National Park Service
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Lowell National Historical Park
Lowell, MA

BOOTT MILLS
COUNTING HOUSE AND MILL #6

Lowell National Historical Park
Lowell, Massachusetts



Historic Structure Report

HISTORIC STRUCTURE REPORT

BOOTT MILLS COUNTING HOUSE AND MILL #6

LOWELL NATIONAL HISTORICAL PARK
LOWELL, MASSACHUSETTS



PART 1

INTRODUCTION, HISTORICAL BACKGROUND AND CONTEXT, CHRONOLOGY OF DEVELOPMENT, CURRENT PHYSICAL DESCRIPTION, CHARACTER-DEFINING FEATURES

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This HSR provides an update to an existing HSR for the Counting House and Mill 6, prepared in 1984. The 1984 HSR also included the Adjacent Courtyard, and the Facades of Building 1 and 2 in its purview, which have not been updated in the 2016 effort. The 2016 report does include complete digital transcription of the 1984 HSR and reformatting with new digital scans of all figures and photographs. This transcription forms Chapter 1.2 of this current report. For credits refer to the Table of Contents and for additional acknowledgments included in the 1984 HSR, please refer to Page 11 of this report.

EYP Architecture and Engineering

September 9, 2016

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1.1 Introduction

I. EXECUTIVE SUMMARY

Purpose and Scope

This Historic Structure Report focuses on two structures within the Boott Mill Complex of Lowell National Historical Park (LNHP) - the Counting House and Mill 6. Both these structures are owned and operated by LNHP. Major renovations at both buildings were last completed in 1993. In the last 23 years, there have been some minor changes in the program areas, layout and systems at the buildings but largely the buildings are very similar to their interior and exterior appearance in 1993.

A Structural Fire Protection Condition Assessment (FPCA) survey of Mill 6 completed in 2007 identified inadequate code compliant egress for higher occupancy functions located on the upper floors of Mill 6. Currently the Park is looking to correct these deficiencies by moving and reorganizing program functions within the two buildings. This may necessitate changes to the existing layout and systems. The intent of this 2016 HSR update to better guide those changes, document the chronological development of the buildings post-1984 and identify the character defining features.

An HSR for these buildings was completed in 1984 and includes only the History Portion. The 1984 HSR contains detailed information about historical contexts, and the history of use and physical changes at Mill 6 and the Counting House. However, it does not contain a list of character-defining features, and since it was completed in 1984, does not document the major renovations completed in the 1980's and 1990's. This document includes a complete digital transcription of the 1984 HSR in Chapter 1.2. It is important to note that the 1984 HSR looked at four distinct parts of the Boott Mills Complex – Mill 6, the Counting House, the adjacent courtyard and the facades of Mills 1 and 2 (which are privately owned buildings). The current HSR update effort will focus only on two of these- Mill 6 and the Counting House.

This historic structure report is written in accordance with NPS Director's Order #28: Cultural Resource Management Guidelines and will include modified components from both "Part 1: Developmental History" and "Part 2: Treatment and Use". Part 1 sections included are: Introduction, Historical Background and Context and Chronology of Development, ; Part 2 sections included are: Character-Defining Features.

Methodology

The research for this HSR Update relied on the following major sources:

1984 HSR: The 1984 HSR served as the primary source of information for physical changes to the building fabric and the dates when these occurred. In order to accurately identify which building features that current exist at the buildings are original to the structure, and which represent later replications/additions/ modifications, it was first crucial to analyze and digest the information contained in the 1984 HSR. This information was used to populate the tabulated building chronology, summarize physical changes at the two buildings and generate a series of illustrated chronological diagrams that are included in Chapter 1.4. This information was also crucial to generate the list of character defining features in Chapter 1.6.

Denver Service Center (DSC) Archives: The DSC provided the authors with 30 digital files (29 PDFs and 1 Excel file) pertaining to Mill 6 and the Counting House. Refer to Appendix 1 for an annotated bibliography of the files that were accessed from DSC.

