquired by Springfield Canal Company agent John Chase who had been sent by Mills to Great Britain in 1843 on a mission of industrial espionage into textile technology and practices.

An agreement between Ames, Hadley Falls, and the Glasgow Company gives a final insight into the way Mills manipulated his companies. When the Glasgow Company complained that the Hadley Falls Company had not fully lived up to its commitment to provide water for Glasgow's turbines, James K. Mills arranged an accommodation whereby Ames would provide Glasgow fifty looms paid for by three 


99 John Chase to James K. Mills and Company, June 25, 1843, Box MO-2, Dwight Collection; Chapin, Sketches, p. 139.
$1000 Glasgow convertible bonds.\textsuperscript{100} It may not have been arms-length dealing, nor was it necessarily in Ames' best interests, but it pleased Mills.

THE EFFECT OF MILLS AND COMPANY ON MASON AND COMPANY

To what extent did Mills and Company become involved in the internal affairs of Mason and Company? Certainly Mills provided some working capital and credit by taking Mason's customers' notes and securities and by accepting Mason's drafts. Likewise, he constantly meddled in the administration of the firm, without much need to do so, considering William Mason's ability as a businessman. However, the Mills and Company partners seem to have provided little of Mason's business. Only 4.8 percent of Mason's mule spindles, 11.0 percent of his frame spindles, 2.3 percent of his looms, and 10.3 percent of his carding engines were sold to mills in which Mills' partners were involved. Most of these sales were to the Whittenton Mill of Taunton and the Indiana Cotton Mill, since James K. Mill's efforts at eliminating competition

\textsuperscript{100}Memo of Agreement, Hadley Falls Company, Ames Manufacturing Company, and Glasgow Company, AB-7, Box 6, Lyman Collection.
between his machine shops left Mason with orders for only a few machines for the great Connecticut Valley mills. With one exception, all Mason sales to the Connecticut Valley were of Mason's patented self-actor mules.\textsuperscript{101} Only in two cases did Mason's sales of railway locomotives seem to have a direct connection to the Mills and Company partners. In 1855 five engines were sold to the Western Railroad in which Dwight and Mills had played an important role, and in 1855 and 1856 four locomotives were sold to the Hannibal and St. Joseph of Missouri of which Mills was a shareholder and of which the Springfield friends of the Dwights were key promoters.\textsuperscript{102} William Mason was forced to hustle for the rest of his business.

Mills and Company's most important contribution to Mason and Company was the capital which established the firm and helped finance its expansion in 1845 and in the early 1850's. From his predecessors Mason inherited in 1842 a small, inefficient physical plant scattered

\textsuperscript{101}"Machinery Records: Masons Machine Works," Old Colony Historical Society, Taunton.

about Taunton. Part of his operations were housed in the small brick shop built on School Street in 1827 for the Taunton Britannia Manufacturing Company and used by Crocker and Richmond and Leach and Keith after the Britannia works moved to a Britanniaville waterpower site. A mile to the north Mason had 30 more men working under his younger brother, Japhet, in the Britannia Company's Britanniaville building. He had only the upper floor, as the britanniaware maker and a nail and tack works occupied the lower floors. A mile to the west of the School Street plant Mason and Company had a third shop in the basement of Charles Richmond's Brick Mill where William Mason had first worked when he

103 Emery, History of Taunton, pt. 1, p. 658; Union Gazette and Democrat (Taunton), Mar. 27, 1862; Hall, "Taunton: Manufacturing Interests," p. 825. This may or may not have been the "building consisting of a main building and additions formerly occupied for a machine shop situated on Fayette Street," later School Street and equipped with a steam engine, for all of which Crocker and Richmond secured insurance on June 11, 1843, with the proviso that the policy would be void if steam engine was run or if the plant was used for manufacturing—a provision that disturbingly suggests that the plant was unoccupied when Mason was supposedly using it. Are these two different plants or a single plant? See Policy, Samuel Crocker Collection, New York Public Library. Supposedly William Mason developed his patent speeder in this plant.

came to Taunton. Transportation and supervision problems resulting from such a fragmented operation must have greatly increased management headaches and operating costs. Moreover, Mason and Company lacked a foundry, a complicating but not unusual circumstance for a mid-1840's textile machinery shop. When the high 1842 tariff launched the 1843-1845 textile mill-building boom, Mason's sales soared to the record pre-Civil War high, severely straining the cramped, inefficient facilities. Impressed with the success of Mason's first two years, the Mills and Company partners agreed in early 1845 to help finance a large new shop of William Mason's own design. Mason himself was able to pay for much of the expansion out of his large earnings from the firm's first years, so by the end of 1845 Mason had a 50 percent interest in the firm.

105 Hall, "Taunton: Manufacturing Interests," p. 827; Emery, History of Taunton, pt. 1, pp. 645-646; "Reminiscences of Mill River," Taunton Weekly Gazette, Jan. 21, 1875; anonymous notes dating from the 1880's, file VC 871 R, OCHS.


107 Livingston, Portraits, pp. 17-18; Ware, Early Cotton Manufacture, pp. 141, 152, 302; "Taunton, Mass.," Waverly Magazine, June 10, 1854.
MASON'S 1845 SHOP

William Mason could have relied as most of Taunton's other factories on Mill River's unreliable waterpower, or he could have constructed his new shop next to the city's docks in the Weir district of Taunton, instead he put his shop along the Taunton Branch Railroad away from water, indicating his belief in the future primacy of railroads over boats and of steampower over waterpower. Mason's new shop also dramatically symbolized the textile machinery industry's liberation from the over-lordship of cotton mills and waterpower companies. Neither a mill-basement shop nor a shop built to fill a waterpower company's mills, Mason's new shop was a large-scale commitment to the concept of the independent machine shop which would succeed or fail on its own without a captive market. If there was any doubt as to Mill's belief in independent shops, 1845 was also the year he liberated the Chicopee textile machine shop by engineering its purchase by Ames from the Springfield Canal Company.

One of the largest textile machine shops of its time--Mason with characteristic braggadocio told Bishop
it was the largest—the 1845 shop set the example other builders soon followed: spacious facilities specially designed for machine manufacture with all processes, including the foundry, in one integrated factory.

Whitin's 1847 plant copied Mason's main machine shop building even down to the decorative battlements. 108 Occupying six acres, Mason's new plant featured a main machine shop 315-by-45 feet and three stories and an attic high for half its length, two stories plus attic for the other half. Separate buildings housed a 100-by-30-foot smithy and a 100-by-50-foot foundry, which freed Mason from the time and trouble of relying on outside foundries. In 1848, a two-story, 100-by-56-foot machine shop was added. 109 By 1848 the plant totaled an impressive 74,412 square feet of floor space. Although Whitin's 1847 shop occupied 93,636 square feet, most competitors had less space. Danforth on the eve of adding locomotives to his cotton machinery

108 Navin, Whitin, pp. 36-37; Bishop, American Manufactures, 3: 321.

109 Livingston, Portraits, p. 17; Bristol County Deedbook 175, pp. 176-178; Emery, History of Taunton, pt. 1, p. 658; Insurance Plan 14562, Courtesy of Factory Mutual Engineering Corporation, Norwood, Mass. An extra floor was added to the main machine shop following an 1868 fire, Union Gazette and Democrat (Taunton), Jan. 9, 1868.
business in Paterson, New Jersey, had but 34,950 square feet and Jenk's Bridesburg plant in Philadelphia used an area 49,270 square feet.\footnote{110}

The tools which filled Mason's shop were highly specialized, many being adapted to a single highly specialized task, such as a multiple-spindle drill press designed to bore at precise intervals the holes in a rail for the rings of a ring spinning frame. This high degree of machine specialization was common to textile machinery shops by the late 1840's and 1850's. Mason's most common machines were lathes, followed by planers, which proliferated in the late 1840's, and drills. Other machines included bolt and screw cutters, roller fluters, polishing machines, punches, gear cutters, grinders, straightening machines, shears, bending machines, trip hammers, and wood morticers, tenoners, lathes,

planers, and boring machines. It was a far cry from the simple lathes, fluting engine, grindstone, and tilt hammer which was all William Mason had had to work with while he was in Killingly in the mid-1830's. Since a separate machine-tool industry did not fully emerge until the 1850's, Mason built many of his own machines. Later in the 1840's and in the 1850's Taunton's Foundry and Machine Company supplied many machines for Mason while other Mills and Company shops built some to orders placed by James K. Mills.

In the 1845 state census, the total capital invested both in Mason and Company's three old shops and in Charles Richmond's tiny operation was $51,000, probably $50,000, of which was Mason's. Five years later, after construction of the 1845 shop and its 1848 addition,

111 Unfortunately no Mason inventories of tools have been found, so this has been pieced together from "Taunton, Mass.," Waverly Magazine, June 10, 1854; Colburn's Railroad Advocate, July 26, 1856; Special Records, MS 205.40, Mason Machine Works Collection, Merrimack Valley Textile Museum, North Andover. Some of these postdate the period under study, but the high degree of specialization is verified by inventories of Machinery Purchased from Hadley Falls Company, Feb. 10, 1859, v. QG-1, Whitin Machine Works Collection; and of Essex Company, Mar. 31, 1847, States of Affairs, 1847-60, Essex Company Collection, both Baker Library, Harvard.

112 Bristol County Deed Book 28, pp. 161-162.

Mason and Company alone listed its capital at $200,000. Yet, in 1845 Mason and Richmond employed 203 men. Five years later Mason's work force stood at only 300, reflecting the post 1845 slackening in mill building which left Mason's shop partially empty much of the time. In the year prior to the 1845 state census, Mason's three small old shops and Richmond's limited operation produced machinery valued at $172,500, 15.8 percent of all reported Taunton manufactures. In the year ended June 1, 1850, Mason produced only $57,500 more. This illustrated the tendency for the nineteenth century machine-building industry to respond to the feast-or-famine cycles of demand by expanding rapidly during booms. This response penalized Mason and most competitors three ways: their expansion was at a time of high boom prices, expansion came too late to enjoy much of the boom-level of business, and they were burdened with a partially empty plant in the recession which arrived soon after. Mason's expansions

all came during booms: 1845, the mid-1850's, the early 1870's, and the early 1880's. Only a few firms--Baldwin was one--had the foresight to develop the strategy of expanding during recessions when prices were low so that they could handle the business of the next boom. Considering the obviousness of the nineteenth-century business cycle, most businessmen seemed peculiarly short-sighted in dealing with it, Mason and Mills included.

Mason and Company fits the Massachusetts pattern of the 1840's. Textile machinery shops were moving out of the mill basements into new buildings, as in the case of Mason or Whitin, and gaining their independence from the great waterpower companies, as in the examples of Springfield Canal and Locks and Canals. The era of the large, independent shop had emerged. However, with the exception of Whitin, the Massachusetts shops were generally still owned by the same merchant capitalists, particularly the commission merchants, who also controlled the textile mills. It was not until 1857 that most of the big shops were freed from the control of the merchants.

Mason's new shop represented the beginning of the late 1840's shop-construction boom which included
Whitin's new building and the new shops at Holyoke and Lawrence. This construction inflicted the industry with excess capacity which it suffered until the 1857 Panic caused the demise of the Hadley Falls and Lawrence shops. This overcapacity was exacerbated by the cessation of mill building in Lowell in the 1850's which led to the huge Lowell shop's entry into the markets of Mason and the other shops. In this increasingly competitive atmosphere, Mason emerged as one of the strongest shops, able to hold its own because of its reputation for fine workmanship, its outstanding designs, and the business skills of William Mason. Because of this, it was the only one of Mill's shops to survive as a textile machinery builder after Mills' 1857 failure.
CHAPTER VI

TEXTILE MACHINERY BUSINESS, 1842-1861:
WILLIAM MASON AND COMPANY

At its formation in late 1842, William Mason and Company had the products and capital with which to build a successful business. William Mason brought to the firm outstanding patterns for a complete card-to-loom cotton machinery line, the new enterprise's passport to success in the competitive textile machinery market south of Boston and Springfield. Equally vital was James K. Mills and Company's ability to provide Mason with working capital and with one of the best plants in the industry. With Mills and Company's connections and Mason's business skills, the firm developed a substantial business outside of New England to augment its basic southern New England market. The new firm also owed its success to its close identification with the emerging steam cotton mill movement led by Charles T. James. With all these forces working for it, Mason and Company quickly grew into the second largest
American textile machine shop in the mid-1840's and the largest in the late 1850's and early 1860's.

PRODUCTS

At its opening in late 1842, Mason and Company offered a complete card-to-loom line of cotton mill machinery: finisher carding engines, drawing machines, speeders, ring frames for both filling and warp, mules, warping frames, dressing frames, and looms. With the possible exceptions of the dressing frame and speeder, these machines embodied William Mason's own designs.\(^1\) Whether the speeders were of Mason's 1838 patent design or of the Danforth tube type is unknown, but it is doubtful that they were fly frames. Mason, in its early years, specialized in ring frames and mules, making most of the other machines only for those few mills which were fully equipped by Mason. As did many other builders, Mason sometimes also provided customers with plans for mill machine layout, power transmission shafting,

and buildings. He even suggested a plan for the
tenements of the Pemberton Mill at Lawrence in 1853.2

After the opening of the new shop in 1845,
Mason's line of textile equipment expanded and his
sales diversified. In the late 1840's, he added railways
and railway heads, devices which conveyed the product
of several cards through a railway trough to a railway
drawing head at the end of the trough. To satisfy the
needs of the fine goods mills, he also developed combers
and replaced the tube speeders with English-style slubbers
and fly frames. Additionally, he made twisters, spoolers,
warpers, dressers, quillers, and reels, which prepared
the thread for the looms. Shafting and belting for
power transmission and mill elevators were installed
in some mills.3 Wellman cards and card-flat grinders
entered the product line in the 1850's. At the same time,

2"Machinery Records;" J. Pickering Putnam
to Charles H. Bigelow, Mar. 29, Apr. 1, May 25, 1853,
Essex Company Collection, MS 306, Merrimack Valley

3"Machinery Records;" Cannelton Cotton Mills
Letterbook, Dec. 5, 1850-Nov. 10, 1852, Indiana
Cotton Mills Collection, Lilly Library, Indiana
University, Bloomington.
looms joined mules and ring frames as one of Mason's product specialties.\textsuperscript{4}

In the 1820's and 1830's, the large textile machine shops had tended to build all machines for a mill, but in the 1840's and 1850's patent monopolies began to create a new breed of specialists from which many other shops purchased the machines needed to complete a contract to fill an entire mill with machinery. Likewise, many mills began to contract separately with the various specialists for each type of machine. Mason saw no need to develop openers, pickers, and breakercards since other firms, Whitin in particular, had patented excellent versions of these pre-card machines. Besides, a large mill needed only a few of all of these types together.\textsuperscript{5} Cotton machinery specialists in mid-century included Whitin in openers, pickers, and breaker cards, Mason in mules, Thomas J. Hill's Providence Machine Company in English-style fly-frames, and Furbush

\textsuperscript{4}William Mason to S. Adams, Apr. 12, 1861, Box MO-2, Dwight Manufacturing Collection; "Machinery Records."

\textsuperscript{5}Whitin's Orderbook KA-1 shows orders built for Mason (so that Mason could equip complete mills) and for many of Mason's other competitors, Whitin Collection, Baker Library, Harvard.
and Crompton in fancy looms. During Mason's first two decades in business, 1842-1861, almost half of his textile machinery output consisted of mules and much of the other half of ring frames, a reflection of his role as the industry's spinning specialist. Indeed, from 1845 to 1865 he installed more spindles than any other builder except possibly Lowell Machine Shop.6

SELLING TEXTILE MACHINERY, 1842-1861

In contrast to the seller of cotton goods, the cotton machinery builder had no need of salesmen or of commission merchants such as Mills and Company. Direct, personal contact between the mill owner, officers, or agent and the machinery builder initiated most sales. In northern New England, the relationship between the large Lowell-type shops and mills was particularly close due to the interlocking ownership of shops and mills, so prior to the 1850's the bulk of these northern shops' machinery was sold to local mills.

6 "Machinery Records;" Gibb, Saco-Lowell, pp. 196, 649. Because Mason's "Machinery Records" only covers cards, mules, ring frames, and looms, one cannot give precise percentages; however these four types of machines would have accounted for most of Mason's machinery output.
Typically a Lowell-system shop contracted to supply all of a local mill's machinery, including turbine and power-transmission equipment. To upgrade their product line, these shops aggressively sought patent rights to build machinery designs developed by other shops.  

Denied such a captive local business, Mason and the other southern New England and Middle Atlantic shops turned to the small mills scattered from Maine to Mexico. Although a given shop's reputation for quality machines and personal connections brought that shop most of its orders from the small mills, occasionally Mason and other southern shops sent officers or agents on sales trips to distant markets, particularly in the South.  

E. Kent Swift, Jr., the son of a former

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7 Unless otherwise stated, this section is based largely on the Whitin, Nashua, Locks and Canals, Naumkeag, Dwight, and Lyman Collections, Baker Library, Harvard; Gibb, Saco-Lowell; Navin, Whitin; and a general knowledge of the industry.

8 Taunton newspapers of the 1860's mention Southern trips by Mason treasurer William Bent and by William Mason's son Frederick, and there is no reason to suspect that William himself did not make such trips earlier. Kilburn, Lincoln and Son's Jonathan Thayer Lincoln made such a Southern trip in 1859, Emery, History of Taunton, pt. 2.
Whitin Machine Works president, recalls stories he heard from company officials who sold cotton machinery in the South in the nineteenth century:

Selling was like belonging to a club. Your men had to be well-known, of good family, good businessmen. There was often no hotel in small Southern towns, so they'd stay in the mill owner's home. They had to make a good impression.9

Understandably William Mason sent his more polished, Cambridge-bred assistant William Bent and his Harvard-educated son Frederick to the South instead of himself.

More commonly, the buyer came to the seller, particularly during mill-building booms. The initial contact between buyer and seller was most often a letter from the mill to the shop or, less frequently, a personal visit by a mill officer. An officer or owner usually represented the mill, but on occasion mill owners delegated to search committees or consulting engineers the responsibility for obtaining machinery. It was in his capacity as consulting mill engineer that Charles T. James brought Mason much of its business.10

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10 See especially Naumkeag Collection, Baker Library; James, Letters; Zanesville Aurora, Mar. 23, 1853.
Advertising and other public relations activities were used to a modest degree by the shops, probably with even more modest results. Business directories and even the advertising pages of popular books carried shop advertisements, as did textile trade journals when they emerged in the last half of the century. Circulars mailed to mill owners announced the existence of a new firm or product. To win acceptance of new machines, builders operated them at trade fairs such as those at the American Institute in New York or at the Boston Mechanics Institute and offered free trial demonstrations in mills. However, all these public relations devices generated few sales compared to friendship and reputation.

Personal association secured many orders. James K. Mills influenced his friends to acquire their mill machinery from Mason, Springfield Canal, and Ames. This is known to have been the case with the Cannelton and Saratoga Victory mills, and was likely true of many others. Another significant generator of sales was the demonstration effect. The successful equipment

11 Letterbook GB-1, p. 55, Nashua Collection; Railroad Gazette 15 (1883): 341.
of a mill often brought many orders from other mills in the area, as in the case of Mason's 1842 mules for the Bartlett Mill in Newburyport which led to 46,568 spindles worth of orders from five mills in Newburyport during the next ten years. Likewise, Kennedy, Childs and Company's 1845 order from Mason for the equipment for the 3960-spindle Penn Mills in Pittsburgh led to nine orders from five Pittsburgh mills over the next fifteen years, plus orders from other Ohio basin mills in Steubenville, Wheeling, Zanesville, Frankfort, Newport, Cincinnati, and Cannelton. Mason's 1847 equipping of William Gregg's prestigious Graniteville Manufacturing Company—the first large, New England-style mill in the South—provided incomparable free publicity for Mason and Company. 12

The quality, design, availability, and price of machinery also determined the choice of suppliers. If a mill desired a particular design or quality of machine, its choice of builders was obviously limited. However, since most mills were built during a boom, they often found themselves forced to buy from the builder who could fill the order most quickly. During slack periods, 12 "Machinery Records."
price and conditions of credit became more important, and on occasion mills even solicited bids. Price cutting among shops led to depression price levels 20 to 50 percent below previous highs. Even in prosperous years, valued old customers could command a 5 to 10 percent discount.\(^1\)

Early in the century, most builders quoted prices F.O.B. at their shop, but by mid-century they often absorbed at least part of the cost of shipping to New England mills, particularly for large orders. By the late nineteenth century most New England mills were charged delivered prices, but more distant mills had to pay for shipping.\(^2\) As important as the prices were the credit terms granted by the shops. Mason and its competitors generally accepted 30, 60, 90, or 120 day notes, or they wrote drafts on a mill when the machines were shipped.\(^3\) In the early 1840's, Locks and Canals' letterbooks showed that Southern customers had to pay in

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\(^1\) See for example Box M0-2, Dwight Collection; Items B-1 and CA-1, Naumkeag Collection.
\(^2\) See note 7.
\(^3\) For example, see especially Journal CA-1, Naumkeag Collection, Baker Library.
advance—a policy that reflected tight-money conditions in the South and heavy Southern defaults in the 1837 Panic.

Once a builder made an initial sale to a mill, he could expect many repeat orders. Repair parts were traditionally considered to be about 10 percent of the cotton machinery industry's business. Furthermore, mills repeatedly reordered to expand their capacity. Mason's nineteen largest spinning machine customers for the period 1842-1861 ordered only 173,616 spindles the first time around, but 276,536 spindles in their reorders. These reorders totaled 61.4 percent of these mills' total ring frame and mule orders, and 36.8 percent of all Mason spinning machine sales. \(^{16}\) Mason's experience suggests that after a couple decades existence a shop's repair and repeat orders from old customers were greater than the total of new orders.

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\(^{16}\)"Machinery Records." These firms were, in descending order of size: Naumkeag, A. & W. Sprague, Atlantic DeLaine, Harmony, Washington, Waumsutta, Hadley Falls, Cocheco, Lonsdale, Pemberton, Conestoga, George C. Ballou, Bartlett, Lancaster, Reading, James, Cannelton, Harris, Agawaum Canal. They accounted for 60.0 percent of Mason's mule and ring frame sales, 1842-1861, and consisted of all customers to which 10,000 or more spindles-worth of these machines were sold.
Mason's Market and Competition, 1842-1861

Mason sold most of his machinery south of the Springfield-Boston line because of the dominance by Lowell, Lawrence, Amoskeag, Saco, Ames, and Hadley Falls of their respective local markets in northern New England. Only 12.4 percent of his spindles went to the large, Boston-controlled water-power mills. He delivered a mere 1440 spindles to Lowell and none to Manchester and Nashua. The bulk of his northern orders came from the steam mills at Newburyport and Salem, Massachusetts, and from the water-power mills at Dover and Great Falls, New Hampshire—all towns without machine shops. The Pemberton Mill in Lawrence, to which he sold 20,672 spindles-worth of machinery, stood as an exception to this pattern. Further limiting Mason's market, James K. Mills reserved the Connecticut Valley business to the Chicopee and Holyoke shops. Reflecting this, between 1842 and 1861 Mason sent only 6.5 percent of his spindles to Mills and Company factories.17

17 Spinning machine spindle totals from "Machinery Records." Since no record of the dollar value of sales by machine type exists for Mason for this period, separate indicies of prices by year for cards, looms, mules (per spindle), and ring frames (per spindle) were constructed from prices in Tsung-yuen Shen, "A Quantitative Study of Production in the American Textile Industry" (Ph.D. dissertation, Yale University, 1956), p. 4; Inventory FC-6, Laconia Manufacturing Company, Pepperell Collection, Baker Library, Harvard; Gregg, Essays, Table B, p. 59; DeBow's Review 7 (1849): 176. Prices for given machines for years in which no price information was available were interpolated using Series L-9, 1949 ed., Historical Statistics: all very unscientific, but adequate to estimate value of sales per year per machine within a few percent error.
New England's small mills and coastal steam mills—particularly those in Connecticut and Rhode Island—were Mason's major market, accounting for 66 percent of his sales. Most of these orders were small, except those from Charles T. James, A. and W. Sprague, and the Lonsdale Company of Rhode Island. Limited waterpower had restricted the size of mills and mill towns in southern New England, engendering a pattern of small, dispersed machine shops, reflecting the distribution of mills. Lanpher's shop and the many small Pawtucket establishments exemplified this situation. When Mason, Whitin, and a few other southern shops expanded in the 1840's, they quickly dominated this large, dispersed market at the expense of the shops that failed to expand.

Mason was well-situated to exploit the Rhode Island system market. His ring frame's low power consumption and labor savings appealed to the small-mill owner, as did the self-actor mule which reduced the fine-goods producer's needs for skilled mule spinners. As southern New England turned to the manufacture of progressively finer goods, the demand for his self-actors rose. During the period 1842-1861, 71.2 percent
of all Mason self-actors went to the small New England mill centers. Indeed, the mules placed in these mills by him represented 52.2 percent of all of his spindle sales, both ring frame and mule. Other factors also helped Mason's sales to the small mills of southern New England. Many mill owners in the region already knew him from the years he spent in the Lanpher, Crocker and Richmond, and Leach and Keith shops. Of equal importance, his new 1845 shop gave him the facilities to meet orders quickly.

Except for P. Whitin and Sons after construction of its 1847 Whitinsville, Massachusetts, shop, Mason's competitors in the southern New England market were small firms. Since the large northern shops sold little machinery in southern New England before the Civil War, only the small Providence-area shops competed with Whitin and Mason. The small size of the Rhode Island-type builders was due in part to their specialization in one product. The English-style fly frames of Thomas Hill's Providence Machine Company dominated the market, while Franklin Foundry and Machine and James S. Brown

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18 For example, see Gibb, Saco-Lowell, pp. 191-192.
concentrated on Roberts-style self-actors. Fales and Jenks, by far the largest of the Rhode Island shops, and Levally, Lamphear and Company became best known for their ring frames. Most of these firms were run by men who had learned their trade under Slater or Wilkinson, and Providence Machine was even founded by Samuel Slater. As to honor Slater's English origins, three of the five firms specialized in English-designed machines: the Roberts mule and the fly frame. Just across the state line from Rhode Island were the two Fall River shops, Hawes, Marvel and Davol, best known for its mules, and E. C. Kilburn and Company, which emphasized loom and turbine production. Of these Fall River and Rhode Island shops, only Providence Machine, Fales and Jenks, and Kilburn and Company competed effectively with Mason, and then only in one machine.

Of all the southern New England shops in the 1850's, only one approached Mason's size, Whitin of


Whitinsville, Massachusetts. Whitin was, much as Mason, a former mill shop which had outgrown the basement. Originally Whitin specialized in pickers, but after the 1847 opening of its big shop building, the firm became a broad-line cotton machinery builder with an opener-to-loom list of products. It was Whitin which would emerge as Mason's greatest competitor.

Selling outside New England

The Middle-Atlantic region accounted for 16 percent of Mason's pre-1862 sales. These customers were mostly in the upper Hudson Valley and in southeastern Pennsylvania and adjacent areas of Delaware and New Jersey. Paterson remained the province of the local builders, Rogers and Danforth. Measured in spinning capacity, Harmony Mills outside Albany in Cohoes, New York, and Washington Mills across from Philadelphia in Gloucester, New Jersey, ranked as Mason's fourth and fifth largest antebellum customers. Other large Middle Atlantic customers included the Conestoga Mills in Lancaster, Pennsylvania (eleventh), the Reading, Pennsylvania, steam mill (fifteenth), and the Saratoga Victory Mill in Schuylerville, New York. Having proper
connections proved of utmost importance in getting this business. Orders for the equipment for the Washington, Conestoga, and Reading mills came from Mason's foremost customer, Charles T. James. In like manner, James K. Mills secured contracts for his Chicopee shops to equip the Saratoga Mill and one of the Conestoga mills, then spun off the mule portion of the contracts to Mason. Not incidentally, the Saratoga Mill was headed by Mills' friend E. R. Mudge of Boston.  

The remaining 9 percent of Mason's sales were divided almost evenly between the Ohio Valley and the South, excepting an insignificant 0.2 percent sent to Brazil and Peru. All but a few of these Southern and Western sales were made in the 1845-1850 mill boom. Cannelton Mills in Indiana and Penn Mills in Pittsburgh stood as Mason's most important Ohio Valley customers, but he also sold to mills in Wheeling, (West) Virginia, in Steubenville, Zanesville, and Cincinnati, Ohio, and in Covington and Frankfort, Kentucky. Most of Mason's

21 The Mason machines which went to Washington were ordered by James to reequip the mill. James, *Letters*, pp. 18, 20; Dudley, "Growth," p. 8; Springfield Canal's contract with Conestoga and Ames' contract with Saratoga, Box MU-2, Dwight Collection, Baker Library; "Machinery Records." See footnote 17.
Southern sales went to the Savannah Valley of Georgia and South Carolina, home of his largest Southern customer, Graniteville, and of several smaller patrons. Southern customers also included the Charleston, South Carolina, mill and two Tennessee mills, but none in North Carolina and Mississippi.  

Southern and Ohio Valley mills of the period were typically small, locally financed, steam mills; a 3000-spindle mill being about the limit of the resources of petty capitalists in these currency-starved regions. Graniteville, to which Mason supplied 8400 spindles plus looms and cards in 1847, was unusually large for a mill built with local capital in the rural South. Indiana's Cannelton Mill managed to build a New England-scale mill of 10,800 Mason spindles only because of the investment of outsiders, including Charles James and James K. Mills. Almost all other regional mills were tiny by comparison. Alabama mills in 1850, for example, averaged under 1700 spindles.  

22 "Machinery Records."

and credit shortages, these Southern and Ohio Valley customers with the exception of Penn, Cannelton, Graniteville, and a few others, became marginal enterprises slow to pay and quick to fail.\textsuperscript{24} Although no evidence remains that Mason had trouble with delinquent payments, other Mills and Company shops did. After sending many letters to the Shelbyville, Tennessee, mill requesting payment for Ames Manufacturing Company machinery, James K. Mills finally wrote fellow commission merchant and Cannelton investor H. D. Newcomb of Louisville asking advice on how to collect from a Tennessee debtor. Two years after delivery, the bill remained unpaid.\textsuperscript{25} Experiences such as this could explain why Mason largely withdrew from the Southern market after such a promising start.

The remoteness of Southern and Western mills created problems for both shop and customer, particularly

\textsuperscript{24}I thank Professor Harold Wilson for his instructive comments on the condition of this industry.

\textsuperscript{25}James K. Mills to H. D. Newcomb, Dec. 6, 1855, and many letters by Mills to Gilliard, Doak and Company, Letterbook PW-3, pp. 54, 82, 345, 358, 366, 423, Lyman Collection.
prior to the establishment of rail links in the 1850's. Shipping was slow, costly, and subject to breakage and pilferage. Mason's machinery for the 1850 Cannelton Mill on the Indiana bank of the Ohio River travelled by coastal ship to New Orleans, thence came up river by steamboat, an extremely long journey of several months. Repair parts also took months to obtain, so local machine shops and foundries supplied some simple replacement pieces, leaving the more complicated parts to the New England shops. Because it was so hard to buy at such a distance, some mills in which Mason, Ames, or James had been involved retained Mills and Company to secure supplies, repair parts, or skilled labor. The deficiency of skilled labor in these mills also affected Mason. Because even self-actors required skilled spinners, he sold no mules to the South and Ohio Valley, but his ring

26 *Cannelton Economist*, Apr. 6, 1850, clipping in Indiana Cotton Correspondence, 1852-1854, Indiana Cotton Mills Collection; "Machinery Records," p. 100.

27 Various correspondence, Lyman Mills, Locks and Canals, and Indiana Cotton Mills Collections. The box of Correspondence, 1852-1854, Indiana Mills, is full of examples of Cannelton's problems. A Louisville shop was so scared of one of Corliss' designs of cylinders that the engine had to be shut down for weeks until Corliss could send a replacement. One can well guess at the lost production involved. Locks and Canals seems to have performed a similar function to Mills.
frames, which could be operated by women and children, enjoyed considerable popularity in both regions. 28

Mason's Competition outside New England

Most of Mason's competition for sales outside New England came from southern New England and Middle Atlantic shops. 29 By 1850, Matteawan had dissipated its technological leadership of the 1830's by diversifying into machine tools, steam engines, boilers, sugar mills and gins. However, the firm still furnished all equipment needed for a cotton mill, a feature which made them popular with Southern mill owners with no cotton manufacturing experience. Forsaking its traditional New York market, in 1850 Matteawan built the machinery for at least one Georgia and three Tennessee mills. It is interesting to speculate that Southern mills' poor debt payment record may have been one explanation of Matteawan's 1851 failure. 30

28 "Machinery Records."

29 In the 1830's the Athens, Georgia, mill had English machinery, despite the British laws, and Harold Wilson informs me that there were others. See Montgomery, Practical Detail, pp. 188-189; White, Memoir, p. 282.

The two Paterson, New Jersey, shops, Danforth and Rogers, competed with both Mason's locomotives and cotton machinery. They dominated the Paterson cotton machinery market and sold many machines in the South. Rogers, Ketchum and Grosvenor partner Morris Ketchum was a New York cotton merchant who had lived previously in Charleston and had extensive land investments in the South. His Southern connections brought his shop many antebellum Southern sales of locomotives and textile machinery.  

The Jenks' Bridesburg shop in Philadelphia specialized in ring frames and looms, but probably sold all machines from gin to loom. Eccles and Son and Fairmont Machine, also of Philadelphia, emphasized looms while neighbor Uhlinger produced ribbon and Jacquard looms and knitting machines. These firms supplied much of the cotton and woolen equipment for the Philadelphia area mills, although not enough to prevent Mason from selling some machinery to Philadelphia.

31 N. Y. vol. 368, p. 473, and N. J. vol. 65, pp. 91, 107, Dun; Gregg, Essays, p. 33; Landers, Textile Industry, pp. 21-23.
customers and large quantities to the close-by Lancaster and Gloucester mills. Uhlinger's specialties faced very limited competition and sold nationwide, although they were especially adapted to the needs of the fancy-goods manufacturers in Philadelphia. By contrast, Fairmont and Eccles seem to have served mostly the local market. Bridesburg, Mason's only strong competitor among the Philadelphia shops, sold extensively in the Southern market.32

Among the antebellum New England shops, Fales and Jenks and, to a lesser degree, Lowell sold some machinery outside New England, but Whitin was Mason's most important competitor for these markets. A comparison of Mason and Whitin sales in 1849 and 1850, the only two years of the Southern and Ohio Valley mill-building boom for which adequate Whitin data is available, shows that Mason sold less than in previous years to the South (only 0.3 percent of his spindles). Whitin, however,

installed in Southern mills 46.5 percent of all spindles it manufactured, 66.5 percent of the looms, and 47.1 percent of the cards. Conversely, Whitin sold nothing to the Ohio Valley, while Mason sent to those mills 16.1 percent of his spindles and 25.1 percent of his cards. In the Middle Atlantic states, Whitin did little business, whereas Mason delivered to this region 39.0 percent of his spindles, 29.8 percent of his looms, and 53.8 percent of his carding engines. New England received only 43.3 percent of Mason's spindles, but 53.5 percent of Whitin's, thus reflecting the importance of the Ohio Valley and Middle Atlantic business to Mason those two years. 33

CHARLES T. JAMES, STEAM MILLS, AND MASON

Consulting mill engineer Charles T. James was Mason's most important customer during the years 1842 to 1853. Mills engineered by James bought during this period 35.8 percent of Mason's spindles, 48.1 percent of his cards, and 57.3 percent of his looms, and even after James' 1853 failure these customers continued

33 Comparison of Mason's "Machinery Records" with Whitin Orderbook KA-1, Whitin Collection.
to give Mason frequent reorders. Moreover, the relationship with James firmly established Mason as a supplier of the rising steam-mill industry.\textsuperscript{34}

Charles Tillinghast James (1805-1862) can without much exaggeration be called the father of the American steam mill. Three years Mason's senior, James had a similar practical education in Rhode Island mill shops, to which he added a self-taught knowledge of mathematics and mechanics. Much as in the experience of Mason, James' practical skills led to his being called upon in the early 1830's by small mills in the Quinebaug Valley of Connecticut and by mills in the Providence area to supervise the erection and start-up of their machines. It is quite possible that Mason and James became acquainted at this time, providing a foundation for their later business relationship. By 1834 James' reputation had grown so much that Samuel Slater brought him to Providence to supervise an overhaul of the first fairly large American steam-powered mill, the 1828 Steam Cotton

\textsuperscript{34}"Machinery Records."
Manufacturing Company. Reequipping the Providence steam mill awakened James to the potential of steam mills so that when he established his mill-engineering business, he became the leading advocate of steam mills. He also became a pioneer promoter and engineer of coastal and Southern mills.

After hearing James' inspiring Newburyport lectures extolling the virtues of steam mills, the citizens of that decaying Massachusetts seaport erected in 1837-1838 the first Bartlett mill. Soon afterwards, the shareholders contracted with James first to equip and operate the mill, then in 1840 to add a second mill. In these mills Mason installed his first self-actor mules. In the mid-1840's the Essex, Globe, and James mills were constructed in Newburyport under varying degrees

35 DeBow's Review 9 (1850): 672-674; Dudley, "Growth," pp. 7-8; Appletons' cyclopaedia of American Biography, s.v. "James, Charles Tillinghast;" Malcom Keir, Manufacturing (New York: Ronald Press Company, 1928), pp. 309-310; Dictionary of American Biography, s.v. "James, Charles Tillinghast;" McLane Report 1: 951, 970. Ibid. 1: 579, 927, 966, 970, 972; 2: 39, 164, show that only a couple other mills by 1831 were all steam powered, and that a handful of mills used steam as an auxiliary power source.

36 White, Memoir, pp. 302-303; Dudley, "Growth," pp. 7-8; Bishop, American Manufactures, 3: 387.

37 James, Letters, pp. 15-16; Dudley, "Growth," p. 8; Keir, Manufacturing, p. 301.
of engineering supervision by James. His success in reviving the fortunes of the depressed city—loudly proclaimed in his lectures, articles, and pamphlets—brought to him in the decade following 1844 a rush of contracts to build mills for other towns which hoped to emulate Newburyport. By 1853 James claimed to have engineered over thirty mills with nearly 300,000 spindles, somewhere around 7 percent of the United States total.38

James fathered the business of consulting mill engineering. Previously, mills in the large waterpower centers of northern New England had been designed by the waterpower companies and their shops. In southern New England, mill design had been even more informal. These mills had obtained their equipment in the 1830's by buying some machines and by hiring bright mechanics such as Mason and James to build and start up the rest. This whole casual process had relied on the availability of skilled mechanics close at hand, as well as upon the technical and industrial skills of the entrepreneurs.

However, when mill building spread to small towns with no previous mills, local promoters lacked the knowledge of how to design, equip, staff, and run a mill. It was precisely this service James provided. James would, on contract, design a mill to fit the promoters' capital resources. He then acquired or recommended the choice of the mill's machinery and steam engine, hired key supervisors and operatives, and started the mill. Machinery orders were personally placed or countersigned by James, who demonstrated a decided preference for the finest equipment made in this country: Whitin openers, pickers, breaker cards, and drawing heads; Providence Machine fly frames; Mason finisher cards, spinning equipment, and looms; and steam engines from Providence's India Point Works run by Fairbanks, Bancroft and Company and its successor, Corliss, Nightengale and Company. As a result, James' mills won a flood of prizes and acclaim for the high quality of their fine goods, while the reputations of his machinery suppliers gained accordingly.  

39DeBow's Review 9 (1850): 673; "Machinery Records," Whitin Orderbook KA-1; Greenough's American Polytechnic Journal 3 (1854): 85-86; Journal CA-1 and Ledger B-1, Naumkeag Collection; Indiana Mills Collection; Conestoga Contract, Box MO-2, Dwight Collection; Naumkeag Contract with James, Directors Record Book, AB-1, Naumkeag Collection; R. I. vol. 9, p. 127, Dun; Bishop, American Manufactures, 3: 381-384; Van Slyck, Representatives, 1: 193.
James especially recommended steam mills for small ports which had lost their trade to Boston and New York because these mills had the effect of, "increasing the business and population of the city, of enhancing alike the value of real estate and security its general prosperity . . . ."\textsuperscript{40} Ports made good mill sites, according to James, not only because they made the goods, but also because they controlled the commerce in the completed goods, something Lowell could not do. Coal and cotton could be delivered by ship directly to the mill without costly transshipment by land transport to an inland factory, and delivery costs of finished textiles would be similarly reduced. These savings, James asserted, offset the higher power costs of steam mills. Also, the damp coastal climate facilitated manufacture of finer goods by reducing static electricity.\textsuperscript{41}

James cited other advantages of steam power. Drought seldom shut down a steam mill, and mill expansion could be easily affected by adding another engine rather than by the acquisition of another expensive, possibly distant, waterpower right. Most significantly, steam

\textsuperscript{40}Charles T. James, \textit{A Lecture on the Comparative Cost of Steam and Water Power Delivered at Hartford, Conn.-Feb. 1844} (Newburyport, 1844), p. 11.

\textsuperscript{41}Ibid., pp. 11-19.
engines liberated the factory from its bondage to remote waterpower facilities. Now plants could be placed close to markets, transportation, raw materials, or labor supplies. Locating steam mills in existing cities, saved promoters the costs of erecting houses, grading streets, digging canals, and recruiting labor from distant places—all costs incurred in creating the Lowell-style mill towns out rural sites. An urban steam mill, James was saying in effect, would use the city's existing economic infrastructure without having to create one.42

While James was prone to exaggeration, time would eventually prove him essentially correct. The 1810's had seen the introduction of power weaving and the large, Waltham-style waterpower mill; the 1820's had brought the large Lowell-type waterpower developments and flyerless spinning; and the 1830's had witnessed the introduction of English fly frames and self-acting mules. Clearly the outstanding technological innovation in the cotton textile industry in the 1840's was the rapid spread of steam mills, a movement created largely by James.

42 Ibid.
The steam engine freed the cities of southern New England from their limited waterpower, making possible the operation of mills as large and efficient as those at Lowell. The construction of dozens of large steam mills in the 1860's and 1870's at Fall River and New Bedford just south of Taunton enabled these two cities to replace Lowell and Lawrence as America's two largest textile manufacturing centers. Steam power, by permitting the adoption of large-mill technology in the south, in part caused the late nineteenth century convergence of the northern and southern New England cotton mill systems. Steam power also permitted the boom of the Southern states' cotton textile industry in the 1880's and 1890's, which resulted in the shift of the coarse goods industry to the South where production costs of coarse goods were lower. Unable to compete with the Southern states, northern New England mills converted to finer goods late in the century, further reducing the differences between northern and southern New England mill technologies.

Next to Graniteville's founder, William Gregg, James was the leading antebellum proponent of Southern textile mills. Building mills in the South, preached James, would save the cost of transporting cotton to the
North and then returning it to the South in the form of finished textiles. The profits would remain in the South and Southern prosperity would be strengthened when the diversion of local capital from the growth of cotton to its manufacture reduced the overproduction of raw cotton. Amos Adams Lawrence, a leading Boston commission merchant and mill owner, bitterly rejected James' arguments, charging that the South lacked adequate capital and skilled labor. The North still had suitable waterpower sites, insisted Lawrence. He charged James with underestimating the capital costs of steam mills and with overstating the profit potential. Mill owner William Gregg, who knew best, took the middle ground, protesting that both Lawrence and James did the South an injustice; one by overstating the costs of


44 A. A. Lawrence, "The Condition and Prospects of American Cotton Manufactures in 1849," Hunt's Merchants' Magazine 21 (1849): 492-502; 22 (1850): 26-35. This was a reply to the James article.
cotton manufacture there, the other by minimizing those expenses. In the short run Lawrence proved correct in his assessment of the South's capital supply, but by the 1880's most of James' arguments were proven true with the beginning of the Southern mill boom. Many of the 1880's mills were founded by Southerners who owed their interest in cotton mills to James' earlier tracts and to Gregg's successful, Mason-equipped, Graniteville Mill.