Lowell National Historic Park (LNHP) Archives: Information at LNHP is at two locations- at the Plan Room, in the basement of 67 Kirk Street, Lowell MA, which is the Park Headquarters building; and at the Archives/Curatorial division of LNHP located on the third floor of Mill 6.

HABS/HAER and MACRIS (Massachusetts Cultural Resource Information System): These online repositories were important for gaining access to historic photographs (mostly from a documentation effort in 1976 and 1983) and to the various NRHP nominations and Inventory forms that have been prepared for these buildings. The following documents were accessed:

LOW.C: Lowell Locks and Canals Historic District, 1976 (NHL 1977). Includes the Boott Penstock and Mill Yard.

LOW.BC: Lowell National Historical Park, National Register District, 1978 (Documented 1985).Lists Boott Mill #6 and Boott Mill Counting House as Contributing Resources.

LOW.1526: Boott Cotton Mills Mill #6. Cultural Resource Inventory Form, 1985. Notes details and includes photos of the building

LOW.1517: Boott Cotton Mills Counting House. Cultural Resource Inventory Form, 1985. Notes details and includes photos of the building

LOW.BG: Boott Cotton Mills, Cultural Resource Inventory Form, 1970, 2005. Includes historical photos and developmental history of entire Boott Mills Complex.

Books/ Web/Online sources: While a complete list of books, articles and websites accessed for the report are included in the Bibliography, there are some important publications that merit mention. The 2014 book '*Mill Power-The Origin and Impact of Lowell National Historical Park*' by Paul Marion was crucial in piecing together the history of events surrounding the creation of LNHP in the late 1970's and the events that led to the acquisition and redevelopment of Mill 6 and the Counting House by the Park Service.

In addition to the sources listed above, the authors visited the buildings on various occasions during the winter of 2015-2016 to observe existing spaces, features and finishes. The existing photos included in this report are from those trips.

Statement of Significance

The following is reproduced entirely from the 1984 HSR

Building No. 6, the Counting House, facades of Mills No. 1 and No. 2, and the Courtyard of the Boott Cotton Mills-Boott Mills complex represent significant examples of the thinking of the developers of the large- scale New England textile industry at the time of its establishment and throughout its life, the manner of their operation of the mills, and the experiences of the workers in them. Furthermore, mills such as these served as models for textile factory development and patterns of industrial development generally for enterprises throughout the country. Building No. 6 stands as an example of mid-nineteenth century cotton mill construction, revealing, in its strengths and weaknesses, a particular approach to the developing industrial capitalism of the time. In the conservatism of its original design, its comparatively slight modifications over time, and its consistently poor working conditions and climate control capabilities, it reveals a great deal about the priorities of the owners, the constraints placed upon its managers, the degree of interest or faith in its continuing profitability. lt also stands as an instructive example of the working conditions faced by those who staffed its operations. The Counting House represents one of only two such survivals in Lowell. The nerve- center of the entire operation of the Boott, it connects all aspects of the mill's history. It also indicates the comparative scale of production and of management at the site. The facades of Mills No. 1 and No. 2, with their connector, document the evolution of the early Lowell mills. They indicate the size and free-standing nature of the earlier generations of mills. The connector presents the fulfillment of original intentions, and the fifth floor reflects a final phase of development, the replacement of gable roofs with a full story. The Court Yard demonstrates the importance of open space in the original organizational pattern of the Boott Cotton Mills, the arrangement of the early mills in long rows, separated by continuous open spaces to provide natural light and ventilation. Later structures further closed in the area and limited access to the John Street entrance. The space itself remains intact, although constricted, and continues to play an important role in the mill's appearance and activity. All these factors work together to present the various elements involved in the operation of a typical Lowell cotton mill, an example to the nation in the nineteenth century, a fruitful object for study for those who seek lessons in the past in the twentieth.

II. ADMINISTRATIVE DATA

Location of the Site

The Counting House is situated along the north edge of the Eastern Canal, at the east side of the John Street bridge that serves the Boott Mill complex. Mill 6 abuts the building directly to the east. To the north of the building lies the Boott mill-yard. Mill 6 is also located along the north edge of the Eastern Canal. It abuts the 2-story Counting House to the west, is bounded by Bridge Street on the west and faces the Boott millyard on its north. Mill 6 is connected to Mill 7 on the north via a five story masonry connector. The street address for the building is 115 John Street, Lowell MA.