James had close ties with Mason, James K. Mills and Charles H. Mills. Mason or Leach and Keith made almost two-thirds, or 173,000, of the spindles cotton mills installed at the order or recommendation of James. When Mason was filled with a backlog of orders, Charles T. James turned to other Mills and Company shops, including the Springfield Canal Company and the Ames Manufacturing Company. Charles H. Mills even named one of his sons Charles James, further testimony to the close ties James had with the Mills cousins. These ties


46"Machinery Records;" and, for example, Springfield Canal Company Contract with Conestoga Steam Cotton Mills, Sept. 27, 1845, Box M0-2, Dwight Collection. Charles James Mills could also claim that he was named after his father and uncle.
began early in both James' and William Mason's careers when Mason built the mules for the Bartlett Mills in Newburyport. Newburyport mills either built or inspired by James installed between 1843 and 1849 mules with 35,072 spindles, 16.7 percent of Mason and Company's output in that period. In total, the six Newburyport mills bought Mason mules with 55,748 spindles in the 1840's and 1850's.47

The Naumkeag Steam Cotton Mill built in 1845-1847 in Salem, Massachusetts, perhaps more than any other mill under James' engineering and supervision, made his reputation by its size and success. It was America's largest mill beneath one roof, with 32,256 Mason spindles and 576 Mason looms. Moreover its cloth won it many prizes at national trade fairs while its financial success gained the admiration of prospective mill owners. By 1856 the Naumkeag had accumulated a $210,000 reserve fund and was paying 3 3/4 percent dividends. In 1860 a second Naumkeag Mill opened. With 70,272 Mason mule spindles, the company ranked as one of the largest cotton manufacturing firms in the

47 "Machinery Records;" "Mason's Claim."
nation; an effective argument on behalf of James' coastal steam mills and Mason's machinery. 48

Other significant James mills with spinning and other equipment by Mason were the Cannelton, part of the Conestoga Mills in Lancaster, Pennsylvania, and the Atlantic Delaine in Providence. Also, James engineered and Mason built machines for the Reading Cotton Manufacturing Company, the Harrisburg Steam Mill, and Pittsburgh's Penn Mills, all in Pennsylvania, and for mills in Sag Harbor, Long Island, Fitchville, Connecticut, Charleston, South Carolina, and Rockport and Saundersville, Massachusetts. In addition, James and Mason reequipped the Washington Mills in Gloucester, New Jersey. Indeed, the only James mills for which Mason seems not to have built the equipment were the Newport Manufacturing Company, the Warren Manufacturing Company, and the Bristol Steam Mill in Rhode Island and possibly two unidentified Tennessee and Maine mills. 49

48 See especially CA-1, AB-1, MA-1, Box 4, Naumkeag Collection; Mass. vol. 23, p. 138, Dun; "Machinery Records."

49 "Machinery Records;" James' Reply to A. A. Lawrence, Hunt's Merchants' Magazine 22 (1850): 290-311; James, Lectures; Dudley, "Growth," pp. 7-8; Indiana Cotton Mills Collection.
No sooner had James become a United States Senator in 1851, than he undid his success in Sophoclean fashion. First came the failure of the Charleston, South Carolina, mill he promoted. James had engineered and equipped the mill in 1847-1848, but the 3,432 ring frame spindles and 100 looms—all Mason—were too few to support the overhead. To encourage the local shareholders to embark on a four-fold expansion of the mill, James offered to subscribe to $200,000 in new stock if the South Carolinians did likewise. When they balked, James withdrew his offer. The uneconomical little mill failed in 1852 and auctioned off its machinery. Not only was James poorer, but some of A. A. Lawrence's predictions on the barriers to Southern cotton mills had proven true—at least for the time being.

Then, in 1853 James failed. Always a bit prone to promise more than he could deliver, James had agreed to build the Atlantic Delaine musline mill for only $90,000 in cash and $150,000 in stock. He had to borrow $75,000 to


finish the mill and was unable to repay. Thereafter James left the mill business. He completed his self-destruction in 1862 when an artillery shell of his own design accidentally exploded in his face.

The association with James was important for Mason. Not only did it provide a large, steady business vital to a new firm, it gave Mason some steady customers which kept reordering. More significantly, the relationship linked Mason's name with a man widely known for his progressive ideas. James' mills stood as outstanding advertisements for Mason machines.

MASON'S OUTPUT AND INDUSTRY RANK

As did other textile machine shops, Mason sold most of his machines to a few customers. The nineteen customers who bought 10,000 or more spindles apiece from Mason took 60.0 percent of all spindles sold by him between 1842 and 1861. Of these firms' purchases, 61.4 percent were reorders, indicating the steady, long

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52 R. I. vol. 9, pp. 197, 264; Caleb Cushing, Arguments for the Plaintiff in the Case of Charles T. James vs Atlantic Delaine Company...(Washington, 1867), pp. 3-4, 8, 16-24.

53 Dictionary of American Biography, s.v. "James, Charles Tillinghast."
term nature of their patronage. Most of the rest of Mason's sales consisted of tiny orders for one to three machines. The average order from the nineteen largest spinning machinery customers was for 4738 spindles; from all other customers, 1502 spindles. Of Mason's orders for spinning machines, 1842-1861, 44.7 percent amounted to less than 1000 spindles, 12.2 percent for less than 150 spindles. Certainly Mason's profit must have come mainly from the sales to the nineteen large customers. Small wonder that they received discounts!

Mason's as well as other textile machinery builders' sales fluctuated sharply from year to year. His orders, stated in spindles, were up 55.5 percent in 1845 from 1844, down 72.7 percent in 1846, then up 18.1, down 49.0, up 355.1, down 74.3, up 299.3, then down 58.5 in 1852. Having had enough of this roller coaster, in 1852 Mason and Mills determined to diversify the business by adding to their products files and railway locomotives, which enjoyed different, cyclical

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54"Machinery Records." For the identity of the nineteen largest customers, see note 16.
pattern of demand. Locomotive sales followed the general business cycle. Locomotive sales followed the general business cycle. In contrast, the fluctuation in cotton machinery sales was caused by and lagged slightly behind mill profits. This in turn related closely to the size and price of the cotton crop and to the amount of mill overcapacity still left from the previous mill building boom. One could say with double entente that Mason's sales were as changeable as the weather. Indeed, the demand for cotton machinery had its own cycle only partially related to the general business cycle.  

Given the quality of Mason's machines, the capital of Mills and Company, and the steady patronage of Charles T. James, by 1845 Mason and Company's cotton machinery sales stood second to Lowell Machine Shop. A decade later, Mason outsold Lowell in spinning machines, and by 1860 he emerged as the industry leader in total sales, total spindles, and total looms. Mason yielded his leadership to Lowell and Whitin in the late 1860's when rising locomotive sales led him to neglect his

textile machinery--fatally--as it eventually turned out.\textsuperscript{56}

If one assumes that the 1860 Census figures are accurate and that few Mason spindles had been scrapped in eighteen years, then Mason had built about 18 percent of the spindles being used in the nation's factories in 1860.\textsuperscript{57} Using 1840-1859 United States spinning machine installation estimates based on an assumption of a twenty-five year life expectancy for those machines, Mason in just over seventeen years production made 21.0 percent of the total American installations, measured

\textsuperscript{56}Comparison: "Machinery Records:" with Gibb, Saco-Lowell, Appendix 8, p. 649; Table 10, p. 196; and with Navin, Whitin, Appendices 26 and 27, pp. 550-551. Mason sales figures are scattered: Mason v. U. S., 6 Ct. Cl. 66; Mason Income Tax Calculations, 1863-1866, Box 62, Old Colony Historical; Seventh and Eighth U. S. Censuses (1850 and 1860), Manuscript Schedules, Massachusetts, State Archives, Statehouse, Boston. Total sales figures have been estimated by multiplying commonly charged prices for cards, mules, ring frames, looms, and locomotives by annual sales of these, Mason's major products. These estimates and real sales statistics both clearly demonstrated Mason's industry leadership in most years, 1857-1865. It is to be realized that most major firms--Whitin excepted--sold other products: Mason, locomotives, files, and rifles; Lowell, locomotives, paper machinery, and machine tools.

\textsuperscript{57}"Machinery Records:" spindle statistics, U. S. Census, 1860.
in spindles. Using a thirty-five year assumption, his share would have been 27.0 percent. In the 1850's, his percentage was 24.5 percent, assuming a twenty-five year life, or 29.0 with a thirty-five year life. Simply put, Mason turned out about one-fourth of all United States spindles in its first two decades.  

WILLIAM MASON'S NEWFOUND POSITION

William Mason enjoyed his new-found wealth and position in a grand, but rather private fashion. Much as his partner and patron, James K. Mills, Mason seems not to have been much of a joiner of civic organizations. His political activities seemed to be limited to one term as a Republican presidential elector, and his charities remained either largely nonexistant or, more probably, silent. The machine works was Mason's life. He invested in few other businesses, the most notable being the Machinists' National Bank, of which he was founder and president, the Boardman Coal-Burning Locomotive Boiler Company and the Toledo, Wabash and Western Railroad.

58 Spindle installation estimates are from Tsung-yuen Shen, "Quantitative Study," p. 257; McGouldrick, New England, p. 228; U. S. Censuses, 1840, 1850, 1860; "Machinery Records." Using these estimates, Lowell would seem to have supplied slightly less than Mason in the 1850's, and Whitin about 5 percent of all spindles installed in the 1850's, Gibb, Saco-Lowell, pp. 196, 649; Navin, Whitin, Appendix 26, p. 15507.
for both of which he built locomotives, and the Taunton Car Company of which he was a director. Otherwise, his energies and capital went to his shop where he supervised business and mechanical details, major and minor. In retrospect, his failure to delegate more authority denied the company a second generation of capable, experienced family managers and ultimately brought the firm's demise in the twentieth century.

Mason relaxed with his animals, garden, farm, and home. He served as president of the county fair and vice-president of the local humane society. A garden behind his estate produced prize vegetables while his Riverside Farm near Taunton bred award-winning cattle and stud, show, and race horses. He kept two cows and some deer behind his home and birds and exotic plants in the conservatory off his mansion's reception room. William H. Bent, Mason's closest associate,

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even credited Mason with the introduction of the English sparrow to Taunton; perhaps apocryphal, but certainly illustrative of Mason's interest. Mason's tastes were also reflected in his Italian-style mansion designed by America's foremost architect, Richard Upjohn. Befitting his new-found position as Taunton's wealthiest man, Mason's $25,000 house had walls four brick-courses thick. Marble from Italy, decorations and ceilings carved and painted by Italian artisans, and European paintings graced the inside of the mansion, while formal Italian gardens beautified the outside. Impressed, the citizens of Taunton rushed to endow the city with other Upjohn-designed buildings: the Union Station, the Taunton Inn, the Bristol Academy (Old Colony Historical Society), Pilgrim Church, St. Thomas Church, and the present home of Mason's great-granddaughter, Bettina Brabrook Robinson.  

While his house was being built, a new industry, locomotive building, came to Taunton, and soon his aesthetic attentions shifted to the beautification of the steam locomotive. It was the tasteful design of his locomotives which finally brought him the fame he so desired.
CHAPTER VII

THE RISE OF THE LOCOMOTIVE INDUSTRY IN TAUNTON

In the decade following 1846 the locomotive succeeded the textile machine as Taunton's most important product. This shift reflected the great increase of New England railroad mileage in the 1840's and the explosive railroad expansion in the Great Lakes states in the 1850's. As a result of the rise of the railroad, locomotive building surpassed textile machinery manufacture as the leading mechanical engineering activity in the 1840's. Since cotton machine builders served as the foremost repositories of machine-building skills, many of them quite naturally turned to locomotive building in order to more fully employ their workers and factories during the frequent periods of low demand for textile machinery. Thus did Mason turn to locomotive building in 1852. In a broader sense, the rise of locomotive building in Taunton stood as part of the development of steam engineering in the Providence area. The needs of
Providence's steamships and steam cotton mills had given birth to two outstanding steam engine and boiler manufacturers: Thurston, Green and Company and the India Point works of Fairbanks, Bancroft and Company. Significantly, two of the most important persons in the Taunton Locomotive Manufacturing Company--Willard Walcott Fairbanks and Parley Ide Perrin--came from the India Point shop.

ORIGINS OF THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY

Willard Walcott Fairbanks and the Crocker brothers, William, Samuel A., and George, organized Taunton's second major machine shop, the Taunton Locomotive Manufacturing Company, in the spring of 1846. Most of the subscribers to the firm's $50,000 capital stock lived in Providence and Taunton. The major shareholders included the three Crocker brothers, some of their fellow copper and iron manufacturers, and several Providence acquaintances of Fairbanks. At the company's first meeting, these stockholders selected
William Allen Crocker as president and W. W. Fairbanks as agent and treasurer.

Willard Walcott Fairbanks

As was so often the case, the leaders of Taunton Locomotive Manufacturing Company, with the exception of the Crockers, were practical mechanics who rose from the New England yeomanry by means of their acquired skills and hard work. Willard Walcott Fairbanks (1805-1878), the original promoter of Taunton locomotive, came from a farm family in Wrentham, fifteen miles north of Taunton and Providence. Fairbanks probably received

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1Parley Ide Perrin, "Autobiographical Note," reprinted in Charles E. Fisher, "Parley Ide Perrin," Railway and Locomotive Historical Society Bulletin 61 (1943): 71; Freedley, Leading Pursuits, p. 307; Emery, History of Taunton, pt. 1, p. 665; Taunton Daily Gazette, Dec. 12, 1935; Parley Ide Perrin, notebook dating from 1830's and 1840's, also timebook dating from May 14, 1846, and also Taunton Locomotive Manufacturing Company (TLMCo.) annual report for the year ended May 1, 1863, all these items in Box 60, Old Colony Historical Society, Taunton. Hereafter the Society will be cited as OCHS. On the latter date 17 people held the 300 outstanding $500 par shares, 137 additional shares being in the company's hands. Only 14 of the 300 shares were held outside a 25-mile radius centering on Taunton, and 172 were held in Taunton and contiguous towns. Reflecting the influence of Fairbanks, 90 shares were still held by four Providence parties.

his training as a machinist in Providence, since he was
known to have been living there in 1826. Three years
later, in 1828 at age 23, Fairbanks began manufacturing
marine and stationary engines in Providence. He soon
gained a reputation as a "1st rate engineer," and by
the 1840's the India Point Steam Engine Works of
Fairbanks, Bancroft and Company in Providence ranked
as one of America's leading steam engine, boiler, and
machine-tool manufacturers. However, Fairbanks' most
important products in his Providence days were mechanics
rather than machines. As did Lowell, Matteawan, and
Crocker and Richmond, the India Point works employed

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3 Lorenzo Sayles Fairbanks, *Genealogy of the Fairbanks
Family in America, 1633-1897* (Boston, 1897), pp. 267-268.
The event which placed him in Providence in 1826 was his
marriage. Was his wife, Eliza S. Wilmarth, related to
any of the well-known machinists of that surname?


5 Mass. vol. 9, p. 554, Dun.

6 Advertising circular, Fairbanks, Bancroft &
Co., Feb. 1, 1843, v. A-33, Locks and Canals Collection,
Bancroft, Nightingale & Co., and Corliss, Nightingale
& Co., was John Barstow, plus, apparently, George
Corliss in BN&Co.
some of America's foremost mechanics. Fairbanks' partner, Edward Bancroft, designed the firm's machine tools, which William Mason praised as "the first I ever saw that had any good workmanship in them."\(^7\) Bancroft made these by duplicating and improving English machine tools.\(^8\) His future partner, William Sellers, also worked for Fairbanks, Bancroft and Company as, apparently, a draftsman and foreman.\(^9\) The India Point works also turned out Parley Ide Perrin, for forty

\(^7\)William Mason to M. N. Forney, 1882 or 1883, quoted at length in, "The Late William Mason," Railroad Gazette 15 (1883): 342.

\(^8\)Ibid.; also Joseph Wickham Roe, "Machine Tools in America," Journal of the Franklin Institute 225 (1938): 505; Hayes, American Textile Machinery, pp. 55-56. Mason claimed that Bancroft imported a planer from England and made a copy, the first American-built metal planer; a questionable claim. Mason also boasted that some of Bancroft's and Sellers' tools were made from designs and castings he made and supplied; again a suspicious statement.

\(^9\)Mason to Forney, "Late William Mason," p. 342, says Sellers was a clerk "conjuring about a sewing machine in his leisure," who finally became a draftsman. Roe, "Machine Tools," p. 505, says Sellers was a foreman. Bruce Sinclair, "The Direction of Technology," Edwin T. Layton, Jr., ed., Technology and Social Change in America (New York, 1973), p. 70, claims that Sellers superintended at India Point for three years, as does the DAB; however, I doubt it.
years Taunton Locomotive's designer and manager, and George H. Corliss, who made India Point the nation's most famous steam engine factory. When Fairbanks left the India Point partnership in the spring of 1846, the firm reorganized as Bancroft, Nightingale and Company and continued in operation until Bancroft and Sellers left for Philadelphia a year later to form their celebrated machine-tool company. Once again reorganized as Corliss, Nightingale and Company, the works became America's foremost stationary steam engine manufacturer in the 1850's.

Parley Ide Perrin

Upon moving to Taunton, Fairbanks brought Parley Ide Perrin (1812-1896) from the India Point shop and installed him as the new locomotive works' foreman,

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10 Hurd, History of Bristol County, p. 884; Perrin, "Autobiographical Note," p. 71; Van Slyck, Representatives, 1: 193. Corliss became a partner about 1846 and began development of the stationary engine design which made him famous, although Mason told Forney that, "Corliss' great success was largely due to Bancroft . . . ," "Late William Mason," p. 342.

draftsman, and locomotive designer. Later becoming superintendent, agent, and treasurer, Perrin personified the Taunton Locomotive Manufacturing Company's style. When Edwin T. Freedley aptly characterized Taunton Locomotive as "careful and conservative, and rather slow to adopt experiments," he unwittingly described Perrin, whose personality was mirrored in his locomotives.\textsuperscript{12} A man of habit, Perrin carefully recorded the details of the locomotive business in tiny, abbreviated script in his ever-present pocket diaries, leaving us in the process the best account of the Taunton locomotive business.\textsuperscript{13} In both his diaries and conversation he used few words. "Thar is no good substitute fur wisdum, but silence is the best that has been discovered yet," he quoted approvingly on the fly of one of his diaries.\textsuperscript{14} Perrin ran both the locomotive

\hspace{1cm}\textsuperscript{12}Freedley, Leading Pursuits, p. 307.

\hspace{1cm}\textsuperscript{13}Parley Ide Perrin Diaries, Box 60, OCHS, hereafter cited as Perrin Diary.

\hspace{1cm}\textsuperscript{14}Ibid., rear 1878 Diary. At the conventions of the American Railway Master Mechanics' Association, Perrin rarely said much, and when he did, it was to respond to a question very briefly; Proceedings.
shop and his personal finances with the thrift of a Puritan—actually he was a staunch Baptist. Yet, he helped widows and orphans of former employees, as well as relatives in need. A relative in danger of losing his farm received $500. Likewise, in the years after an employee's death in a shop accident, Perrin saw that the widow's new roof and daughter's funeral were paid for.

Perrin's education and career as a mechanic reveals much about the transmission of technological skills and ideas in the early nineteenth century. Born on a Seekonk, Massachusetts, farm in 1812, he obtained the nearly universal three-year New England common-school education. After presumably working on the farm for ten years, he apprenticed from 1830 to 1833 as a machinist. During the following decade Perrin enriched his knowledge of machinery design and manufacture by moving from shop to shop and from city to city in a conscious effort to learn his trade from the most progressive machine designers and builders. For two

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15 Mar. 28, 1874, Perrin Diary.
16 Mar. 22, 1854, Sept. 22, 24, 1855, Jan. 11, 1858, Perrin Diaries.
years he worked on textile machinery in Pawtucket and on saws in Bridgewater, Massachusetts. The following year he built calico printing presses and locomotives for George W. Whistler at Locks and Canals' Lowell machine shop, the "graduate school" for so many early nineteenth century mechanics. When he heard in July 1836 about Seth Boyden's preparations to build locomotives in Newark, New Jersey, Perrin, not yet turned conservative by age, hired on because "a man of Boyden's genius would not follow in the beaten path, but would attempt some new design . . . ."17 Because there existed no heavy machine-tool industry at this time, Boyden assigned Perrin to make the tools for the new shop, then afterwards asked him to draft the crude plans for Boyden's locomotive. After leaving Boyden's shop, Perrin repaired mules in Pawtucket, worked in a Philadelphia steam engine and textile machinery shop, ran his own machine shop in

17 Perrin, "Autobiographical Note," p. 70; see also the autobiographical note by Perrin in Locomotive Engineering 5 (1892): 228. Unusual they were: 30-inch stroke, adjustable cut-off, outside-connection; Eugene S. Ferguson, ed., Early Engineering Reminiscences (1815-40) of George Escole Sellers (Washington: Smithsonian Institution, 1965), p. 188.
Providence, tended a dying uncle's farm, and finally entered Fairbanks, Bancroft and Company's employ in 1845.18

During this decade as an itinerant mechanic, Perrin methodically obtained a mechanical education by filling his notebooks with formulas, specifications, and notes on processes he observed; by attending evening school; and by accumulating a small library of mechanical engineering books. In his mechanics classes, probably at the Franklin Institute, he studied logarithms, algebra, trigonometry, surveying, and drafting, all of which he mastered and later applied. While in Philadelphia he recorded in his notebooks information on

steel, soldering, wire making, and other topics from technical literature in the Franklin Institute's library. He buttressed his shop experience in locomotive building by purchasing in 1836 the first United States edition of F.M.G. Pambour's 1835 classic, *A Practical Treatise on the Locomotive Engines upon Railways* (Philadelphia, 1836). From this he learned of British practice and of Pambour's extensive 1834 experiments. The text provided Perrin with a wealth of formulas helpful in determining the proper ratios between boiler size, steam pressure, and cylinder diameter and stroke. Perrin's copy of Pambour shows that there existed some communication between science and the mechanic at this early date, since Pambour presented formulas derived from physics. However the impact of science was quite limited because few mechanics had Perrin's degree of education. While in Philadelphia Perrin read and took notes on the Franklin Institute's copy of Thomas Tredgold's popular manual on railroads and locomotives, *A Practical Treatise* (London, 1835). After coming to Taunton in 1846, he continued purchasing engineers and mechanics manuals. Charles H. Haswell's *Engineers and Mechanics Pocket Book* (New York, 1846) and John W. Nystrom's
Pocket Book of Mechanics and Engineering . . . (Philadelphia, 1855) provided many formulas helpful to a locomotive builder. To keep up to date, he read journals such as Scientific American and The Journal of the Franklin Institute and applied what was useful to locomotive building. Impressive as this self-taught education appeared, especially when compared with that of most other contemporary mechanics, it must be remembered that most of Perrin's mechanical knowledge came in the ordinary manner from practical shop experience.  

The Crocker Brothers

Differing from Fairbanks and Perrin, the other promoters of the Taunton Locomotive Manufacturing Company--the Crocker Brothers--gained their livelihood as businessmen rather than as mechanics. Part of the Crocker-Leonard extended family, these brothers, William Allen, Samuel Leonard, and George Augustus, were raised by their uncle Samuel Crocker of Crocker and Richmond after the death of their father, William Augustus Crocker. The two brothers most involved in Taunton Locomotive,  

19 Examination of Perrin's notebooks and technical books, OCHS.
William Allen and Samuel Leonard Crocker, attended Brown University. Thereafter, the three brothers founded the Taunton Copper Company and invested heavily in the Old Colony Iron Company. Just as Fairbanks interested the Providence investors in the new locomotive works, so the Crocker brothers brought in Taunton area industrialists, lawyers and businessmen. Most notable were the Parkers, Robinsons and Stetsons, families associated with the Crockers in the iron and copper industries. Reflecting their leadership among the Taunton investors, William Crocker served as Taunton Locomotive's first president and, following a term by Fairbanks, Samuel L. Crocker became the third president.²⁰

Starting Taunton Locomotive

The founding of the Taunton Locomotive Manufacturing Company demonstrates the ease of entry into the mid-nineteenth century locomotive industry. In part the readiness with which an infant firm could borrow the technology from other shops made this possible. Patents protected few parts of a locomotive, making

²⁰Taunton Daily Gazette, Feb. 12, 1883, Feb. 14, 1887; V file C871S and V file C872, OCHS.
copying of another builder's designs a practical way to develop a new shop's designs. One merely hired a skilled draftsman with locomotive experience, such as Perrin, lured some qualified machinists and mechanics from railroad shops and locomotive builders, and used the best engine of a handy railroad as a guide when necessary. Taunton Locomotive used all these methods of technological acquisition. When Farley Perrin arrived in the spring of 1846, he found:

neither shop nor tools except a few second hand lathes . . . . The first business was to build a steam engine to run the new shop, the foundation of which was then being laid. The castings for the steam engine he Fairbanks obtained from his old shop, with no plan or drawing to work by.

Meanwhile, during the summer and fall of 1836, the company built its factory cater-corner across the railroad and Wales Street from William Mason's works. A brick machine, boiler and erecting shop with one story and an attic measured 55 by 200 feet with an ell 40 by 75 feet.

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21 A surprising number of locomotive builders in the 1830's and 1840's copied a local railroad's engine, making whatever modifications deemed desirable. Examples are Baldwin, Rogers, and Locks and Canals.

A foundry and, probably, smithy occupied a one-story brick building 50 feet by 105 feet.23 When the shop stood ready to begin building locomotives in December, Boston and Providence Railroad master mechanic George S. Griggs, also a Taunton Locomotive shareholder, "kindly furnished nearly all the castings from his patterns" necessary to build the prototype locomotive, then sent one of the best mechanics in the Roxbury shop of the Boston and Providence, Benjamin F. Slater, to help complete the locomotive.24

Much as it borrowed its patterns, Taunton Locomotive also drew its skilled labor from virtually every important machine-building center in the Middle Atlantic states and New England areas. No record of the origins of Taunton Locomotive's employees exists for the late 1840's, but Perrin's diaries in the early 1850's


recorded details about employment practices. In 1851, for instance, he entries on twenty-eight job applications from journeymen: six from large northern New England machine shops of the Lowell type; six came from Boston and suburbs; nine from Providence and nearby areas of Rhode Island, Connecticut, and Massachusetts (including four from Taunton); four from the New York City area and northern New Jersey; and two from Philadelphia. Only one application came from England, although many of the other applicants were probably British born. Additionally, five Taunton boys sought apprenticeship. The journeyman applicants came largely from steam engine shops, including Corliss, Nightengale and Company; from textile machinery shops, such as Saco Water Power Company; from railroad shops; and from locomotive builders, including Lowell, Lawrence, Hinkley, and Norris. Other surviving Perrin diaries from the 1850's reveal a similar pattern. This heavy flow of mechanics between machine-building centers served as one of the
most important vehicles of technological diffusion in the mid-nineteenth century. Because this movement spread knowledge of shop practices and machine designs among employers, it became the means by which North American steam locomotive design and manufacture attained a high degree of uniformity in the mid-nineteenth century.25

EARLY LOCOMOTIVES OF THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY

Taunton's first locomotive, aptly named Rough and Ready, made its trial runs on May 19, 1847.26 As was frequently the practice among fledgling locomotive builders, W. W. Fairbanks set out to prove the quality of his new engines to the railroads by arranging free trial use of the Rough and Ready and its sister locomotive, the Witch, by the Eastern Railroad of Massachusetts. Both engines

25Perrin Diary. For 1851 the breakdown of journeyman applicants listed was: Maine: Saco 1; Mass.: Lowell 2, Lawrence 3, Boston 3, Cambridge 1, Roxbury 1, Canton 1, Taunton 4, Fall River 1; R. I.: Providence 2, Portsmouth 1; Conn.: New London 1; N. Y.: New York City 2, West Point 1; N. J.: Rahway 1; Pa.: Philadelphia 1; England 1. Obituaries and old-times agree that a substantial portion of Mason's machinists were British born.

26Perrin Diary for 1847; Bristol County Democrat (Taunton), May 21, 1847.
satisfied the Eastern enough for the railroad to buy them. 27

Because of their easy-running qualities and conservative adherence to the standard eight-wheel, Stephenson-boilered, inside-connected design favored by New England railroads, Taunton's locomotives gained rapid acceptance on regional railways. Indeed, only two of the forty-four engines Taunton built prior to 1850 went to railroads outside of New England. 28 The foremost locomotive historian, John H. White, Jr., describes Taunton's design as "a slavish copy" of

27 Vol. I, Locomotive Specification Book, TLMCo. Collection, Baker Library; List of TLMCo. locomotives compiled from TLMCo. and railroad records by the late Charles E. Fisher and S. R. Wood, and by myself; hereafter cited as Taunton Locomotive List. Trial usage and 30-day waiting periods were very common in the 1830's and 1840's, see: Henry Blandy, Rejoinder by Henry Blandy to the Reply of J. H. Sullivan... (Zanesville, Ohio, 1854), pp. 1, 6, a copy bound with Baltimore and Ohio annual reports for the 1850's, Ohio Historical Society, Columbus; John H. Sullivan, Reply of Central O. R. R. Committee to Application of City of Zanesville... (Zanesville, 1854), p. 18, also to be found in the same place; Papers Relative to the Recent Contracts for Motive Power by the Baltimore and Ohio... on the Relative Advantage of the Winans Camel Engine and the Ten Wheel Engine... (Baltimore, 1857), p. 8, copy in Baker Library, Harvard, stacks. The examples cited cover H. & F. Blandy, Smith & Perkins, and Baltimore & Ohio specifications for bids. Most builders also gave a warranty.

the Boston and Providence engines built by George S. Griggs, a rather obvious point since the patterns were borrowed from Griggs. Griggs' early espousal of the Stephenson boiler and inside connected cylinders had done much to popularize these features in New England, so it made doubly good sense for Taunton to adopt his designs.

The Stephenson boiler, introduced by Robert Stephenson in 1830 on his Planet class engines, consisted of an outer firebox wrapper sheet arched at the top with a greater radius than that of the boiler to which the wrapper was connected. In the New England Stephenson boilers of this period, the boiler and firebox were connected by a vertical sheet with flanges. While shops found the Stephenson far easier to construct than the


30 For more on the Stephenson boiler, see White, American Locomotive, pp. 94, 323.
hemispherical-topped Bury firebox which was popular with the Paterson and Philadelphia builders, the Stephenson possessed too little steam storage space above the water level, causing it to prime easily in limestone regions with water harder than that found in New England's granite hills. Therefore, it may have been more than coincidence that the early 1850's, which witnessed the railroad building boom in the limestone regions of the Midwest, also saw Taunton and the other builders switch to the wagon-top boiler, which combined the easier staying and construction of the Stephenson boiler with the greater steam space of the Bury firebox.  

Inside connection, a design in which the main rods connecting the pistons to the main exle was placed inside the drivers and frame, also characterized Taunton and other New England locomotives in the late 1840's and early 1850's. By placing the cylinders and rods

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In fairness to the New England builders, the wagon-top offered fewer advantages over the Stephenson than it did over the Bury, so New England shops had less incentive to turn to the wagon-top than did their Bury-using competitors to the south. Therefore, New England shops made the conversion more slowly than their Middle Atlantic counterparts. The wagon-top boiler had an outer wrapper much higher above the firebox crown sheet than did the Stephenson boiler, and also had a gently sloping course between the firebox wrapper and the round boiler courses instead of the sharply angled connections of the Bury and Stephenson.
nearer to the center of the engine, inside connection simplified the insulation of cylinders and steam pipes and produced a smoother running engine than did the more common outside connection, which placed the main rods and cylinders outside the frame. However, a high center of gravity, the difficulty of getting at the running gear for repairs, the damage caused by the frequent breakage of the cranked axles which could send a rod through the boiler shell, and the cranked axle's short life, great weight, and high cost offset any of its advantages. In mute testimony to the difficulty of making cranked axles, Taunton Locomotive relied on Lowell Machine Shop to turn them. Slow to give up a design so popular in New England, Taunton Locomotive built 128 inside-connection engines before it made its first outside-connection locomotive in 1853. It continued selling inside-connecteds until 1857.\textsuperscript{32}

Following the leads of other New England builders, in the 1840's and 1850's Taunton used the common V-hook valve gear to govern steam distribution, often augmenting it with the independent cutoff valve motion popular with

\textsuperscript{32}\textit{Vol. I, TLMCo. Collection, Baker; White, American Locomotives, pp. 208-209; Sinclair, Development, pp. 328-329.}
many contemporary master mechanics. This device was intended to save fuel and water by admitting steam to the cylinders during only the first half of the piston stroke, thereby permitting steam expansion to do the work on the last half of the stroke. Contrary to Perrin's and Fairbanks' conservative natures, Taunton did engage in a brief flirtation with variable cutoff valve gear, a mechanism which enabled the engineer to vary the amount of the stroke over which steam was supplied. Applied by John Gray to the Liverpool and Manchester Cyclops in 1839, and used in Germany as early as 1844, the variable cutoff valve motion with its curved link and sliding block saw its introduction to the American market in 1833. Taunton used the separately mounted version rather than the riding-valve model. See White, American Locomotives, pp. 52, 189-190; J.G.H. Warren, A Century of Locomotive Building by Robert Stephenson & Co.; 1823-1923 (New Castle upon Tyne, 1923), for more on the subject.
United States in the Cuyahoga version designed by Ethan Rogers and John Child. This was first applied to the locomotive Cleveland, turned out by Cuyahoga Steam Furnace of Cleveland on March 6, 1850.  

A skilled engineer could obtain outstanding fuel and water economies with the Cuyahoga valve gear. Shortly afterwards, Horace Gray of Boston contrived a similar device which differed slightly from the Cuyahoga in that a third eccentric drove a separate rocker for the cutoff valve. Successful tests on the Fitchburg Railroad in the summer of 1850 soon led Amoskeag, Manchester, and Lawrence to adopt the design. Rogers built a few such engines to order, and Baldwin adopted its own design similar to the Cuyahoga. Even William Mason, an early proponent of the link valve motion, built fifteen of


his first twenty-two locomotives with variable cutoffs to satisfy customer requests. Taunton Locomotive became an important user of the Gray variable cutoff after its 1851 New York and Erie order. Taunton's use continued until at least 1857, well after many other builders had abandoned the variable cutoff for the link motion. Not until March 1856 did Taunton build its first link valve gear locomotive, long after the general acceptance of the link.

The variable cutoff valve gear could provide substantial savings when used by a skilled engineer, but in the hands of less careful men, these were lost. In operating practice, the economies failed to offset the added cost of keeping the more complicated mechanism in repair. Once again American railroads, with their less careful maintenance and more punishing operating conditions...

36 White, American Locomotives, pp. 191, 194; Holley's Railroad Advocate, August 30, 1856; Mason Locomotive Specification Book, OCHS.


38 White, American Locomotives, pp. 193-198; Holley's Railroad Advocate, Aug. 30, 1856.
conditions, rejected an efficiency device popular across the Atlantic. The situation would be repeated later with such devices as rotary valve gears and compounding. Ironically, the first American adoption of the variable cutoff motion occurred in the Midwest, despite the skilled labor shortages of the region. While a few master mechanics in the Midwest remained proponents of the Cuyahoga valve gear, the Mason specification book significantly reveals that all engines sold by Mason and Company to the Midwest had the less complicated link motion, and that the fifteen variable cutoff engines Mason built were made to the order of New England railroads.

The link motion replaced the older hook motion and variable cutoff valve gear in the 1850's. Stephenson and Company developed it in England in 1842, and Thomas Rogers adopted it about 1850 as part of his design reforms of 1850-1852, that resulted in the American standard locomotive design. With only one steam chest

39 Warren, Century, p. 364, f. 370; White, American Locomotives, pp. 194-198. White makes a case for W. T. James' prior invention in 1832, but the James invention seems to have been one of those technological dead ends without future impact. Forgotten, the link motion had to be reinvented.
per cylinder and with fewer working parts, the link valve gear proved much easier to maintain than variable cutoff motions, yet it gave almost as much control over cutoff. Also, it could not fail to engage properly, a malfunction hook motions sometimes suffered. Mason used the link motion on his first engine in 1853, and even conservative Baldwin applied the link in 1854; however the Taunton Locomotive works did not build its first link-motion engine until 1856.  

Conservative, yet popular; Taunton locomotives sold well. Zerah Colburn understood why:

The engines built here have had large boilers and steam pipes, good travel of valve, and are otherwise proportioned for smart running. These engines have generally been very loose jointed, going out of the shop with as much play in all the bearings as other makers' engines would have after two month's wear. This one thing has helped the Taunton engines in acquiring a reputation for smartness—and sometimes at the expense of durability.

But Taunton engines enjoyed longevity equal to that of other builders. After stopping trains every few miles

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41 Colburn’s Railroad Advocate, Oct. 20, 1855.
to cool the bearings on new locomotives made by other builders, railroads must have appreciated the trouble-free operation of a new Taunton engine, even if the first set of bearings lasted a couple months less than those of competitors. This mattered little since bearings required replacement many times in the life of a locomotive.

They may have been smart running, but Taunton Locomotive Manufacturing Company locomotives were never smart looking. As did most pre-Mason New England locomotives, early Taunton engines appeared unbalanced and cluttered because of the two engine truck wheels set closely together, the tacked-on clapboard cab, and the square steam dome and sand box and their D-shaped smokebox. None of these visually fit the round boiler. Worse yet, a wide running board and the inside connection deprived the viewer of that captivating sight of the working rods and valve gear which made the steam engine one of the most exciting and beloved of all machines. In late 1853 Taunton adopted a graceful cab and an acorn-shaped sand box based on the design used by Cuyahoga since 1851, an unusual case of an Eastern builder borrowing from a Midwestern shop. Sharing these
features, along with variable cutoff and a tender
dickey that was higher at the rear, Taunton and Cuyahoga
locomotives have been confused often, although
Cuyahoga built much more gracefully proportioned
locomotives. It remained for William Mason to reform
the aesthetics of the American locomotive, much as the
Paterson shops reformed its engineering design.

MASON TURNS TO LOCOMOTIVE BUILDING

Induced to diversify by a decline in textile
machinery sales, William Mason was attracted to the
locomotive business by the high demand for steam engines
in the early 1850's. He also found the steam locomotive
appealing because it was the most glamorous and public
machine of the Industrial Revolution: the perfect
instrument to aggrandize his name. Once he began to
build locomotives, he gained the fame he sought by
improving the aesthetic quality of the American locomotive

42 See photos of the Cuyahogas in White, "Cuyahoga,"
pp. 61, 66-70, 72-73; Vol. I, TLCo., Baker. As fine
a historian of locomotives as John H. White, Jr., had
trouble distinguishing a Cuyahoga from Tauntons, White
to Author, Feb. 24, 1967. For illustrations of Taunton
and other contemporary locomotives, see White,
American Locomotives, especially pp. 324-325.
of the period, although, contrary to later claims, he contributed few inventions to locomotive design.

Asked many years later to explain why he had gone into locomotive manufacture, Mason replied, "At the time I commenced there was a little slackness in cotton machinery, and for that reason I took hold of locomotives." In the late 1840's and early 1850's Mason and Company faced a highly fluctuating demand for its textile machinery, and even in good years sales failed to reach the levels of 1845 because of a decline in mill building and because of the overexpansion of the machinery building industry. At the start of 1845, only Lowell Machine Shop and possibly Amoskeag and the Saco Water Power Company could have been classed as large textile machinery shops, but the next five years saw the construction of large shops by Mason, Whitin, the Essex Company at Lawrence, and the Hadley Falls Company at Holyoke. At the same time, Amoskeag and Saco doubled

the size of their shops.  

Intensifying the competition, in the early 1850's the Jenks' Bridesburg shop in Philadelphia, Matteawan in Beacon, New York, Danforth in Paterson, and Pettee in Newton, Massachusetts, had operations at least half the size of the big textile machinery shops. As if this was not enough to create overcapacity, mills installed 28 percent fewer new spindles in the United States in the 1850's than in the 1840's, reflecting the decline of profits in the face of the record-low textile prices of 1847-1853. Mason's yearly sales from 1846 to 1859 averaged 53 percent of 1845. This overcapacity not only encouraged Mason and many other cotton machinery shops to diversify into

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unrelated products; it also precipitated the 1857 failure of three of the four new big machine shops.

Reacting to the slack demand for textile machinery, Lowell Machine Shop, already a locomotive and machine tool builder, expanded production of these lines and later installed paper mill machinery. Likewise, Amoskeag and Lawrence added locomotives, fire engines, and, in the case of Lawrence, printing, paper, shoe, and leather machines in the late 1840's and the 1850's. Mills and Company, finding that Hadley Falls Company's textile machinery was little needed, diversified the shop into turbines, paper machinery, and gas plant equipment. To the south, Fales and Jenks of Providence added rotary steam pumps; Kilburn and Company of Fall River, turbines; and Matteawan, steam engines, sugar mills, and machine tools. In Paterson Charles Danforth began building locomotives in 1853, and Roger's Ketchum and Grosvenor let its textile machinery business languish while it became for a few years the nation's largest locomotive builder. Of the major cotton machinery shops, Whitin remained almost alone in withstanding the trend toward diversification—a major reason that in the 1860's it emerged as one of the two largest and most
successful of the American textile machinery shops, a position it still holds.

A boom in railroad construction drew Mason and many other textile machinery shops into locomotive building. An eightfold increase in the mileage of Midwestern railroads alone in 1851-1857 added 7,000 miles to the nation's network. Annual locomotive production rose sixfold between 1845 and 1854, encouraging textile machinery shops to utilize part of their idle facilities and workmen in locomotive manufacture. Ironically, the rapid increase of locomotive shops in the early 1850's also created an overcapacity in that industry by 1854, leading to the departure of Amoskeag, Lawrence, and Lowell from locomotive building in 1854-1857, and leaving only Mason, Danforth, and Rogers as builders of locomotives and cotton machinery.⁴⁷

Two other factors probably enticed Mason into locomotive building: the high profits being earned by Taunton Locomotive across the tracks, and the steam locomotive's grasp upon the imagination of nineteenth-century Americans. The locomotive could fulfill

⁴⁷See Chapter VIII for a longer description and sources.
William Mason's need for self-expression and public recognition. As Brooke Kindle suggests, "Perhaps technology was not so much a tool or a means as it was an experience—a satisfactory emotional experience." Mason's efforts at locomotive design and manufacture seem ultimately to have been taken as much for the emotional satisfaction as for the profit. With a bit of wry exaggeration, he told an interviewer: "I . . . tell my friends that I got up locomotives for fun, but that it was the most expensive fun I ever had." In point of fact, Mason made profits on railroad engines most years before 1874.  

THE FIRST MASON LOCOMOTIVES

Mason's preparations for locomotive building started in mid-1852, but his first locomotive did not emerge from his shop until September 1853. First, during 1852, Mason built locomotive, erecting, and boiler shops, expanded his foundry and smith, and acquired a whole new set of machine tools.


Upon completing the buildings, he began planning his locomotives.

From the first Mason desired to build locomotives of "fine taste," and "symmetrical elegance and beauty." Needing a skilled locomotive designer to put his ideas into effect, he hired Charles F. Thomas, who as Amoskeag's draftsman had helped design their locomotives from 1849 to 1852. Nothing is known of Thomas' career before Amoskeag or after Mason, but the skillful delineation of Amoskeag's second locomotive Gen. Stark suggests that Thomas may have designed Amoskeag's first engines and that he must have had experience with another builder prior to coming to Amoskeag in 1848 or 1849. While his use of the domed Bury firebox seemingly implies previous employment with a Middle Atlantic builder, the unusual execution of the connection between the firebox and boiler and the remaining design features indicates that Thomas was a New Englander willing to borrow ideas and to experiment. Precisely how much of Mason's progressive first locomotives represent Thomas' or Mason's

50 Livingston, Portraits, p. 18. Almost certainly Livingston is paraphrasing what Mason told him.

51 Dudley, "Growth," p. 6. Again, this must be based on what Mason told him.
work cannot now be judged. Whatever the relative contributions of the two men, Taunton's _American Whig_ viewed the first test run of a Mason locomotive on September 26, 1853, as "a triumph of the skill of Mr. Thomas who drafted and superintended its construction." 52

As early as November 1852, Mason's first locomotive design was well established, and the new builder was writing railroads with offers to build locomotives. Interestingly, Mason stressed capacity rather than the arrangement of the cylinders and engine truck as the innovative aspect of these engines. Except for a one-inch smaller boiler, the locomotive offered was identical to the first run out of the shops eleven months later. The eleven-month delay may have been caused by the slow completion of the new buildings or by the rather high price the untested builder was

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52 _American Whig_, Sept. 29, 1853; Photograph of engraving of the Gen. Stark, R&LHS Collection, Kresge Hall, Harvard. The _Taunton Directory_ of 1855 lists Charles F. Thomas as a mechanical engineer, and the previous (1850) and following (1857) _Directories_ do not mention him, leading me to conclude that he came to Taunton in early or mid-1852 and left soon after he received an award at the county fair in October 1855 for two "finely done" drawings of locomotives, _American Whig_, Oct. 4, 1855. When he interviewed Taunton oldtimers in the 1900's for articles in the _Taunton Daily Gazette_, Herbert Fisher was also told that Thomas assisted Mason in designing his locomotives.
asking, but more likely the hold up came from a sudden spurt of textile machinery orders in late 1852 and 1853.\footnote{Wm. Mason & Co. to William P. Cutler, President, Marietta & Cincinnati, Nov. 24, 1852, Cutler Collection, Marietta College, courtesy John H. White, Jr.; Mason Loco. Spec. Book; Locomotive Engineering (June 1898): 274-276; "Machinery Records;" Letterbooks, 1852-1853, Baldwin Collection, Historical Society of Pennsylvania, Philadelphia.}

**MASON AND THE DESIGN REFORM OF THE EIGHT-WHEELER**

Later in life William Mason incorrectly boasted that he had initiated the basic design reforms that created the American standard locomotive of the last half of the nineteenth century. These claims have been accepted by most people since. With characteristic immodesty, he stated:

> The first idea I had about improving the engine was to put the cylinders down level. As it was built at that time, the locomotive looked like a grasshopper. The old Baldwin engines were worse in this respect than the Rogers. The cylinders were all put up so as to be above the truck.\footnote{William Mason interviewed, "The Late William Mason," p. 341.}

He also claimed to have invented several of the other basic reforms of the early 1850's, including the spread truck, cylinder saddle, and divided frame.\footnote{Ibid., pp. 341-342; William Mason to Editor, Railroad Gazette 14 (1882): 656.} The facts indicate otherwise.
What Mason claimed was nothing less than the design changes of the early fifties that produced the basic pattern of locomotive that would reign in America for the next third of a century. These reforms replaced the Bury and Stephenson fireboxes with the wagon top, introduced the Stephenson link valve gear, and spread the wheels of the engine truck, thus permitting the cylinders to be lowered from their former inclined mounting on the side of the smokebox to a level position. Improved track structures had permitted a great increase in operating speeds and locomotive size late in the 1840's, giving rise to a need for a more solid and stable arrangement of the locomotive. Spreading the truck gave much better stability and tracking at speed and permitted the lowering of the cylinders. Leveling the cylinders gave them a more solid mounting on the saddle, prevented the weakening of the sides of the smokebox, and lowered the center of gravity. Lowering the cylinders and spreading the truck placed the stack, smokebox, cylinders, and engine truck on the same vertical line when viewed from the side, creating a more balanced, symmetrical appearance. Substitution of the link motion provided a more simple, rugged valve gear easier to
repair and less likely to be battered out of adjustment by the fifties' larger locomotives and faster speeds.