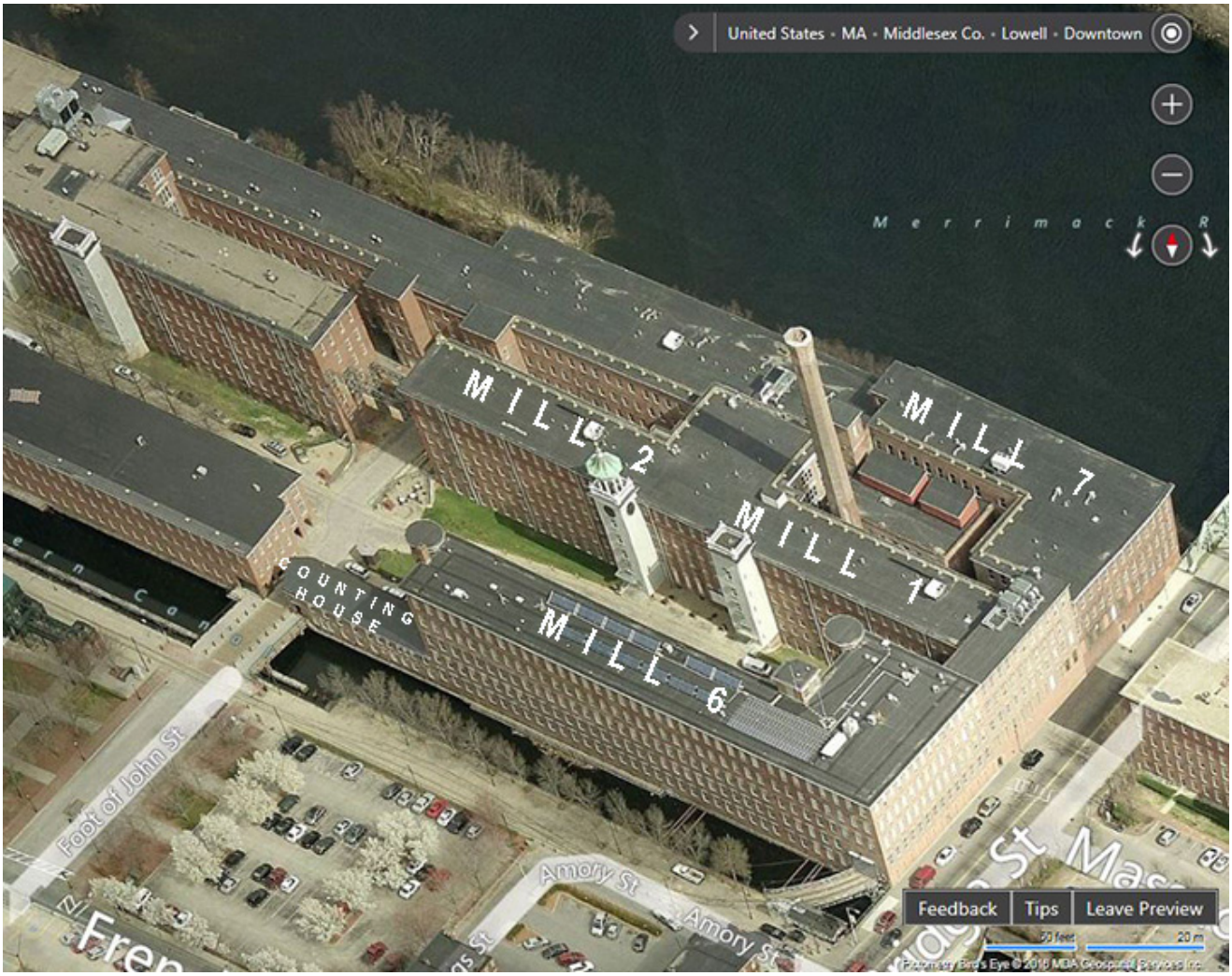


Photo A.1. Aerial view of the Boott Mill Complex, 2016
Source: www.bing.com

National Register of Historic Places Information

The Counting House and Mill 6 are part of the following NRHP documentation---*LOW.C: Lowell Locks and Canals Historic District, 1976 (NHL 1977)* that includes the Boott Penstock and Mill Yard; *LOW.BC: Lowell National Historical Park, National Register District, 1978* (Documented 1985), which lists Boott Mill #6 and Boott Mill Counting House as Contributing Resources; *LOW.1526: Boott Cotton Mills Mill #6. Cultural Resource Inventory Form, 1985*; *LOW.1517: Boott Cotton Mills Counting House. Cultural Resource Inventory Form, 1985*; and *LOW.BG: Boott Cotton Mills, Cultural Resource Inventory Form, 1970, 2005*.

CHAPTER 1.2 1984 HSR

HISTORIC STRUCTURE REPORT- HISTORY PORTION
BUILDING 6;
THE COUNTING HOUSE;
THE ADJACENT COURTYARD;
AND THE FACADES OF BUILDINGS 1 AND 2

WORK DIRECTIVE NO. 3-0011-84-02
BASIC AGREEMENT NO. CX-2000-3-0011

BY
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FOR THE
DENVER SERVICE CENTER
NATIONAL PARK SERVICE

1.2 1984 HSR: History Portion - Building 6, The Counting House, The Adjacent Courtyard, and the Facades of Building 1 and 2

Acknowledgments

The authors wish to acknowledge the contribution by Betsy Bahr of material informing the sections on the development of factory interiors, particularly as regards heating, ventilating, lighting, and fire- protection systems. We are also grateful for the research assistance of David Zarowin and Martha Mayo. Without the cataloging of the Flather Collection done under the direction of R. Nicholas Oldsberg, that valuable resource could not have been utilized.

Statement of Significance

Building No. 6, the Counting House, facades of Mills No. 1 and No. 2, and the Courtyard of the Boott Cotton Mills-Boott Mills complex represent significant examples of the thinking of the developers of the large- scale New England textile industry at the time of its establishment and throughout its life, the manner of their operation of the mills, and the experiences of the workers in them. Furthermore, mills such as these served as models for textile factory development and patterns of industrial development generally for enterprises throughout the country. Building No. 6 stands as an example of mid-nineteenth century cotton mill construction, revealing, in its strengths and weaknesses, a particular approach to the developing industrial capitalism of the time. In the conservatism of its original design, its comparatively slight modifications over time, and its consistently poor working conditions and climate control capabilities, it reveals a great deal about the priorities of the owners, the constraints placed upon its managers, the degree of interest or faith in its continuing profitability. lt also stands as an instructive example of the working conditions faced by those who staffed its operations. The Counting House represents one of only two such survivals in Lowell. The nerve- center of the entire operation of the Boott, it connects all aspects of the mill's history. It also indicates the comparative scale of production and of management at the site. The facades of Mills No. 1 and No. 2, with their connector, document the evolution of the early Lowell mills. They indicate the size and free-standing nature of the earlier generations of mills. The connector presents the fulfillment of original intentions, and the fifth floor reflects a final phase of development, the replacement of gable roof s with a full story. The Court Yard demonstrates the importance of open space in the original organizational pattern of

the Boott Cotton Mills, the arrangement of the early mills in long rows, separated by continuous open spaces to provide natural light and ventilation. Later structures further closed in the area and limited access to the John Street entrance. The space itself remains intact, although constricted, and continues to play an important role in the mill's appearance and activity. All these factors work together to present the various elements involved in the operation of a typical Lowell cotton mill, an example to the nation in the nineteenth century, a fruitful object for study for those who seek lessons in the past in the twentieth.

PREFACE

This Historic Structures Report [HSR] has been prepared by Laurence Gross and Russell Wright in conjunction with Earl R. Flansburgh and Associates, Inc. While the several participants have worked closely together, the sections dealing with Occupation and Use, by Gross, and Structures, by Wright, stand separately within the body of the HSR.