Angus Sinclair and John H. White, Jr., have argued correctly that William Mason did not invent these reforms.\(^6\) William Swinburne's 1852 *America* and Thomas Rogers' 1852 lithograph of the New Jersey show that these two Paterson builders had switched to the wagon top firebox, link motion, spread truck, level cylinders, and modern domes, although they still retained the ornamental outside frame and square-bottomed smokebox. While most of these innovations had been used earlier, Swinburne's and Rogers' adoptions marked the first known combination of these features. The modern American standard had been created, but the designer of the 1852 Paterson engines cannot be identified. The probable candidates are Swinburn, Rogers, or Rogers' new superintendent, William S. Hudson. Even some of Mason's other claims were spurious: the cylinder saddle and detachable double bar frame had been used by Walter McQueen

on the Albany and Schenectady Railroad of New York in 1847 or 1848, while Mason clearly learned of the perforated dry pipe and straight boiler from Wilson Eddy, master mechanic of the Western Railroad and one of the most progressive New England mechanics of the early fifties. What was significant about Mason's designs were their aesthetic appeal, the advanced machining techniques involved in their manufacture, and Mason's keen ability to recognize a useful technological advance. Few builders as readily incorporated ideas from as broad a range of sources as did Mason. Perhaps this eclecticism resulted from having been a textile machinery builder, as was the fifties' other progressive locomotive builder, Thomas Rogers.

It is possible to further deflate the claims made for or by Mason by tracing some of the influences on him. In 1851 Wilson Eddy designed the Addison Gilmore with a divided frame, outside connection, level cylinders, and a centered arrangement of the stack, smokebox, cylinder, and truck, quite possibly inspiring Mason's and Thomas'

use of these two years later. Amoskeag's locomotive \textit{Cuyahoga} of May 1853 also embodied many of these reforms: outside connection, link motion, and nearly level cylinder. The design of the cab and domes as well as the absence of an ornamental outside frame on the \textit{Cuyahoga} resembled improvements made to Mason and Company engines in 1855 and 1856. Even more striking was an 1854 lithograph of Amoskeag's two-hundredth locomotive, which had level cylinders, spread truck, centered configuration at the smokebox, hemispherical dome, a cab, and proportions strikingly similar to those adopted by Mason in 1855 and 1856, despite the reversion to steam columns and outside frame.\textsuperscript{58} Since Charles Thomas who designed Mason's engines came from Amoskeag, he probably kept well informed of his former employer's new patterns and was influenced by them. Finally, a progressive designer of Thomas' caliber would have been familiar with the Paterson reforms. Could Rogers' \textit{New Jersey} have been one of the several lithographs of other builders' locomotives seen by the \textit{Waverly Magazine} reporter on his 1854 visit to Mason's office?

\textsuperscript{58}\textit{Lithographs and engravings in author's and R&LHS collections.}
Evolution of the Classic Mason Eight-wheeler

No clearly identified plan or picture of Mason's first locomotive, *James Guthrie* remains, although pictures of the second locomotive had been misrepresented as the first. Most of what is known about the *Guthrie* comes from the Mason Locomotive specification book and from the recollections of Reuben Wells, master mechanic of the Jeffersonville Railroad which purchased the engine. Its progressive features included outside connection, link motion, spread truck, level cylinder, cylinder saddle, centered configuration at the smokebox, steam dome above the firebox, and cast iron wedges with flanges to protect the pedestal jaws from wear. Yet, it still retained the outside running boards, a Stephenson firebox with flanged connection to the boiler, an extremely low-set boiler which gave the engine a squat appearance, and solid-spoke drivers with plate counterbalances. Inside-frame trucks on the tender preserved the harmony of spoked truck wheels unobscured

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59 *Locomotive Engineering* (June 1898), pp. 274-276.

60 Counterbalances are weights attached to the opposite side of the driver from the crank pin in order to offset the thrust and weight of the piston and rods.
by outside frames, but they ran hot and wore quickly, forcing Mason to return to the traditional outside frame. His goal of building a beautiful locomotive apparently attained success since articles described it as "beautiful," "handsome," and of "great beauty." A sister locomotive, the William G. Armstrong, for which lithographs exist, matched the Guthrie except for 6-foot rather than 5½-foot drivers.

Mason—or was it Thomas?—continued improving his engines over the next three years until the classic designs of 1856-1857 emerged. In 1854 on his fifth engine Mason freed the drivers of the unsightly plate counterbalances bolted to the spokes by placing lead inside hollow drivers to provide the weight needed to counterbalance the reciprocating motion. At the same time he eliminated the outside frame obstructing the view of the drivers. Clearly he wished to beautify the steam engine by reducing it to a series of balanced, harmonized, uncluttered, simple geometric shapes. However, conservative New England customers failed to appreciate all of his


62**Lithograph, Charles Mason Collection, Boston Athenaeum; American Railroad Journal** 26 (1853): 678.
design reforms and in 1854 and 1855 forced him to revert briefly to hook motion, variable cutoff valve gear, and inside connection for New England locomotives. Midwestern railroads, perhaps because they were new, accepted his reformed designs. An 1855 order from the Western Railroad for Wilson Eddy's favorite straight-boiler engines introduced Mason to the straight boiler and the perforated steam pipe, which he thereafter built interchangably with wagon top boilers.

In 1856 and 1857 Mason introduced his classic wagon top and straight boiler engines. Their popularity was spread by famous lithographs of the wagon top Amazon of 1856 and the straight boiler Phantom of 1857. The matched steam and sand domes, the straight running board above the drivers, the cab with two large square windows, and the higher mounting of the boiler were so balanced and aesthetically appealing that other builders soon copied these features.


64 Actually, most of Mason's straight boilers were telescope boilers in which each course fit inside the one behind.

Kouwenhoven and others have suggested that nineteenth century American designers eliminated ornaments on machinery and followed functionalist tenets. Indeed, many machines enjoyed a nearly complete absence of ornamentation, as in the cases of steam locomotives prior to the late 1840's and of the machine tools of Bement and Sellers in the 1850's. John J. Greenough, the editor-publisher of the American Polytechnic Journal, and a few other writers did argue that the machine possessed its own type of beauty if not debased by ornaments. However, they were exceptions. Unornamented functionalism did not represent the dominating principle of nineteenth-century American machinery design. The functionalist theories of design of John J.'s sculptor-uncle, Horatio Greenough, and others applied primarily


to art and architecture and only tangentially to mechanical design. Furthermore, most nineteenth century writers advocating functional designs called not so much for the elimination of ornament as for a more organic relationship between embellishment and the nature and function of the building or machine. Nobody could argue that a Horatio Greenough statue or a Frank Lloyd Wright or Louis Sullivan building lacked ornamentation. Neither did Mason's locomotives. The often mentioned functional beauty of his 1856 locomotives lie in the elimination of those embellishments which detracted from the basic geometric shapes of the locomotive. With their brass brightwork, ogee dome casings, and florid paint schemes, the Mason's of the 1850's little resembled the clean, slightly ornamented, twentieth-century locomotives.

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69 I feel that Kasson in his otherwise fine criticism of the Kouwenhoven Thesis is under this misconception, Civilizing, Chapter 4.

70 Kouwenhoven is unfairly taken to task by Kasson (Civilizing, p. 155) over the issue of ornamentation of the American locomotive in the mid-nineteenth century; Kouwenhoven does admit that the locomotive went through a highly ornamented phase, 1850-1870, Arts, p. 33. Actually, the period lasted to about 1890.
The beauty of Mason's engines derived from their symmetrical balance and repetition of geometric shapes. A sense of symmetry and balance arose from the even spacing of the stack, bell, and domes at the top of the locomotive; and from the drivers and truck wheels at the bottom. Centering the stack, smokebox, cylinders, and engine truck on a vertical line further integrated the design, as did the placement of the large steam dome over the mid-point between the drivers. These arrangements gave the appearance of firm support for the large masses of the stack and domes. Likewise, his big domes fit better with the roomy cab and wide stack than did the small steam columns used by many other builders. The variety of geometric shapes that make a steam engine such a visually interesting machine were harmonized and unified by repetition throughout the design. The shape of the steam dome repeated in the sand box, and the pattern of spokes in the drivers reappeared in the spoked truck wheels, which he used in place of plate wheels that reminded him of "cheeses".71 Neither running boards nor

71Quoted in "The Late William Mason," p. 341.
counterbalances interrupted the pattern of spokes on the engine. Expressive of the function of a locomotive, the straight running boards and handrails emphasized the length and forward motion of his engines. Yet, these features were often functional: the dome over the drivers contributed to good weight distribution, and the arrangement of the cylinders and engine truck provided a more solid, stable-running locomotive.

Mason delighted in simplification, often accomplished by having one element accomplish two purposes. His distinctive bell yoke of the 1860's supported both the bell and hand rails. In his effort to reduce clutter on the locomotive, he replaced the smokebox door bolts and closures with a simple lever handle that operated an inside mechanism similar to that which shut a bank vault door. It was not an original solution, but it characterized his simple, elegant, eclectic designs. His claim to have made the American standard an aesthetic success still stands the test.

The Influence of the Mason Eight-wheeler

While the Paterson shops seem to have instituted the design reforms which brought the American standard
into being, Mason popularized these reforms and set the artistic standards of the locomotive for the next thirty years. Few other builders had accepted the Paterson reforms by 1855, yet in the next two years virtually all builders adopted these designs. What caused this abrupt turn about? Zerah Colburn suggested at the time that the expansion of railroad mileage in the 1840's and 1850's limited builder competition and incentives to improve locomotives, but he felt that overcapacity and competition after 1854 "compelled" locomotive builders "to that improvement and assimilation of style which has since been forced on them."72 By 1856 it was "purchasers, and not builders of engines" who dictated "the general direction of improvements in locomotives."73 Certainly the fine running qualities of the Paterson locomotives helped explain why customers demanded engines with these reforms, but it was as much the beauty of Mason's locomotives, coupled with their fine design, machining, and operation, that led builders to adopt the Paterson innovations. Indeed, many persons in the late

72 Colburn's Railroad Advocate, Mar. 3, 1856.
73 Ibid., Jan. 12, 1856.
1850's even associated the ideas with Mason rather than the Paterson builders. When Charles T. Parry of Baldwin saw the Mason engine Allentown on the North Pennsylvania Railroad, he so admired its "simplicity" and "graceful form" that he ordered many of its design features to be copied by Baldwin. Testifying to the Mason influence, Baldwin drawings in the 1860's showed many locomotive parts such as domes and stacks listed as "Mason style." Other contemporaries raved about Mason engines. According to Alexander Holley:

There is not a homely place on the engine. And there is no "deep scratch and high polish" work. Everything that is smoothed at all, is smoothed on a planer, not by the buff wheel." and Zerah Colburn:

On the whole we regard this as a model engine, combining great beauty of design with excellence of workmanship. It is strong, light, and especially simple.


75 Card Directory No. 1, Item M-15-8, Baldwin Collection, Stanford University Library.

76 Holley's Railroad Advocate, Aug. 9, 1856.

77 Colburn's Railroad Advocate, Mar. 8, 1856.
Also, an old railroad man told J. Snowden Bell they were:

... the neatest, best proportioned, trimmest engines ever built by anybody, and they did their work all right too.⁷⁸

And another railroad man to Bell:

How symmetrical the whole machine was from pilot to drawbar.⁷⁹

An extensive examination of photographs and lithographs of locomotives of the late 1850's through the 1880's shows the rapid acceptance by Baldwin and the New England builders of Mason's rather than the Paterson shops' proportions and standards of ornamentation. Even little features such as dome moldings and bell yokes were copied by the New England shops.

Since 1880 the legend of Mason's locomotives has been kept alive by Mason's own boastful claims in the early 1880's and by writings of the late Charles E. Fisher, son of an old Mason executive and long-time editor of the Bulletin of the Railroad and Locomotive Historical Society. Today the railfans and modelers favor Mason locomotives above all other nineteenth


⁷⁹Ibid.
century builders, further leading to the excessive claims and the fame of Mason. Such is the stuff of legends.

OTHER MASON LOCOMOTIVE TYPES

Mason normally turned out standard eight-wheelers, but between 1859 and early 1862 he built for the Lehigh Valley six large ten-wheelers—locomotives with three pairs of drivers instead of the usual two. The type was not new, but his version had several notable features. A large telescope boiler of 48-inch diameter at the first course steamed well. The firebox had a shallow waterbridge and a 21-inch combustion chamber extending into the boiler to permit more complete combustion and to lessen the harsh action of ash and gas on the tubes. A huge 93-inch by 35-inch firebox provided adequate grate area for the slow-burning anthracite fuel the Lehigh Valley used. Since the grate had to be placed close to the crown sheet in order to capture the heat of the anthracite coal, he was able to place the drivers close together under the firebox where there was the greatest weight for traction. This also permitted connection of the main rods to the first driving axle, thereby providing more room for the Stephenson valve gear's eccentric rods. It also caused
the engines to nose, or oscillate, less than other types on the many curves of the Lehigh Valley's coal branches. To start heavy trains, the drawbar between the tender was offset so as to throw part of the weight of the tender on the drivers. Lehigh Valley used some of the engines for as long as 46 years, hauling trains of 175 to 190 5-ton capacity coal cars, a spectacular performance equalled by few other mid-nineteenth century locomotives.  

In 1861, when Mason's locomotive sales suffered from the general depression, he sold only two normal-sized new engines. Probably recalling Danforth's and Wilmarth's two-driver engines of the 1850's, Mason concluded that this type would be ideal for economy-minded railroads. His three tiny two-driver engines of 1861 with their single-axle engine truck weighed only 12 tons--half a normal engine--and trailed an odd combination tender and baggage car designed to save

weight so that the bantams could pull a single passenger car in local service. Three more emerged from the shop before he concluded that the Fairlie type locomotive represented the ideal light branch-line locomotive.\textsuperscript{81}

\section*{COAL-BURNING LOCOMOTIVES}

During the late 1850's, depletion of wood supplies close to railroads and the declining price of coal encouraged railroads to consider conversion to coal, as did the fire hazards and passenger complaints caused by wood cinders and sparks.\textsuperscript{82} Burning coal, however, presented several problems for the locomotive designer. Getting a strong draft was difficult, and the intense heat quickly burned out the grates and firebox sheets. The life expectancy of coal fireboxes was two


to three years, as opposed to ten or fifteen for wood. These difficulties led many designers to incorrectly assume that coal burning required radical changes in boiler design. This led to the 1850's experiments with the Dimpfel, Boardman, Phleger, Gill, and Bayley boilers. Both the Dimpfel and Boardman boilers were tried in Taunton.

Taunton Locomotive's Dimpfel Engines

F. P. Dimpfel patented his boiler in 1850, and Norris built one or two such locomotives about 1851 for the Little Schuylkill Railroad. Taunton Locomotive then constructed seven Dimpfel-boilered locomotives between 1854 and 1860. In the normal fire-tube boiler, the combustion gases and smoke passed through flue tubes surrounded by water, but in the Dimpfel's water-tube boiler, it was the water which flowed through tubes surrounded by hot gases. Dimpfel used water tubes in the belief that they would capture more heat from

slow-burning anthracite coal by circulating the water vigorously. As with most such complex devices in railroad service, the higher repair costs offset any fuel economies. A crown sheet running the length of the boiler, increased the problems of staying far beyond that of a conventional boiler. The curved tubes, running from the horizontal crown at the rear of the boiler to a tube sheet at the front, proved difficult to install, and even more troublesome to repair. When one began leaking, it was next to impossible to locate it, requiring the removal of many tubes to find and repair the offending tube. Furthermore, boiler scale and sediments collected on the inside of the tubes, interferring with the circulation of the water. The boiler of Taunton's first Dimpfel locomotive, the *Anthracite*, lacked enough draft to burn properly without the use of a steam jet in the stack. Because of its weight and slow steaming, the purchaser of the *Anthracite* could get it to work only by reducing the size of the cylinders. With all these deficiencies, it is not surprising that the Taunton Branch Railroad returned its 1855 Dimpfel to Taunton
Locomotive in 1862 for rebuilding into a conventional locomotive.\(^84\)

Mason's Boardman Locomotives

Between 1855 and 1857 Mason built ten locomotives with the Boardman boiler. Although he later claimed that the design was forced on him, the 1856 Boardman Coal-Burning Locomotive Company catalog shows Mason as a trustee of the firm. Horace Boardman, the boiler's inventor, instead of letting the gases flow directly through the flue tubes to the smokebox, attempted to improve combustion by lengthening their journey. A large, horizontal flue ran the length of the boiler. A partition in its middle diverted the gases through vertical tubes in one side of a rectangular boiler extension that hung down almost to the track. The gases then returned through other tubes to the front half of

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\(^84\) Taunton Locomotive List; Vols. I-II, TLMCo., Baker; American Whig, Aug. 24, 1854; Railroad Record 2 (1854): 665-666; Colburn's Railroad Advocate, Aug. 2, 1856; American Railway Master Mechanics' Association Proceedings 19 (1886): 58; American Republican (Taunton), July 15, 1858; Zerah Colburn, Locomotive Engineering and the Mechanism of Railways (Glasgow, 1871), p. 94; Perrin Diary, Nov. 8, 1855; U. S. Patent 7506, July 16, 1850.
the flue and exited through the smokebox. This arrangement had the incidental advantage of removing the flue tubes from the direct action of the intense heat of the firebox. It also lowered the locomotive's center of gravity. However, it placed excessive weight on the engine truck and posed maintenance problems. Eighty cross stays and 168 crown stays in hard-to-reach places created a shop nightmare, as did the inaccessible tubes. Worse, 1857 tests on the Boston and Providence proved the Boardman less economical than conventional locomotives. After just three years service, the Providence and Worcester began sending its Boardman locomotives back to Mason for rebuilding with standard boilers. 85

Slowly designers learned that successful use of coal required very simple modifications: a slightly

larger grate, good drafting, particularly through the coal, rocking grates to keep air passages through the coal open, and a brick arch to lengthen the passage of gases. More important to successful combustion than all the patent devices was proper firing techniques by the fireman. Simplicity remained the key to locomotive design, yet in the Boardman locomotive Mason had briefly forgotten that principle.

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CHAPTER VIII

MANUFACTURE AND SALE OF LOCOMOTIVES
1846-1861

With minor variations, the manufacture and marketing of locomotives by Taunton Locomotive and Mason followed the practices of the rest of the locomotive industry. This uniformity of industry practices came from the increasing similarity among different builders' locomotive designs in the 1850's, from the flow of mechanics and designers between shops, from the interregional sales of locomotives, and from the rise of a separate heavy machine tool industry.

THE TAUNTON SHOPS' MATERIALS AND SUPPLIERS, 1846-1861

By the time Mason and Taunton entered the locomotive business, a large locomotive parts industry had evolved. Specialty manufacturers made semi-finished components such as axles, frames, and rods which were then machined by the locomotive shop. Others supplied ready-to-apply items, including springs, wheels, tires, flues, and steam gauges. The high initial cost of production facilities for some of these
items, the small amount needed by one locomotive builder, and the specialists' skills or patents discouraged locomotive shops from making these parts themselves. As would be expected, the specialty producers tended to be located in the major areas of locomotive production: eastern New England, New York City and northern New Jersey, the Philadelphia area, and Ohio.¹

As did most builders in the fifteen years prior to the Civil War, Taunton and Mason purchased their wheels for the engine and tender trucks. The most commonly used supplier was Kinsley Iron and Machine of

¹Unless otherwise indicated, the information in this section for Taunton Locomotive comes from Vol. I, TLMCo., Baker; Perrin Diaries; Perrin's "Job-Book" and Notebooks, Box 60, OCHS. For Mason it comes from the Mason Locomotive Specification Book; Holley's Railroad Advocate, Aug. 9, 1856; Indenture Agreement, Trustees, William Mason & Co., Dec. 10, 1857, Private Collection of J. D. Fiore, Taunton. For comparison of practices of other builders, see Boston Locomotive Works, Specification of Locomotive Passenger and Freight Engines (Boston, 1859), copy in Boston Public Library; Records, In the Matter of Seth Willmarth, Insolvent Debtor, Case 469, 1838-56 Docket, Suffolk Court of Insolvency, Courthouse, Boston; Baldwin Collection, Historical Society of Pennsylvania, Philadelphia; Baldwin Collection, Stanford University Libraries, Palo Alto, Cal.; Baldwin Collection, and Day Book, New Jersey Locomotive and Machine Co., both DeGolyer Library, Southern Methodist University, Dallas; Zerah Colburn, The Locomotive Engine . . ., 2d ed. (Philadelphia, 1853); Railroad Advocate, 1855-1856; Cuyahoga Steam Furnace Collection, Western Reserve Historical Society, Cleveland; White, American Locomotives.
Canton, an iron-working community midway between Taunton and Boston. Other sources used by the Taunton shops were the Brandon Car-wheel Works in Vermont, the Ames Iron Works of Village, Connecticut, Converse and Washburn in Worcester, and Taunton's own Foundry and Machine Company. Taunton and Mason also obtained some wheels from some shops which, unlike those in New England, had developed a national market through their superior technology and product: Asa Whitney and Son of Philadelphia and Bush and Lobdell of Wilmington, Delaware. Bush, by 1860, produced over one-fourth of the car wheels in the United States, while Delaware, Pennsylvania, and New York made over three-fourths, reflecting the concentration of car shops, locomotive builders, and railroads in those states.²

Mason and Taunton generally made their own driving wheels. However, when Taunton was rushed, it ordered some completely finished, except for tires and crank pins, from the nearby Bridgewater Iron Works of Lazell, Perkins and Company. Bridgewater was the logical supplier for Taunton to turn to since the two

firms shared some common owners. Mason also ordered six sets of Mallary, Morrison and Company's Gothic-spoked drivers at the request of the Western Railroad, although it must have pained him to use those ornamented excrescences. Wrought iron tires came from Kinsley Iron and Machine and from New England's most respected maker, the Nashua Iron Company in New Hampshire. Many of the Taunton builders' customers, however, specified the finest wrought iron tire of the day, the English Low Moor Iron tire. Not surprisingly, Taunton Locomotive built many engines with shareholder George Griggs' design of driver, which used a cushion of wood between the driver center and tire, and both Mason and Taunton built a few engines with Perkins and McMahon's patent cast iron tires from L. B. Tyng of Lowell. Rough-forged axles came from eastern New England: Nashua Iron, Kinsley, Bridgewater (Taunton's preferred supplier), and Dearborn and Robinson (Mason's favorite). The latter Boston firm, appropriately owned by Axel Dearborn, was the only New England forge to break out of its local market, selling extensively to Baldwin in Philadelphia.  