In the course of discussion over the approach to be taken in this HSR, agreement was reached that it would be very site-specific, avoiding the large body of information on the cotton textile industry and Lowell in general. Furthermore, inclusion of interpretive information on the use and occupation of the site, including such things as wages and labor- management relations, was mutually agreed to by all parties.

The report follows a set chronological organization which divides the history at 1870, 1904, and 1930. The period to 1870 saw the establishment of powered textile production in this country, the founding of Lowell, and the incorporation of the Boott Cotton Mills. The company erected its first buildings and began operations. This period, called by some the "Golden Age" of Lowell's history, has received by far the most study of any part of that city's history. In fact, the general perception of the city in the history of the United States relates to the events of this time. For some of the corporations rich records survive from these early days, but such is not the case for the Boott.

The period 1870-1904 begins with the building of Mill No. 6, the centerpiece of this report, and ends with the failure of the Boott Cotton Mills. The new mill was part of the great expansionist boom in the industry following the Civil War. Its history established patterns of operation which persist in the story, particularly in the area of reinvestment, or rather the lack thereof. It was also the era which witnessed the onset of serious conflict between North and South over cotton production, the advent of non-Yankee domination of the workforce, the invention of new automatic machinery, and

the eruption of violent fluctuations in the economy with profound effects of the mill's operation.

During this time the information on which to base a history of the Boott and its people begins to mushroom. Most significant, the data begins to become available at just the time where historical attention to Lowell has declined. Despite the interest in and treatments of early Lowell, the study of the city throughout most of its history has been slight. While collections of essays on the community treat particular events and themes in this period, and a very few analyses of the industry incorporate some of the city's story through the early years of the twentieth century, historians have offered little study of cotton in Lowell from 1870-1 954. Fortuitously, the available information on the Boott coincides with those periods for which knowledge about the Lowell industry's situation is least studied, least known. In the period 1870- 1904 such information begins to appear, and particularly for those areas little treated: labor, machinery, and local management.

This Report's next section, 1904-1930, marks the takeover of the buildings by new owners and management at its outset. It offers a record of unparalleled completeness, including a wealth of information from outside evaluators of the mill's ever y aspect, enabling the historian to observe the information flow to the owners and management, as well as their responses. The impact of World War I, the coming of the Depression, and the shift of leadership expertise from cotton production to business management dominate this era.

The final section of the cotton mill story, 1931-1954, enters a period of stark conflicts. Operation within the confines of a decision not to reinvest in the North, the impact of two wars, and the struggle over unionization combine with the ever- growing spectre of southern competition to create a time of desperation and disagreement. Still, the efforts of all parties to these disputes present a more clear and specific account of the time leading up to the mill's closing than has received scholarly treatment previously. The quality of this record insures that the discussion of the fate of the Boott Mills represents a story of enduring importance.

I. INTRODUCTION

A. Development Of The American Textile Industry

One often hears about the important role played by textile manufacturers in blazing the trail toward mechanical production as a machine/industrial economy came to replace the domestic economy of the United States in the eighteenth and nineteenth centuries. Yet, while industrialization brought impressive changes in the material environment during the past 200 years, those changes have also meant a fundamental reorientation in people's lives: a reorientation in their relationship to each other and in their roles in the country's economy. The development of industrial capitalism in the United States during the nineteenth century represented a more profound event than the resultant availability of inexpensive cloth. But the nature and extent of these social changes, the drastic alteration of human relations that accompanied industrialization, have attracted less attention from scholars.

To some extent this avoidance is understandable. Living in an industrial society, it is difficult to appreciate the extent of the social changes brought about by the Industrial Revolution, changes which continued throughout the nineteenth century. One views this industrial society from within, without a familiar benchmark with which to judge the changes it imposed. Its tenents and presuppositions dominate the outlook and conceal the magnitude of their novelty, the "otherness" of what existed previously.

But it is important to recognize that the decisions of entrepreneurs, decisions regarding the form and organization of the new factory-production technology, entailed tremendous social changes as well. These decisions represented issues of vital interest to the American people of the colonial and early national periods and the changes come through clearly in early documents relating to textile production.