^Baldwin Iron Order Recordsbooks, 1851-1859, Baldwin Collection, DeGolyer.
Philadelphia, and Ohio forges sold almost exclusively to their local locomotive builders. Other forged parts such as crank pins, wrist pins, center pins, and rods Taunton builders bought in the rough from Bridgewater Iron and other suppliers. Bar frames, massive forgings with complex pedestals, were also obtained by most builders, including Mason, from nearby forges, but conservative shops, such as Taunton, using the old built-up riveted frame were able to forge the smaller frame components in their own smith shop. A few other finished items were also purchased, such as tubes, mainly from the American Tube Works in Boston, rubber and steel springs, and steam gauges. For elegance Taunton's famed silversmiths, Reed and Barton, plated the locomotive numbers and names.

A steam engine required great quantities of finished and raw metal. A 44,000-pound Palm and Robertson locomotive in 1854, for example, used 24,500 pounds of cast iron in its cylinders, drivers, wheels, and fittings; 9,200 pounds of plate and sheet iron in its boiler and firebox; 12,000 pounds of roller bar iron in various fittings; 7,500 pounds of hammered iron for frame, rods, and pins; 1,400 pounds of steel springs
and slides; 4,200 pounds of copper in the firebox, tubes, and tube sheets; and 500 pounds of tin, zinc, and brass. Taunton and Mason bought most of the bars and sheets of metal from Boston metal merchants, but obtained specialty products directly from the maker or from an exclusive agent, such as Low Moor Iron's H. Baily Lang and Company of New York. Parley Perrin took the morning train about once a week to Boston to inspect metal for purchase at the local merchants' warehouses.

Pennsylvania charcoal iron boiler plate from the Boston dealers went into most boilers, but Mason built his first engines with imported Low Moor Iron Company plate, the best money could buy. Hammered, rolled, cut, piled and rerolled three times, Low Moor was more expensive, but lasted much longer. Interestingly, once Mason made his name in locomotives, he switched to cheaper Pennsylvania iron, unless his

4 John Hogan, Thoughts about the City of St. Louis and Her Commerce and Manufactures and Railroads &c. (St. Louis, 1854), p. 18.

customers specified otherwise. Russia iron, used for boiler jackets and spark arresters, came from the Boston dealers, as did the pig iron. The pig, generally from the Salisbury and Glendon districts of Connecticut or from Pennsylvania, arrived on coastal boats at the Taunton docks, along with the Cumberland coal to work it. Brass and copper bars, sheets, and tubes for dome casings, cylinder covers, tube sheets, railings, and castings were also obtained through Boston traders. Fireboxes were normally made of copper, excepting the crown sheet, which was of Low Moor Iron for strength, the common American practice of the period. Nearly all locomotives built in Taunton prior to the 1860's had copper flues, although Mason's 1857 Baltimore and Ohio locomotives had, by request, Low Moor tubes. In the late 1850's and 1860's, American builders abandoned copper tubes, sheets, and fireboxes for wrought iron, because coal, which was being adopted as a fuel was harder on copper than was wood. By contrast, the British and Japanese, who were more fuel cost conscious, continued to use brass and copper because of its superior heat-transfer characteristics, in spite of the higher initial cost and shorter life. Finally, in addition to
all the metal, a surprisingly large quantity of Maine lumber went into the cab, tender frame, buffer beams, cow catcher, truck frames, and boiler lagging.

MANUFACTURING METHODS, 1846-1861

In the decade and a half before the Civil War, the machines used in locomotive manufacture increased in number, diversity, and specialization as locomotive builders sought to engineer more skills into machines so as to improve the quality of their product and to replace back-breaking, skilled labor. During the 1850's new machines such as shapers and slotters were adopted, while each shop evolved new versions of old machines to perform highly specialized tasks. The number of operations and machine set-ups were both reduced in the process.6

The typical locomotive shop in the mid-1850's, including Mason and Taunton, had more lathes than all other machine tools combined, including at least one

6Unless otherwise stated, the information in this section is from Perrin, "Job-Book" and Notebooks, Box 60, OCHS; Holley's Railroad Advocate, Aug. 9, 1856; Vol. I, TLMCo., Baker; Locomotive Engineering 5 (1892): 228.
sliding lathe of 10- to 20-foot length for turning axles and rods and one lathe of 6- to 7½-foot swing to take drivers (swing refers to the largest diameter workpiece that can be taken on the lathe). A profusion of smaller lathes made locomotive fittings. Shops also had specialized cousins such as bolt cutters and screw cutters. In 1850 most holes bored in drivers, wheels, rods, and journals were bored by a class of chucking lathes called boring machines, but as the decade progressed, vertical boring mills began to be installed to do these jobs.

Planers composed the second most common type of machines in Taunton and other locomotive shops. The typical shop roster included one at least 7 feet wide and 30 feet long to plane frames. Many planers were highly specialized, as was the one at Taunton Locomotive adapted to plane the curved sides of the solid links for the variable cutoff valve gear. Tasks such as this would be performed later on by milling machines, which seemed to have been absent from the 1850’s locomotive shops. William Mason developed a reputation in the industry for designing many of his engines’ parts so that they could be easily planed. His frames were arranged so they could be planed from end to end, and all
abutting faces of the cylinders, steam chests, and cylinder saddles were similarly designed. He set up his planers so that both ends of the cylinders and saddles could be planed without removal from the carriage, thereby maintaining a precise relationship between sides. Charles T. Parry, a Baldwin partner, was so impressed after looking at the North Pennsylvania's Mason locomotive Allentown in 1857, that he ordered similar design reforms at Baldwin.\(^7\) The Taunton shops, and most other builders, also mechanically planed driving boxes, crossheads, crosshead guides, air pumps, throttle parts, and steam and cutoff valves, jobs once done by hand with cold chisels, blocks, files, and emery.

Slotters, with a vertically reciprocating tool much as in a wood-mortising machine, made keyways and finished pedestals on the frame, while their sisters, shapers, in which the tool moved horizontally, were used to make strap joints, cranks, and round or uneven surfaces. Whatever their time and labor savings or quality control

\(^7\)American Railway Master Mechanics' Association Proceedings 21 (1888): 201; see also Colburn's Railroad Advocate, Mar. 22, 1856.
advantages, these did save grueling hand labor. Samuel Vauclain, later board chairman of Baldwin Locomotive Works, recalled slotting keyways in rod straps and fluting side rods by hand using mallets and chisels:

My palms were worn down to the tendons and, without any cushioning fat to take up the pressure and vibration, the third and fourth fingers of each hand gradually turned palmward. They have stayed there . . . .

Fifty-five years later, Vauclain still could not open fully his hand. Perhaps, as Louis Hunter suggests, the greatest contribution of the machine to mankind has been the elimination of harsh, man-killing labor.

Mason, Taunton, and other builders used drills on braces, saddles, tube sheets, and engine frames. Either drills or punches were used to make rivet holes in boiler or firebox plate, the former method being more expensive, but causing less distortion to the plate. Shears cut the boiler plate, then rolls rolled it to the curve of the boiler. During the 1850's quartering machines to bore crank pin holes at right angles to each other came into use, the first reputedly

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9 In discussion at a conference on "America's Wooden Age" several years ago at Tarrytown, N. Y.
being built by Perrin in 1853. Other machines included cylinder boring mills, gear cutters, saws, wheel presses, grindstones, and tilt hammers, although neither of the Taunton builders nor most other shops had steam hammers or tube-drawing machines such as were in the shops of the Norris Locomotive Works of Philadelphia and the Cincinnati Locomotive Works.

These machine tools came from a great many builders, but William Sellers and Company and Bement and Dougherty were emerging in the 1850's as the pre-eminent locomotive tool builders. English tools, particularly Whitworth's, still graced many shops. Builders of the machine tools used by Taunton and Mason included a Willimantic, Connecticut, shop and Machine Company of Taunton, and L. W. Pond of Worcester.

10 Actually, Perrin found that the angle was about 97½ degrees. The first engine so equipped was construction number 127, Jan. 1853. Vol. I, TLMco., Baker; Locomotive Engineering 5 (1892): 228.

11 For other locomotive builders' tools and practices, see especially Colburn, Locomotive Engine, pp. 162-163; United States Magazine (Oct. 1855): 151-157; Colburn's Railroad Advocate, Jan. 12, Feb. 2, 23, 1856; In the Matter of Seth Willmarth; John H. White, Jr., Cincinnati Locomotive Builders: 1845-1868 (Washington: Smithsonian Institution, 1965), pp. 11, 25, 26; Chattel Mortgage, Oct. 16, 1858, Folder 2, Container 1, Cuyahoga Collection, Western Reserve Historical; Zanesville Gazette, Dec. 10, 1851; White, American Locomotives, p. 17.
Both Mason and Taunton built many of their own machines, as did most other locomotive shops. Often a shop developed a machine to perform a special task and ended making copies of it for other shops, as did Taunton with the quartering machine. Several locomotive builders, notably Lowell Machine Shop, Seth Wilmarth of Boston, Lawrence Machine Shop, Amoskeag Manufacturing Company of Manchester, New Hampshire, Smith and Perkins of Alexandria, Virginia, and Niles of Cincinnati engaged in a large machine tool business in the 1850's. However, all but Niles abandoned their tool business when specialized builders such as Sellers and Bement came to dominate the market late in the decade. In fact, Niles dropped its locomotive business in 1857 and soon joined Sellers and Bement as one of the three major heavy tool makers.¹²

Besides those made in the machine shop, many locomotive parts were made or finished in the smith shop, foundry, and finishing erecting shop. Parley Perrin's job books show that braces, levers, truck parts, straps, springs, large bolts, throttle stems, cutoff shafts and rockers, and members for the riveted frame were among the products of Taunton Locomotive's smithy.

¹²Niles' tool business had been conducted early on as a separate business from the locomotive business.
Parts subject to wear, such as valve gear and working joints, were case hardened. Taunton's and Mason's foundries cast brass, copper, babbitt, and iron for bells, bearings, packing, cylinder heads, dome casings, and various fittings. Much hand labor remained. Since Taunton Locomotive did not follow Mason's lead by designing its cylinders, steam chests, steam pipes and valve and pump seats so that they could be planed; their faces had to be laboriously ground together by hand. Rods were smoothed to a fine finish by draw-filing and hand polishing with emery. Reflecting the vice work needed to make many small parts fit, it took one man at Taunton 65 1/8 working days, plus 1 1/2 helper days, to key and fit six locomotives' rocker shafts with boxes, caps, and screws. Openings and steam ports on the cylinders and steam chests had to be chipped and filed by hand until the gauge fit, and at Taunton Locomotive, the cylinders of outside connection engines, exposed to view, were filed and finished with a stone. One of the most punishing jobs was riveting the boiler. At Mason, the rivets were turned slightly larger than the holes, so a helper inside the boiler pounded the rivet

13Rodney Briggs of Taunton recalls Bill Adams, an old Scotsman who had worked for Mason, telling of doing this.
through—a cramped task in a 42-inch diameter boiler. Then, while the helper pressed against the rivet, two men on the outside with a 20- to 30-pound mallets smashed the end of the rivet into a head, a process that took about 175 blows.14 Worse, one boiler required hundreds of rivets. How quickly a helper must have gone deaf inside that boiler!

Job Contract Labor

Both Mason and Taunton used the job-contract system of labor, a practice wide-spread in the locomotive industry both inside and outside of New England, despite John White's suggestion that it was peculiar to New England.15 Possibly originating in the textile machinery shops in the 1810's, the practice soon spread to many other industries and survived as late as 1930 at Baldwin Locomotive Works near Philadelphia.16

15 White, American Locomotives, p. 14.
A job contract was an agreement in which a master craftsman undertook to produce so many items, subassemblies, or operations of a given quality at a specific price. Such a contract could be oral or written, and could be performed inside or outside the shop. In Taunton, contracts were recorded in the superintendent's notebook and were all inside contracts. One in Parley Perrin's 1847 "Job-Book" reads:

Oct. 29: Luther Anthony: Contracts to make Pistons + Packing, Springs, Bolts + Nuts for the Same, fit and key the same to the Rod the whole of Which Shall be completely finished and the rods turned + draw-filed the whole to be done in a workmenlike manner for the sum of 32 dollars for each locomotive engine.

Additions to the contract also assigned Anthony to fit and key at $15 an engine and to turn, fit, and finish four cylinder heads with stuffing boxes and brass bushings for pistons and rods at an additional $15 per engine. Job contractors such as Anthony differed from modern pieceworkers in that job men had greater responsibility for their tasks and had to pay certain costs out of their earnings. At Taunton Locomotive the company, not the job contractor as in

17 Box 60, OCHS.
other industries, hired and paid the day laborers and journeymen working for the job man, deducting the helpers' wages from the contract price paid the job worker. Again differing from other industries, Taunton Locomotive furnished materials without charge to the contractor, although occasionally a contract was voided for "bad management of the work." Machines were provided by the locomotive shop, but the contractor was responsible for furnishing his own hand tools. Other locomotive shops followed much the same practice.  

Rates for these contracts were based largely on experience. Parley Perrin kept detailed records of jobs and the number of hours spent by craftsmen on jobs so that he could calculate their earnings, and he also exchanged information on job rates with other shops. When one contractor's job earnings fell below the best day worker's rate, Perrin raised his contract price. Conversely, when another contractor made $6 a day setting tubes at 14 7/8¢ apiece, Perrin cut the rate to 12¢ on the next contract. However, either harder work by Wilmarth or greater proficiency

18This section is based largely on Perrin's "Job-Book," and his Notebooks, Box 60, OCHS.
kept his earnings under the new contract at almost $6 per day. Rates were also affected by business cycles: the 1857 Panic led to 25 percent reduction in November 1857 and an additional cut in 1858. Earnings were generally about double those of other workers. Taunton Locomotive's seventeen job contractors' earnings in 1853 ranged from the low man's $657.07 to Luther Anthony's high $1797.36, a per-day range of $2.13 to $5.82. Most of the other fifteen men earned between $2.25 and $2.90 a day from their contracts.19

Both labor and management enjoyed several advantages under the job contractor system. Job hands received extraordinarily high incomes for nineteenth century workingmen and a less highly disciplined environment. Job security was good since shops, unwilling to lose their most skilled workers, placed job men on day work if there were no job contracts available. In turn, the manufacturer secured faster, harder working employees and simplified cost estimating because the risk of uncertainty was transferred to its job worker. Ultimately, both labor and management were rewarded because the job hands were dedicated, self-reliant

19Ibid.
employees with a high degree of self-respect. Not until the Taybrite efficiency movement came to Taunton on the eve of World War I did management find the job contract system a serious impediment to their efforts to control the production process.

Other Workers

Beneath the job workers were journeymen, apprentices, and day laborers. Journeymen, generally younger and less skilled than job hands, had passed through an apprenticeship of similar training and were paid, as their name suggested, by the day. In the late 1840's and early 1850's in Taunton, their rates varied from about $1.25 to $1.75, depending on their skill. During the mid-1850's, the top day rate rose to $2.00, then fell about 35 percent in the late 1850's. The apprentices, mostly young Taunton men aged seventeen to twenty-one, worked beside master craftsmen learning the trade. Under contract, the apprentice could be discharged if he disobeyed strict rules or progressed insufficiently. In the mid-1850's, apprentices' pay, set by contract, rose by annual steps to $1.00 per day. At age twenty-one when the apprentice had successfully
completed his four year contract, Taunton Locomotive presented him with a certificate in a little graduation ceremony. Below the apprentice and at the bottom of the hierarchical shop society was the unskilled day laborer, who performed the menial tasks beneath the dignity of apprentices. Wages ranged between $0.75 to $1.10 per day for day laborers in the late 1840's.  

Pay in the Taunton Locomotive shops was in cash. No company stores were maintained, the day of Crocker and Richmond's store and payment in kind being long gone. Most workers lived in private housing, although Mason owned the small Mason Block of apartments on the north side of the factory property, and Taunton Locomotive owned a few houses along the south side of the factory and two double houses in the west end of town. In 1851 the work day at Taunton Locomotive, and presumably Mason, was eleven hours, six days a week. Soon after it went to ten and a half hours, and by the 1860's it was 10 hours.  

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20 Perrin's Timebook and Diaries, Box 60, OCHS. For comparison, see "Day Book of the New Jersey Locomotive and Machine Company," DeGolyer Library, SMU, Dallas.
Working conditions in the two shops were generally good by the standards of the day, although industrial accidents and deaths were common, as in any machine shop. Taunton newspapers were full of reports of fingers and limbs caught, cut, torn, crushed, and amputated in machines, belts, and gears. Falling parts and exploding boilers also extracted their toll. More lucky, but embarrassed, was the Mason employee who found himself suddenly undressed when he caught his clothes in a power transmission belt. Less spectacular were the effects of noise and pounding which accumulated over the years. Otherwise, the shops were a rather pleasant place to work. Perrin and Mason knew their men well and took care of them. Mason's great grandson, Leonard Brabrook, recalled elderly men working leisurely in the shop part of the day, kept on by Mason out of kindness in sort of an unofficial semi-retirement program which provided income and dignity.

Few work rules seem to have been imposed on the shop hands in the city of Taunton. So long as the work was done, a man enjoyed considerable freedom. Employees seem to have been permitted to take breaks both on and off the property, providing that these neither lasted long nor interfered with the production process.
No evidence examined indicates the existence of an effort to control the private lives of the Taunton shop men to the degree attempted in the textile mills of, for example, Matteawan and Lowell. In the 1840's the Matteawan Manufacturing Company of Fishkill Landing, New York, posted detailed regulations for their workers' conduct both in and outside the factory. By maintaining these regulations, the owners hoped to promote local "harmony" and convince the nation's opponents of industrialism that mills were not "sinks of vice and immorality." These rules required mill hands to be on the job at all times during working hours unless excused by the overseer. Yet, shop hands and workers in other non-mill departments were merely requested "to give notice to the agent or superintendent, if they wish to be absent from their work"—further evidence that mechanics generally suffered from less regulation than mill hands. Conversation was to be confined to work-related topics, and smoking, liquor, and amusements were prohibited in the buildings or yard. The company threatened to dismiss employees guilty of intemperence or gross impropriety of conduct outside as well as in the factory. Church attendance
was strongly encouraged. Unlike the Taunton shops, Matteawan held job contractors responsible for the adherence to these regulations by both themselves and the hands they employed.

Several differences between the natures of machine shops and mills may have partly accounted for the less strict rules in the Taunton shops. Mills had continuous production processes which faced the danger of shut down if a person left his machine untended. The extensive division of labor in mills probably required a greater degree of workforce regimentation in order to coordinate the different elements of the production process. In contrast, the job-lot nature of machinery and locomotive orders led shop owners to place greater emphasis on the skill and self-reliance of shop workers than upon regimentation. The job contract system also shifted much of the burden of supervision to the contractors, thereby reducing management interest in the control of the shop. Likewise, the scarcity of skilled machinists placed them in a much stronger position than unskilled mill hands to resist workplace rules. In its effort to keep a watchful eye
over its workers and to provide for their housing needs, Matteawan built a hundred tenements. This large investment in housing not only kept workers' private lives and rent payments under the firm's control, but also impelled the company to supervise employee conduct more closely in order to protect the property. The same situation existed at Lowell and other mill centers. In Taunton, by contrast, most shop employees lived in private housing scattered about a much larger city than the village of Fishkill Landing where Matteawan was located. This rendered close supervision of the private lives of workers more difficult in Taunton. One other cause of the stricter regulation in mills arose from the composition of the work force. Women and children, as well as men, also worked in large numbers in cotton mills, but machine shops hired only men. Impelled by the contemporary social belief that the morals and health of frail womankind and children demanded greater protection than a man's, mill owners experimented in social controls. With opponents of industry citing the abuses of the factory system in England, American mill owners sought not to
give their enemies ammunition. This was particularly true of the Schencks of Matteawan who were leaders of the tariff movement. 21

Shops also tended to enjoy a higher degree of personal contact between owners, managers, and workers than was the case in the large textile mills. Many mills such as those at Lowell and even Matteawan were owned by outsiders in Boston or New York and were managed by a professional overseer. Mason and Taunton Locomotive were managed by owners such as Mason and Fairbanks who spent much time in the factory. Personal supervision rather than highly formalized work rules served to keep order and to maintain the production process. Furthermore, machine shops were more likely than cotton mills to be run by men with work experience in factories. Mason, Fairbanks, and Ferrin all had a practical mechanical training, so they better understood and sympathized with their workers than did many mill agents. In turn, the men of the

21Ferrin Diaries and Notebooks, Box 60, OCHS; Hunt's Merchants' Magazine 15 (1846): 371-372 (Matteawan work rules).
Taunton shops respected their owner-managers. Management willingly listened to grievances and labor relations remained good.

No serious strike seems to have taken place at Mason or Taunton Locomotive until 1886. After William Mason's death in 1883, control of the Mason Machine Works passed to William H. Bent and Frederick Mason, both men of gentile background who had never worked in a shop. Three years later, in mid-1886, fifty moulders walked out demanding restoration of wage cuts and recognition of the Knights of Labor as their bargaining agent. The situation was not eased by the stubbornness of treasurer William Bent who insisted that "I shall not yield to the principle demand by the men of 'recognition as a body,' even if I have to close the works for good . . . ." Bent broke the strike in a few weeks, but under him work controls became more important, particularly during the Taylorite efficiency movement in 1916.22

MARKETING LOCOMOTIVES, 1846-1861

In many ways the marketing of locomotives resembled that of textile machines. Buyers and builders were few, and the product had to be tailored to each customer's needs, dictating direct, personal contact between railroad and manufacturer. Credit, however, proved a more difficult problem in the locomotive business than in the textile machinery industry.

Advertising and Promotion

Mason, Taunton, and other builders advertised regularly through trade journals such as the Railroad Advocate, commercial directories, circulars, and commercial cards, all with little probable impact other than good will. The large lithographs of locomotives issued by builders in the 1850's became a popular art form and a valuable engineering record for historians, but they were of dubious sales value, other than as a kindness to customers. The Lehigh Valley Railroad, a regular Baldwin patron, requested three lithographs
from Baldwin because "our Superintendent wants to decorate his office." Mason's famous lithographs of the *Amazon* and *Phantom*, however, were so striking that they probably did much to create his reputation as a great stylist and helped to spread the design reforms he championed, a rare case where advertising significantly influenced a builder's business. Baldwin and other builders also maintained good customer relations by lending mechanics to hard-pressed railroads and by supplying parts, hand tools, and dies. Yet, the most important sources of publicity for a builder were trial runs of locomotives, as in the case of the first Taunton locomotives, and word of mouth.

**ORDERING LOCOMOTIVES**

The buying and selling of locomotives was almost completely a process conducted directly between builder and buyer. Since the locomotive normally embodied

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24 Incoming Letterbooks, 1850's, Baldwin Collection, Historical Society of Pa.
modifications requested by a master mechanic, and because there was a profusion of track gauges, rarely were commission merchants retained to sell locomotives. However, Taunton Locomotive did list Boston and New York offices, probably those of commission merchants, and received at least one order through Kasson and Davis in New York in 1856. A few locomotives were advertised by commission merchants in the Railroad Advocate in the mid-1850's, but quite likely these were locomotives from aborted orders builders were attempting to unload. Since the notices ran for a long time, the merchants must have had no better luck.

In the most common ordering process, a railroad's operating offices went to the board for authorization to purchase locomotives, then the president or other officer wrote to or journeyed to the builder. There are many entries in Perrin's diaries similar to the one of August 14, 1851:

Mr John O Sterns from N J Centrall R. R. here to day Says their Engines will be 15x20 Cyl & 15½ whee unless other Wise ordered.

In boom times, the railroad was far more likely to contact the builder than the reverse, but in depressions
builders sent officers far and wide in search of business. Perrin and Fairbanks did make frequent trips to Boston in good times and bad to talk to local railroad officials and promoters about possible orders, and each made several sales trips to the Midwest, particularly after business fell off in the mid-1850's.  

Either in the face to face meetings or by letter, a builder would submit an offer to a railroad, which would frequently reply that another builder had made a better offer. Often the builder then improved his terms to meet the competition. To prevent railroads from dishonestly talking down prices this way, builders frequently exchanged price information. Once a railroad accepted an offer, a letter or verbal agreement sealed the order, although a formal contract was usually soon made and signed.

Contracts for locomotives were generally quite simple. One between the Cuyahoga Steam Furnace Company and the Grand Gulf and Port Gibson Railroad in 1855 consisted of only one page which stated the cylinder size, number of drivers and their size, boiler diameter, 

\[25\]Perrin Diaries.
number of flues and their material and type, place and date of delivery, price, and terms of payment.\textsuperscript{26} Large roads such as the Baltimore and Ohio had two-page contracts with much more detail, but few builders or railways went to the lengths of Boston Locomotive Works whose printed contracts specification form ran ten pages.\textsuperscript{27}

Determinants of Railroads' Selections of Locomotive Builders

The officers and promoters of a railroad tended to purchase from a builder near the city in which they lived partly because of lower shipping costs, but probably also due to friendship and regional loyalty. Both Taunton and Mason sold a fraction over 30 percent of their pre-1862 locomotives to railroads either in eastern New England or controlled by New Englanders, such as the Hannibal and St. Joseph.\textsuperscript{28} Likewise, railroads controlled by men in New York City favored Paterson

\textsuperscript{26}Contracts Book, p. 26, Container 3, Cuyahoga Collection, Western Reserve Historical.

\textsuperscript{27}Papers Relative to the Recent Contracts for Motive Power by the Baltimore and Ohio Rail Road Company... (Baltimore, 1857), pp. 9-10; Boston Locomotive Works, Specification, pp. 1-10.

builders, and Philadelphia roads, the local shops. Virtually all sales by the Midwestern builders were to railroads west of the Appalachians. Interlocking ownership of railroads and shops were uncommon, but Crocker's offices in the Taunton Branch Railroad secured Taunton Locomotive its business. Matthias W. Baldwin was a large shareholder in the Pennsylvania, an important customer, while Morris Ketchum's roles in the New Haven, the Illinois Central, and many Southern roads brought Rogers, Ketchum and Grosvenor many orders from those roads.\textsuperscript{29}

Certainly the quality of design and a builder's reputation accounted for many orders. One of the keys to Baldwin's and Rogers success lay in the fine workmanship, advanced design, and trouble-free performance of their engines, and most certainly Mason's artistic designs and quality workmanship brought many orders. Price seems to have been far less important a determinant of sales than might be expected. Rarely were formal bids requested, and normally different builder's quotes were fairly close. Only in depressed times did price competition become a strong factor; the

\textsuperscript{29}Pa. vol. 131, p. 144, Dun; Baldwin and Rogers construction lists, edited by S. R. Wood, author's collection.
rest of the time credit terms and speed of delivery seem to have been greater concerns of railroads. For example, in 1854 the Central Ohio Railroad ordered a dozen locomotives from Taunton Locomotive rather than from on-line H. and F. Blandy of Zanesville because Taunton engines had a fine reputation among mechanics, and because Taunton could supply the locomotives much sooner, and at more reasonable rates and credit terms than Blandy.\textsuperscript{30} When in 1856 the Baltimore and Ohio found the Baltimore builders full of work and the cantankerous Ross Winans unwilling to build to the road's specifications, it turned to Mason for the engines needed in a hurry.\textsuperscript{31} If the connections, quality, design, reputation, price, credit terms, and delivery date were satisfactory enough for a railroad to order from a given builder, that builder could expect many reorders if the railway was satisfied with the product. Of the 106 new locomotives Mason sold in his first nine years in business (1853-1861), 44 were purchased by roads which had previously ordered from him.\textsuperscript{32}


\textsuperscript{31} \textit{Papers Relative}, pp. 9-10.

\textsuperscript{32} Mason Loco. Spec. Book. Roads under the same ownership, such as the units of the Wabash, are considered one railroad, and none of the engines in a multiple-engine initial order are considered reorders.
Pricing and Credit

Complete price information is unavailable for Mason and Taunton, however, in 1850 the average Taunton Locomotive engine cost $8,250. By 1854 the 15 Taunton engines for which information is available cost an average of just over $9,000. Credit stringency caused a lower demand for engines in 1855, and Taunton's average price fell to $7,600; however a temporary revival in 1856 and 1857 brought the prices back to 1854 levels. Taunton prices are unavailable for next four years, but as did all other builders' prices, they undoubtedly fell sharply.  

Given the variety of locomotives, there was no such thing as a single locomotive price. Builders based their price offers on the size of the cylinders (which determined the size of the boiler), the number of drivers, and market conditions. Then the charges for extras were added: patent appliances, Low Moor iron tires or boiler plate, and so on. Builders would cut the price to meet the competition, and old or cash

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customers often received discounts, although there was little volume discounting. However, in depressions, demand became far more elastic, causing prices to fall rapidly.\(^{34}\)

Inadequate capital was a persistent problem of railroads in the 1850's, particularly in the credit-starved Midwest, so until the Panic of 1857, Mason, Taunton, and most other shops accepted notes, stock, bonds, old locomotives, and land in payment. In the 1850's builders typically asked only for one-half down in cash and accepted notes ranging from 4 to 12 months for the rest. Very often no interest was charged, and in some cases no downpayment was requested. Notes were discounted as quickly as possible at banks, although if the railroad could not pay them at maturity, the locomotive builder had to make good the banks' losses. Land seemed to have been held longer, possibly as a speculative venture, but more likely because of the difficulty of selling at such distance, since it was the Midwestern and Southern roads that gave land in payment.

\(^{34}\)Perrin Diaries. Compare with Orders Books, Baldwin Collection, Historical Society of Pa.
Mills and Company partners took the securities Mason received, while Taunton distributed them as special dividends to shareholders.35

After the 1857 Panic caused the dishonoring of notes and the collapse of stock and bond prices, with disastrous effects on locomotive builders, shops became more reluctant to grant credit. A measure of the problem was the $67,000 in bad accounts receivable (over two-thirds of all receivables) and the $26,000 in defaulted notes that forced the 1859 failure of the Boston Locomotive Works. Boston also held land, $134,000 par in bonds, and $21,000 par in railroad stocks, all probably selling at a small fraction of par on the open market.36 Although they took notes and securities, neither Mason nor Taunton accepted


36 Item 4, In the Case of the Boston Locomotive Works, Insolvent Debtors, Records, Case 524, 1856-67 Docket, Suffolk County Court of Insolvency, Boston. Boston had received houses in Rochester and 1000 acres in Wisconsin. Midwest builders frequently accepted land.
such quantities. Note collection could be a headache. Baldwin had to send partners in the firm to the South and Midwest in their attempts to collect notes in the late 1850's, and lawyers and bill collectors were retained by other builders—all without guarantee of any return. Although builders continued to extend credit after 1857, seldom did they accept a cash down payment of less than 65 percent of the purchase price. During the boom of the mid-1860's, Parley Perrin, mindful of the troubles credit caused Taunton in 1857, insisted on full payment in gold at delivery.37

NATURE OF THE LOCOMOTIVE BUSINESS, 1846-1861

Building steam locomotives was essentially a job-order rather than mass-production business. One of the principal reasons the diesel quickly supplanted the steam locomotive in the 1950's was General Motors' application of true mass production and standardization to locomotives for the first time.

Although by the end of the 1850's the American standard locomotive's basic technology was fairly well established, each railroad master mechanic ordered engines equipped with his pet design modifications

37 Baldwin Collection Historical Society of Pa.; Perrin Diaries.
and applications. A welter of track widths also prevented thorough-going standardization of locomotives. Still, builders attempted to reduce production and tool-up time and costs by introducing standardization and interchangability into some parts of locomotives, notably fittings. Baldwin in the 1850's began using gauges and templates to aid in the standardization of many of their parts such as valve gear, rods, pump parts, and cylinders. There is some indirect evidence that Mason may have begun their use before Baldwin. Other builders adopted the practice by the 1870's. Boston Locomotive Works was using the Whitworth thread standard in 1859, several years before the creation of the Sellers' standard. To further maintain engineering standards, Baldwin kept a large book, named by draftsmen, "The Old Man," and supplements called "Junior Law," which listed Baldwin's design standards and conventions. Each entry had to be initialed by all designers. In the last analysis, probably the greatest advantage of this primitive standardization was the simplification of the process

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of supplying railroads with repair parts. Builders must have been cognizant that this degree of standardization encouraged roads to return to them for parts.

Although most engines were built to order, new builders, as well as established builders in dull times, built locomotives for stock in advance of orders. It was a dangerous practice since a builder could get stuck with an expensive inventory if the market remained dull. Also, given master mechanics' propensity to demand many options rather than an off-the-shelf model, engines built for stock were hard to sell and often went for little or no profit. Still, the practice of building for stock did keep together a work force during depressions and put food on the men's tables. Taunton built stock engines in the 1840's and 1850's, however, its inability to sell these locomotives in the late 1850's depression led it to discontinue the practice.

During the 1840's and 1850's a few builders rounded out their business with foreign sales. Such sales were particularly welcome during recessions, such as followed the Panic of 1857. Between 1851 and 1857,
seven Eastern builders sold 7.6 percent of their output to Canada and 2.1 to other countries, notably Cuba, yet in the recession year of 1858, the percentages were 25.4 and 6.8 respectively. Prior to 1862, Mason sold two to Egypt, and Taunton, five to Canada. Generally Canadian and Cuban engines followed United States practices, and engines sold to other nations were but slightly modified versions of American designs. Mason's Egyptian engines were coke burners and had British-style buffers, no pilot, and polished frames and parts where Mason normally used a planed finish; otherwise, they would have looked at home on an American line. Foreign sales embodied several problems, including language, transportation, insurance, duties, 

39 Mason, Taunton, Portland, Amoskeag, Lowell, Schenectady, Rogers.

40 Charles E. Fisher lists of Amoskeag, Taunton, Lowell, and Portland locomotives, Railway and Locomotive Historical Society, Kresge Hall, Graduate School of Business Administration, Harvard, Boston; S. R. Wood lists of Schenectady and Rogers locomotives, author's collection; Mason Loco. Spec. Book. Taunton records from 1855 to 1865 are so fragmentary that the Fisher list is a reconstruction. Mason began building in 1853, Schenectady in late 1851, while Lowell stopped in 1854 and Amoskeag in 1856, although both sold engines already in stock later.

41 Colburn's Railroad Advocate, May 24, 1856.
and repair part supply, as well as the difficulties of setting up locomotives at such great distances and of dealing with alien governments and technological processes. Manana and mordida must have been quite a shock to a naive Yankee locomotive builder.

All locomotive builders made products other than locomotives, if nothing other than repair parts. Among the few shops capable of machining large parts, locomotive shops were requested by other industries to do occasional job orders. Lowell Machine Shop, Lawrence Machine Shop, Amoskeag Manufacturing Company, Mason, Charles Danforth, and Rogers, Ketchum and Grosvenor for instance, engaged in textile machinery. Smith and Perkins of Alexandria, Virginia; John Souther of Boston; Niles of Cincinnati; the Portland Company of Maine; Steam Furnace of Cleveland; and the Cincinnati Locomotive Works built marine engines. Niles, Lowell, Lawrence, and Seth Wilmarth of Boston turned out makers of stationary engines—Corliss, Nightingale and Company of Providence; C. Cooper and Company of Mt. Vernon, Ohio; and H. and F. Blandy of Zanesville, Ohio—flirted with locomotives in the 1850's, but wisely returned to the field in which they became famous. On the other hand, the Schenectady (New York) Locomotive Works, the Norris Locomotive Works
of Philadelphia, the Baldwin Locomotive Works of the same place, the Manchester (New Hampshire) Locomotive Works, the Boston Locomotive Works, William Swinburne of Paterson, New Jersey, Breeze and Kneeland of Jersey City, Taunton Locomotive, and a few small shops seem to have concentrated most of their energies on locomotives.

Both Mason and Taunton did a healthy repair parts business, and they sometimes rebuilt engines of their own and other builders' manufacture, particularly during recessions. From November 1859 to March 1860, three of the four engines Mason turned out were rebuilds. Likewise, Taunton made a few machine tools and stationary engines, and Mason turned out files. Both of the Taunton shops accepted a few special orders from local industries for heavy casting and machining, including cranes, steam engine parts, roll mills, gears, pulleys, fly wheels, squeezers, and spindle bolsters, the last by Taunton. Taunton even did the rifling and chambering for J. P. Morgan for 1,000 of the infamous Hall Carbines which Arthur Eastman, Simon Stevens, and Morgan purchased as surplus, rifled, and resold to the government at great profit. As varied and interesting as this non-locomotive
business was, it, however, added little either to Taunton's profit or to Mason's locomotive and cotton machinery earnings. 42

Profitability

No adequate records of the earnings of William Mason and Company remain, but some survive for Taunton Locomotive Manufacturing Company. Throughout the late 1840's and early 1850's, Taunton Locomotive earned a good profit, although as prices and capitalization rose, both profit margins and the rate of return to capital fell. In 1848 the new firm had a 52.8 percent rate of return on its capital. However, by 1850 this had declined to 25.5 percent, and by 1854, to 14.8 percent. Losses appeared in 1856 and in 1858 because of

poor business. Except for the boom years of 1865 and 1866 in which astronomical prices were charged for locomotives, Taunton never again enjoyed such high profits as in its first years. During 1850-1853, the firm's estimated profit margin was a healthy 12 percent, a figure not attained again until 1865. Except for the depression years of 1856, 1858, and 1861, the early Taunton locomotive business was quite profitable. In 1861, Taunton Locomotive's net cumulative profits were 76 percent of the $218,500 capitalization. 43

 STRUCTURE OF THE INDUSTRY, 1846-1861

The years 1846-1854 witnessed the rapid expansion of the locomotive industry both in capacity and geographic extent. As the industry spread from New England and the Middle Atlantic states to the South and Midwest, the

43Perrin's Notebooks and Diaries; Vols. I-II, TLMCo., Baker; particularly Perrin's notes on "Records," inside "Job-Work" Notebook, Box 60, OCHS. Profit margins were calculated using the known prices of 40 locomotives sold during these four years, at an average price of $8119. Since the average profit per locomotive for these years was $993, a profit margin of 12.2 percent was probable. It was assumed that non-locomotive contributions to profits were very small.
number of builders jumped from seven to twenty-six
(discounting the shops which built only a few locomotives
for a brief time). Reflecting the increased railroad
construction, particularly in the Midwest, locomotive
production rose from 90 to 100 engines in 1845, all
built in New England and the Middle Atlantic states,
to 300 to 350 engines in 1851, approximately 10 percent
of which were made in the South and Midwest, and about 8
percent, in Taunton. In the peak antebellum year of 1854,
output jumped to about 650 locomotives, about 23
percent of which were built in the South and Midwest,
and 6 percent, in Taunton. With the collapse of the
railroad building boom in 1855, many firms failed or
discontinued locomotive manufacture. By 1858 only a
dozen active shops remained. The Southern and Midwestern
shops disappeared as suddenly as they had appeared in
the early fifties. Freedley estimated the entire
industry's capital at the peak in 1854 to be $3 million;
its labor force, 6,000; sales; $8 million; and payrolls,
$2.5 million. Although locomotive sales in 1854 stood

44 Estimated from remaining production figures and
C. E. Fisher's lists taken from railroad annual reports.
These lists rather consistently record 70 percent of
total output when compared to known output totals.

45 Freedley, Leading Pursuits, p. 301.
closer to $6 million, Freedley's sales figure may include non-locomotive business such as repair parts and the general machine-shop business, such as Taunton Locomotive performed on the side. His other estimates seem plausible. Shortly afterward—in 1855—Zerah Colburn estimated the production of the locomotive builders at 600 to 800 per year. He also suggested that the railroads' shops built 100 per year. Yet, he calculated the capacity of the industry at 1200 engines a year. It was this over-capacity which led to the mass exit of firms in 1855-1857.

New England Builders, 1846-1861

Except for Lowell Machine Shop, Holmes Hinkley of Boston, and Taunton Locomotive Manufacturing Company, all of the nine important New England shops of the 1850's started during the 1848-1854 railroad expansion boom. Only Hinkley, the Portland Company of Maine, the Manchester Locomotive Works of New Hampshire, and the two Taunton shops survived as locomotive builders after 1857. Because the New England market was so limited, local builders sold much of their output to other regions.

\[46\text{Colburn's Railroad Advocate, Oct. 20, 1855.}\]
particularly the Midwest. Between 1846 and 1852, Taunton Locomotive sold 58.1 percent of its railway engines in New England, 27.4 to the Middle Atlantic states, 11.3 to the Midwest, and 3.2 to Canada. Reflecting increased competition in New England and an explosion of railroad building in the Great Lakes states, New England sales fell to 20.2 percent of the two Taunton builders' output in the period 1853-1861, being offset by an increase of Midwestern sales to 52.4 percent. During 1853-1861 Middle Atlantic sales slipped to 17.2 percent and foreign to 1.1, while the South received 9.0 percent. Other New England builders experienced a similar distribution of markets. Because of their remoteness from markets and raw materials, and because of their small size compared with the Paterson and Philadelphia shops, New England builders were forced into a higher cost situation than their Middle Atlantic competitors. This explains in part why so many New England shops withdrew from production in 1858-1857 and why the New England industry died long before the Middle Atlantic shops. Moreover, the Paterson and Philadelphia shops controlled much of the Middle Atlantic market, forcing the New England
shops more heavily into the risky Midwestern market. Baldwin sold only 11.3 percent of its 1852-1858 output to the Midwest; Norris, 8.7; the Taunton builders, by contrast, sold 51.0 percent of their output to the Midwest. When credit stringency forced large numbers of Midwestern railroads to default on their obligations in 1855 and 1857, the New England and Midwestern locomotive builders were driven to the wall while Norris, Baldwin, and Rogers rode out the storm in good order.

Three leading New England locomotive builders were the large waterpower machine shops which equipped the big textile mills: Lowell Machine Shop, Amoskeag Manufacturing Company of Manchester, New Hampshire, and the Lawrence Machine Shop built by Essex Company. Lowell, which was active as a builder from 1835 to 1854, was oldest of the New England shops in this period, but disinterest in the risky locomotive business led Lowell to relinquish leadership of the New England Locomotive business to Hinkley. Amoskeag was unusual among the large waterpower shops in that the cotton mills, power

canal, and machine shop remained under one company. An eclectic shop making a wide range of machinery from cotton equipment to fire engines, Amoskeag engaged in locomotive manufacture from 1849 until 1856 when it, as had Lowell, became disenchanted with the business. In 1855, Manchester Locomotive Works was opened next to the Amoskeag plant, drawing many of its workers and management from Amoskeag, and leaving one with the suspicion that it was not by chance that Manchester opened at the moment in history when Amoskeag abandoned the locomotive business. The third waterpower shop, Lawrence, was a persistent money loser both as part of the Essex Company and as an independent. It built locomotives from 1850 until its collapse in 1857, along with many other products.  

Of the three Boston shops, Hinkley, also known as the Boston Locomotive Works, was the oldest and largest, succeeding to Lowell's leadership of the New England industry in the mid-1840's. Seth Wilmarth's Union Works built locomotives in South Boston from

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1848 to 1854, when problems with a huge Erie order led to his failure. Neighbor John Souther built engines at his Globe Works from 1848 to 1857 when he turned to other products, particularly his steam dredge. The other large shops, the Portland Company in Maine (1848-1894), Taunton, and Mason, continued locomotive building several decades. A few marine or stationary shops looking for prestige or a quick profit entered the locomotive business briefly, particularly Lewis Kirk of Cambridge (1850-1852), Jabez Coney of South Boston (1847), the Ballardvale Manufacturing Company of North Andover (1848-1849), A. Latham and Company of White River Junction, Vermont (1854-1856), the Matfield Manufacturing Company of E. Bridgewater, Massachusetts (1854-1856); and the Springfield (Massachusetts) Car and Engine Company and its successor, S. C. Bemis and Company (1848-1857).^49

Middle Atlantic Builders, 1846-1861

The two Philadelphia shops, the Norris Locomotive Works and the Baldwin Locomotive Works, were the largest and oldest American builders, their locomotive

^49 These histories are drawn from Dun; Freedley, Leading Pursuits; Colburn’s Railroad Advocate, Oct. 20, 1855; and C. E. Fisher’s locomotive lists, unless otherwise stated.
production dating from 1834 and 1832, respectively. Preferring to leave the risk to others, neither were innovative leaders in design in the 1850's. Both stressed sound construction and lowered costs by maintaining larger volume and a higher degree of standardization and vertical integration than other builders achieved. Norris was one of the few shops which forged its own rods, frames and tires. Allied with the Philadelphia capitalists and railroad owners, both Baldwin and Norris were very successful firms which sold a quarter of all locomotives produced in the United States.