Thus the textile industry not only played a major role in the colonial economy and set patterns for industrial development nationally. Its history also reveals the patterns of social change that would eventually create a new society.

The earliest settlers, alone amidst a cold and fearsome wilderness, recognized clothes for protection and sails to power transportation as essential to the survival not just of the individual, but of the community. The colonists saw their lack of the necessary tools, skills, and raw materials as, first, a dangerous weakness, and later, as a source of an unwelcome dependency on England.

The English were equally conscious of the significance of the capability to produce these vital materials and erected every obstacle to a domestic textile manufacture: embargoes on the emigration of skilled labor from England and on the exportation of sheep, machinery, plans, or models, all eventually raised to its logical conclusion by the blockade of colonial ports during the Revolution.

The colonists' awareness of their dependent position and its consequences appears throughout their records. In 1645 the General Court of Massachusetts ruled:

> *"Forasmuch as wollen cloth is so useful a commodity without which we cannot so comfortably subsist in these parts, by reason of the cold winters, it being also, at present, very scarce and deare amongst us, and likely shortly to be so in parts from whence we can expect it, by reason of ye wars in Europe destroying in a great measure the flocks of sheepe amongst them, and also ye trade and means it selfe of making woolen cloaths and stuffs, by ye killing and other wise hindering of such persons, whose skill and labor tended to that end; and whereas, through the want of woolen cloaths and stuffs, many pore people have suffered much could and hardship..."*

They therefore urged the towns to encourage the importation and keeping of as many sheep as possible. [1] Service to and perpetuation of the settlement, not individual profit, were their goals, and they trusted to God for their success in this righteous cause.

But encouragement of keeping sheep could not by itself solve the colony's problem, so two decades later the General Court again moved to proclaim and protect the community interest:

> *"1. This Court, taking into consideration the present straight and necessities that ly upon this country in respect of clothing, which is not like to be so plentifully supplyed from foreign parts as in times past, & not knowing any better way and means, condusable to our subsistence, than the improving of as many hands as may be in spinning woole, cotton, flax, etc.; --It is therefore ordered by this Court & the authority thereof, that all hands, not necessarily employed on other occasions, as women, girls, & boys, shall be, & hereby are, enjoyned to spin according to their skill & ability, and that the Selectmen in every towne do consider the condition & capacity of every family, & accordingly to assess them at one or more spinners.*
>
> *2. That every one, thus assessed for a whole spinner, do after this present year, 1656, spin for thirty weeks every year three pounds per*

> *week of lining, cotton, or wooling, and so, proportionably, for one half or one quarter spinners, under the penalty of twelve shillings for every pound short, and the Selectmen shall take special care for the execution of this order. "* [2]

These injunctions may have served a secondary purpose, in that they worked to prevent those idle hands for which the devil was said to make work, but the communal need clearly represented the overriding motivation.

Another avenue directed to the same end can be seen in the account of the coming of a weaver to a Massachusetts town:

> *In 1656, William How was admitted as an inhabitant of Chelmsford, Mass., a part of which town was incorporated one hundred and seventy years later, receiving the name of Lowell. Twelve acres of meadow and twelve acres of upland were allotted to him "provided he set up his trade of weaving, and perform the town's work."* [3]

These three events make clear the philosophy which led to the identification of the State as a "Commonwealth," an entity devoted to the general welfare of its inhabitants, one in which production had to serve communal needs first, and an individual's purposes only as they could be accommodated.

The colonials' program of required production, bounties, penalties, free training, and facilities served not only to lay the groundwork for s elf-sufficiency but also contributed to the economic independence ultimately needed to make the success of the political revolution meaningful. Furthermore, insofar as the settlers were drawn together from their isolated farmsteads to assist one another in various aspects of the textile process, whether at sheep shearings, spinning bees, or at other such tasks, they served an important socializing function for the otherwise separated families, as well as furthering the common purposes of self- preservation. Motivated by necessity, the desire for independence, and an underlying dedication to the general welfare, the colonists produced increasing quantities of material for clothes, furnishing fabrics, and sails.