Under Thomas Rogers, William Swinburne, and William S. Hudson, whose design reforms produced the American standard locomotive during the 1850's, the shops of Paterson, New Jersey, became the progressive leaders of the American locomotive industry. Perhaps encouraged by the small size of the local cotton mills, both Rogers, Ketchum, and Grosvenor and their neighbor, Charles Danforth were old cotton machinery manufacturers which had added locomotives in 1837 and 1853, respectively. Morris Ketchum, a Rogers partner, was a cotton broker and Southern-land speculator with many Southern connections, who steered 23 percent of Rogers' 1851-1858 sales to the South.
Blessed with Ketchum's and Grosvenor's capital and connections, Rogers' annual sales caught up with Baldwin and Norris in the 1850's and even briefly surpassed the Philadelphia builders. Charles Danforth added locomotives to cotton machines in 1853. Another Paterson locomotive builder, Swinburne, Smith and Company (1848-1851), became better known as New Jersey Locomotive Works (1851-1866) and as the Grant Locomotive Works (1866-1896). On leaving the firm in 1851, William Swinburn set up his own locomotive building firm in Paterson (1851-1857).

Other important Middle Atlantic shops were the Schenectady (New York) Locomotive Works, begun in 1848 as another Norris family enterprise, the Jersey City shop (1853-1866) of Breeze and Kneeland and the Jersey City Locomotive Works, and Ross Winans in Baltimore (1837-1860). Small shops included the Lancaster Locomotive Works in Pennsylvania (1853-1857), the New Castle Manufacturing Company in Delaware (1840-1858), and two

50 S. R. Wood's Rogers and Baldwin lists; and Fisher's Norris list, the last inflated by 1.4285.

51 N. J. vol. 65, pp. 43, 123; and N. Y. vol. 65, p. 43, Dun; Trumbull, Industrial Paterson, pp. 128, 147; Fisher lists.
Baltimore shops, Murray and Hazlehurst (1854-1857) and A. and W. Denmead and Son (1853-1859). Even the fading Matteawan shop turned out two locomotives in 1849.52

Southern and Midwestern Shops, 1846-1861

The locomotive builders of the South and Midwest were general machine shops and marine and stationary engine builders drawn into the locomotive trade by the railroad boom of the 1850's. Credit stringency, a normal state in these parts of the country, eased temporarily in the Midwest between November 1849 and October 1853, sparking a five-fold explosion of railroad mileage in the Great Lakes states from 1105 in January 1851 to 5628 just four years later, January 1855. The boom drained banks of loanable assets in 1854, creating a recession in late 1854 and 1855. The partial recovery of 1856 and 1857 was followed by the collapse of late 1857. Reflecting this situation, mileage grew from 5628 in January 1855 to 8535 in January 1858, then to only 9514 by January 1861.53 Responding to the


boom, the number of major builders in the Midwest and South rose from one in 1850 to six in 1854, augmented by ten smaller, new shops. Only one, Cincinnati, the oldest, carried on a locomotive business after 1860, and then only for five years. Most of the rest withdrew to their other products during 1855-1857 because of slackened road building, tightened credit for their operations, and increased competition from Eastern builders.

Faced with higher interest and materials costs and inefficient small size, the Midwest builders were initially protected from Eastern competition by high freight costs. Ironically, however, the railroads which gave birth of the Midwest builders soon destroyed them by providing Eastern shops lower freight rates to the Midwest. Cleveland's Cuyahoga Steam Furnace Company's 1850 cost for building a locomotive, $7,500, was $250 above Taunton's price, which included a $1,000 profit. Clearly it was the $670 shipping cost from Boston to Cleveland that enabled Cuyahoga to compile with Taunton. Completion of Eastern rail links to the Midwest in 1852-1853 cut the freight rates, so that by mid-1857 the Boston-Cleveland rate for a locomotive had been halved to $330. When one also compares the experience of H. and F. Blandy at Zanesville, Ohio, the conclusions are the same.
Blandy admitted losing money in 1852 on engines sold at $600 more than Tauntons' cost per locomotive, and in 1853, for $400 more, yet a $750 to $800 shipping cost for Taunton to Zanesville protected Blandy. Clearly a shipping cost under $400 that Taunton enjoyed a couple of years later put Blandy at a severe disadvantage.\(^5^4\)

Another difficulty of Midwestern builders was the high cost of interest in their region. This cut two ways: on one hand it raised the operating costs of Midwestern shops and made it more difficult for them to get the credit needed to carry on their operations, yet it also prevented Midwestern shops from granting as easy credit terms as Eastern builders, whose banks were far more liquid than those to the west. The president of the Central Ohio Railroad admitted that he bought from Taunton rather than on-line Blandy because of Taunton's willingness to grant him one year to pay.\(^5^5\)

\(^{5^4}\) Calculations based on rate structure quoted in Freedley, Leading Pursuits, p. 91; Aurora (Zanesville), Feb. 2, 1853; Zanesville Gazette, Dec. 20, 1853; Daily True Democrat (Cleveland), Mar. 7, 1850; Contracts Book, pp. 26, 38, Cuyahoga Collection, Western Reserve Historical. A study of Orders Books, 1853-1854, Baldwin Collection, Historical Society of Pa., yields the same conclusion.

\(^{5^5}\) Sullivan, Reply, pp. 13, 17, 19, 39-40.
Midwestern and Southern builders were also disadvantaged by the difficulties of getting good mechanics and by railroads' prejudice in favor of Eastern shops. Cincinnati Locomotive Works tacitly admitted the existence of this prejudice when it advertised its engines as being "equal in efficiency and durability, to the best Eastern manufacture."\(^{56}\) Despite these problems, several shops built locomotives to progressive designs generally equal to Eastern builders, and Cuyahoga even influenced slightly Eastern locomotive design.\(^{57}\)

Three Midwestern shops were conducted with the vigor and scale of Eastern shops: the Cincinnati Locomotive Works owned by Anthony and William Harkness, Robert Moore, and John G. Richardson (1846-1865), first, largest, and last of the shops of this period; Niles and Company (1852-1857), also in Cincinnati; and Cuyahoga Steam Furnace's Cuyahoga Locomotive Works in Cleveland (1850-1857). These three firms produced about 60 percent of the approximately 530 locomotives built in the region, Cincinnati alone accounting for 30 percent.

\(^{56}\)See National Car Builder 14 (1883): 16, for one man's recollection of labor difficulties. The advertisement ran in Railroad Record 1 (1854).

\(^{57}\)See White, Cincinnati; idem, "Cuyahoga."
of all Midwestern production. The rest of the production was spread among shops which built fewer than 50 locomotives in their career: Detroit Locomotive (1854-1858), H. and F. Blandy of Zanesville, Ohio (1851-1855), Palm and Robertson of St. Louis (1853-1858), Menominee Furnace (later Menominee Locomotive Works) of Milwaukee (1852-1857), Chicago Locomotive Works (1853-1854), and C. Cooper and Company of Mt. Vernon, Ohio (1853-1854). In 1850 the Midwest took 83 percent of the known locomotives by the Midwestern builders, and the South, 17 percent, and in the peak year 1854, the Midwest absorbed 99 percent of the output. Reflecting the decline of railroad building in the Midwest, by 1857 the South took 32 percent of these builders' production, and by 1859, 91 percent.

58 Assuming that the 133 identified Cincinnati locomotives are 70 percent of its production, it built 190 locomotives. Using the same process, I estimate Niles' production at 120, Cuyahoga's 75, Detroit's 45, Blandy's 26, Cooper's 10, Chicago's 13, Menominee's 14, and Palm and Robertson's 26, suggesting a total industry output of about 530 locomotives. In making the above estimate, it is assumed that almost all Cuyahoga and all Blandy engines have been identified.

59 Dun reports for these companies; trade press; C. E. Fisher's locomotive lists; Zanesville; Cleveland; and Mt. Vernon newspapers; Cuyahoga Collection; and White's Cincinnati and Cuyahoga histories.
Two Southern builders accounted for most of the region's output, the Tredegar Works of Richmond (1850-1860), and Smith and Perkins of Alexandria (1851-1856). The former was attached to the premier industrial establishment of the South, while the latter was essentially a Middle Atlantic shop. Burr and Ettinger (1852-1857) and Talbott and Brothers (1849-1852), both of Richmond, Uriah Wells at Petersburg, Virginia, (1851-1857), and the Nashville Manufacturing in Tennessee (1851-1853) added a handful of engines to the total. Smith and Perkins sent most of its output north of the Potomac, but the other shops sold their engines strictly in the South. The entire output of the Southern industry probably did not exceed 100 locomotives, a figure which contrasts sharply with the nearly 500 sold in the South by Rogers, Baldwin, and Norris between 1851 and 1858. In the face of such competition, the Southern shops withered as quickly as the Midwestern shops when hard times struck. 60

By 1854 there was serious overcapacity in the locomotive industry which was quickly eliminated by the

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60 Fisher lists; Dun reports.
1854 recession and by the 1857 Panic. Departures from the locomotive business included Lowell, Amoskeag, Lawrence, Wilmarth, and Souther in New England; Lancaster, Newcastle, Swineburne, and the Baltimore shops in the Middle Atlantic states; and all but Cincinnati in the South and Midwest. Many of the survivors failed and reorganized as did Mason.

PANIC AND FAILURE: 1857

The panic of 1857 brought the Taunton shops bankruptcy, closure, and a final divorce from outside capital. Overexpansion of railroads, industry, money supply, and credit were underlying causes of the Panic. By July 1857 high cotton prices and low cloth prices had forced many cotton mills to cut back or suspend production, and railroads and other industries were experiencing increasing difficulty securing credit, discounting notes, and selling paper. When the Ohio Life and Trust Company failed on August 24 due to speculation in Midwestern railroads, business confidence was seriously shaken. Failures in the East spread rapidly during the next three weeks in a chain reaction
that placed Charles H. Mills and Company in a financial squeeze. Since Mills and Company was obligated to pay the cotton mills' drafts it had accepted, and because it could reimburse itself only out of the proceeds for the sale of goods upon which those drafts were issued, the collapse of cotton prices meant that Mills and Company lost the difference between the amount of the drafts and the income from the sales made in the demoralized dry goods market. During the difficult summer when loan sources dried up, Mills and Company attempted to keep its client shops and cotton mills afloat by extending them unusually large amounts of credit. This, in turn, forced the firm to discount notes more heavily. When in the first two weeks of September many of the jobbers and commission merchants to whom Mills and Company sold failed, Mills became responsible for payment of the notes it had discounted. Failure of some of the units of Mills' industrial empire caused further damage. Unable to borrow, responsible for large amounts of defaulted paper, and unable to

61 American Republican (Taunton); Boston Journal; Taunton Democrat; all July to Oct., 1857; Letterbooks, same period, Baldwin Collection, Historical Society of Pa.
obtain much on the market for the cotton goods on hand, Mills and Company failed on September 17, 1857, causing the suspension of William Mason and Company whose affairs were so closely entangled with those of Mills. Through the rest of September and October the failures gathered momentum, preventing the recovery of Mason and Mills and pushing Taunton Locomotive Manufacturing Company to the brink of disaster. The same week of Mills and Company's suspension, other commission merchants failed, including the Philadelphia firms of Hacker, Lea and Company and John Farnum and Company. The following week banks in Baltimore, Providence, and Philadelphia suspended specie payment, and on October 1 the second of the five big Boston commission dry goods houses, Lawrence, Stone and Company, went under. Two weeks later, on Black Friday, October 13, the third major Boston house, Francis Skinner and Company, failed. On the same day, the stock market and New York banks joined the Panic. By late November five of the smaller Boston commission dry goods houses had suspended, as had the Northampton, Whittenton,

Middlesex, Bay State, Hampden and Pemberton mills as well as the Hadley Falls and Lawrence shops. Northampton, Whittenton, and Hadley were all part of the Mills empire. At least thirteen major railroads had also failed, several of which had recently purchased locomotives from the Taunton builders.63

These failures deepened Mason's problems because his iron and other materials had been purchased with 20, 30, or 40 day notes. When the Panic struck, the cancellation of locomotive orders left Mason with large inventories of raw materials, and partly finished and completed locomotives for which there was no longer a market. Moreover, the failure of railroads which had paid Mason partly in notes left him responsible for those notes discounted at banks. Hard pressed themselves, the banks were unwilling to grant Mason new loans or extensions. Without Mills and Company as a lender of last resort, and with his assets suddenly reduced to only two-thirds of his liabilities, Mason's temporary

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suspension became permanent. On November 6, Mason filed as legally insolvent and assignees were appointed. Taunton Locomotive, facing similar problems, narrowly escaped bankruptcy. Six of its recent locomotives had been shipped to railroads which failed in the first weeks of the Panic, and orders were cancelled for twenty-nine more locomotives, leaving Taunton with bills for unused materials. Taunton also had a pile of unpaid notes for nine locomotives ordered by the Central Ohio Railroad eighteen months earlier. Perhaps H. and F. Blandy, which lost the order because it could not offer such generous credit, was really the winner. Zerah Colburn pointedly wrote the Baldwin Locomotive Works, "I think you may be congratulated on having your hands loaded with the class of paper which several Northern builders have taken and which is going so hard with some of them." Baldwin survived the Panic in good order, but in October Taunton was forced to temporarily suspend payment. The shareholders bailed out the firm by a series of loans and assessments during the next year, raising

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64 Mass. vol. 9, pp. 540, 556, Dun; Bristol County Deedbook 252, pp. 485-491.

capitalization $100,000. Losses for 1858 exceeded $33,000 and not until 1861 did the shop return to a full ten-hour day.66

The Mills and Company's failure destroyed the partners, who lost all their property. The only exception was Samuel A. Eliot, who retained a small portion of his holdings. Eliot, who had had a small interest and role in the firm, lost his Beacon Street mansion, books, art collection, and wine. George Ticknor, Nathan Appleton, and Frank Lowell not only bought back and returned Eliot's library, engravings, and Allston pictures but also gave him a house in Cambridge. Not being members of the Harvard elite, there was no salvation for James and Charles Mills. Charles spent the rest of his days running a tiny commission business, while James, finding his reputation ruined in Boston, joined a commission firm in Baltimore. The younger men, Dwight and Jackson, were able to recover more quickly, perhaps because of youthful optimism, possibly because their reputations had not been so

badly damaged. The final irony was that even though the partners had lost almost everything, the firm eventually paid off all its debts.67

William Mason managed a swift recovery. Recognizing the importance of the firm to the local economy and the fact that the assets would gain if the partly finished textile machinery in the plant was sold, Mason and Company was put under trusteeship on December 10, 1857. The same day the locomotive Prometheus, which had been completed when the plant closed, was released to the New York and New Haven Railroad. It was the last of the ill-fated Boardman engines. On February 21, the trustees reopened the factory to finish the machinery already under contract.68 In celebration of the rehiring of 150 men, a song, "Mason's Bell," was sung in public concert:

There's breakfast and dinner and supper
In the ring of "Mason's Bell."
Wake, Mother, and list to its music,
I know you remember it well.


It has hung in its watch tower in silence,
While Winter was passing away,
Forgetting its mission to herald
The very first streak of day.
There's food and clothing and lodging
In the ring of "Mason's Bell."

Moved by similar sentiments and cognizant of
William Mason's past business success, the trustees
permitted him to accept orders for eight locomotives
to be delivered in the fall of 1858. In November they
sold the works back to him for $125,000, and threw his
home in for an additional $25,000. Mason paid by
promissory note, backed by a $50,000 mortgage from
Suffolk Savings Bank for Seamen and a mortgage on his
house from Ebenezer Francis of Boston. By February 1859
Mason had already earned profits exceeding $50,000. Not
so fortunate were Mason and Company's creditors who
received only 69½ percent of what was due them. 70

Neither Mason's nor Taunton's locomotive business
recovered fully from the 1857 Panic until the Civil War

69 American Republican, Feb. 25, Mar. 11, 1858.
70 Mason Loco. Spec. Book; American Republican,
Sept. 30, Nov. 11, 1858; Bristol County Deedbooks 244,
p. 206; 270, pp. 19-20; 252, pp. 485-491; 276, pp. 411-
412; Mass. vol. 9, p. 540, Dun; Taunton Democrat,
Nov. 13, 1860.
boom in 1863 and 1864. Taunton sold an average of 30.5 locomotives per year in 1851-1854, and an average of 21.25 in 1854-1857, but its sales slipped to an average of 11.5 from 1858 to 1861. Similarly, Mason's locomotive sales fell from a yearly average of 18.5 in 1854-1857 to 7.75 in 1858-1861. Not until 1863 and 1864, respectively, did Mason's and Taunton's locomotive sales reach pre-Panic levels. However, Mason's textile machinery sales recovered so quickly that 1860 marked a record year.71

71 Taunton Locomotive List; Mason Loco. Spec. Book; "Machinery Records."
CHAPTER IX

RETROSPECTIVE

Beginning as a typical small southern New England mill shop serving primarily the needs of neighboring mills, the shop owned at various times by Crocker and Richmond, Taunton Manufacturing Company, and Mason and Company grew into one of the largest textile machine shops because of its outstanding machinery, access to capital, and fine physical plant. Needing another product to offset periodic low demand for cotton machinery, Mason followed the lead of many New England textile machine shops as well as the Taunton Locomotive Manufacturing Company by adding steam locomotives to its products. In the early 1860's Mason led American textile machine shops in output and design quality, and was recognized as one of the nation's foremost locomotive designers.

Yet, this lead was dissipated in the next few years. During the Civil War both Mason and Taunton Locomotive undertook many arms contracts, including Mason's large order for Springfield muskets.
Following the war, which had brought a sharp increase in locomotive prices, Mason and Taunton Locomotive expanded their output to meet the 1866-1873 railroad building boom. The Whitin Machine Works, by contrast, concentrated on textile machinery during the war and post-war years, refusing to divert its energies to war contracts and diversification. As a result, Whitin, along with Lowell Machine Shop, which had dropped the production of steam locomotives and machine tools in 1854, replaced Mason as leaders of the cotton machinery industry. Mason further undermined his position among cotton machinery producers, squandering his developmental efforts on the Fairlie locomotive, a complex design which the drivers and cylinders were on a pivoted frame separate from the boiler and tender. This allowed the Whitin Machine Works, the Drapers of Hopedale, Massachusetts, and the Pettee Machine Works of Newton, Massachusetts to develop textile machinery superior to Mason's. Draper's high-speed spindles and automatic looms captured much of Mason's market, as did Pettee's revolving-flat cards and Whitin's spinning frames. Improvements in ring frames and the desire of textile producers to eliminate costly, troublesome mule spinners led to the replacement of mules with ring frames in the 1890's and early 1900's.
thereby destroying the market for Mason's most important product. At the same time, Mason neglected the conventional American standard locomotive, deciding instead to devote his resources to the Fairlie design which had a small and declining market. The failure of both Mason and Taunton to expand their small factories in the 1870's and 1880's left them with higher unit costs than the large locomotive shops in the Middle Atlantic states, notably Schenectady, Brooks, Baldwin, and Rogers. This situation, coupled with the inherently high cost of doing business in a region remote from most raw materials and markets, led Mason and Taunton to abandon the locomotive business in the late 1880's. Taunton Locomotive managed to survive into the 1900's, by producing a motley line of unrelated products, including printing presses and snow plows for street railways. The Mason Machine Works remained a fairly important textile machinery builder until the 1900's. Thereafter, uninspired family leadership and inadequate research and development left the firm with a rapidly declining share of the market. Faced with a depression in the textile industry and the pending demise of its major customers in Fall River, the Mason Machine Works
discontinued the manufacture of textile machinery in 1925 and subsisted for almost two decades by selling repair parts for the thinning ranks of textile machines it had once manufactured. The firm finally went out of business in 1944. Today, except for the small Mount Hope Machine Company, which manufactures paper and cloth winding machines, the machinery industry is dead in Taunton.

The history of the machinery industry in Taunton illustrates the importance to machine builders of access to a progressive technology, either by a good research and development program, such as brought the Taunton shops to the fore in the 1830's and 1840's, or by aggressive efforts to obtain patent rights or mechanics familiar with the latest advances in the industry. The failure to maintain its position of technological leadership led to the gradual decline of the Mason Machine Works.

The history of Crocker and Richmond, Leach and Keith, and Mason also underscores the significance of an adequate source of capital to a machine shop. Inadequate working capital hastened the fall of Crocker and Richmond and Leach and Keith, whereas James K. Mills' access to capital gave Mason the funds to build his large,
efficient, 1845 factory. Such financing not only provided the capacity needed to attract the large, profitable orders, but also allowed Mason to manufacture machinery at lower unit costs than most of his competitors. Ironically, Mills and Company's 1857 failure led Mason to insist for the rest of his life on family ownership of the shop which, in turn, denied the firm the outside capital it needed to expand and remain competitive with large shops such as Baldwin.

The growth of the Taunton machine builders also demonstrates how small, residentiary shops, serving mainly the needs of local industry, developed into nation-wide businesses. This evolution occurred because of the Taunton shops' superior technology. Moreover, the economies of scale the machine shops in Taunton developed enabled them to penetrate distant markets because their lower unit costs offset higher transportation costs. The role that efficiencies of scale played in expanding a firm's market can be seen in Mason's and Taunton's penetration of the Midwestern locomotive market.

The history of these firms underscores the geographic constraints on technology. Differing water supplies to a great degree accounted for the dissimilarities
of the Lowell system of cotton manufacture and the Rhode Island system. Likewise, the mineral contents of water seems to have been one determinant of the regional variations in locomotive boiler types. It must be remembered, however, that many other factors helped determine the choice of technology: comparative cost and availability of the factors of production, the competitive position of an industry, tradition and custom, and the legal and political framework within which an industry existed, to name a few. Above all, the lives of the mechanical leaders of these firms exhibit the geographic mobility which served to transmit technological innovation throughout the nation and even overseas, thus rendering American textile and locomotive technology more nearly uniform.
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