Also a result of this economy which required productivity from all able hands was a social structure with little poverty and comparatively little economic stratification. Devotion to the Commonwealth left litt le opportunity for the accumulation of wealth from either one's own labor or from that of others. Meeting society's pressing needs and serving its shared goals generally precluded the amassing of great riches at the expense of one's fellow citizens.

The earliest of what would become the elements of industrial production, non- human- powered machinery, appeared in Massachusetts in the seventeenth century. Water wheels in fulling mills captured the force of falling water and used it to lift heavy wooden hammers which, falling on wet woolen cloth in a box beneath, pounded the fibers and caused them to mat together, or felt, greatly increasing the material's strength and warmth. Thus those producing cloth were spared one of the tasks previously required to finish it. People welcomed and encouraged this assistance. Towns (e.g. Andover, Massachusetts in 1673 and in 1682) provided land and waterpower privileges, which they controlled, in order to insure the availability of this useful service. [4] The manner in which cloth was produced did not change appreciably, however. The social r ole of the fulling mills and their relationship to the larger economy were of a piece with their time. Their historical connection to factory production is primarily technological for they were simply absorbed into the existing social and economic structure.

The operators of saw- and grist-mills received similar encouragement; they were given grants of land or timber or other inducements to assure the local community the benefits of these mechanical innovations. In each case, the water powered mills were grafted onto local economies which remained essentially unaltered. They permitted the production of increased amounts of materials, thus enabling the people to make use of more cloth, flour, or boards. These "labor- saving" devices did not reduce the amount of labor to be done but simply shifted the composition of daily labor. Labor changed, for example from grinding wheat to producing and transporting more grain and flour, from hewing timber to transporting logs and building with more lumber, and from finishing cloth to tending more sheep, to spinning, carding, and weaving more material.[5]

Throughout this period, people worked hard, as they always had and as they expected to do, but the rhythm of work was pre-industrial. Work schedules were determined by many things: weather, seasons, and pressing needs. Schedules were interrupted by innumerable events, whether visitors, pedlars, holidays, or simply the unplanned occurrences of any household's day. Work varied daily, from tending animals and crops to preparing food, repairing utensils, or producing goods to provide directly or through barter for family needs; and it varied seasonally, as nature's cycles dictated. Periods of intense activity and labor were interspersed with times of rest and entertainment. Drinking was pervasive, as were numerous other common entertainments.

After the Revolutionary period, the pattern began to change. The spinning jenny, water- frame, and power loom initiated quantum leaps in the quantities of yarn and cloth which people could produce. Emerging technologies differed in style, as between the jenny (and

its successor, the mule) and the water-frame : both multiple-spindle spinning machines, but the former hand-controlled with strength and skill, the latter run with little skill but producing poorer yarn from equal stock.

These machines did not impose systems of productions, but offered new implements for accomplishing old ends. Which would be developed and how they would be organized remained to be determined.

B. Advent of Industrial Capitalism

In the United States Samuel Slater first succeeded with powered yarn production in 1791 (Figure 1). By that time, successful meant profitable for the investors, the owners of the machines and building.

The break with the earlier system of production was not complete: Slater himself worked in the mill with his employees (mainly children) and their product was woven on hand looms, often by the parents of the young workers. This "putting- out system" utilized early production methods, then, but still made great changes. Weavers no longer determined their product; they might even work together in a factory, in which case they would be subject to the owner's schedule and oversight. Things were changing (and objections were raised), but patterns of the developing system were obscured by the small scale, the mixed modes of production, and the direct involvement of the owners, in many cases, in the production process. Still, production was now capitalist, individualistic, not communally/socially motivated or controlled.

The developments at Waltham, Massachusetts, represent the fulfillment of the promise of Slater's Mill. In 1810 Francis Cabot Lowell visited England for his health. As a New England trader of some importance, he was warmly welcomed by British manufacturers. Since they saw him as a merchant rather than as a competitor, they allowed him to visit their factories and examine their machinery and observe their system of organization.

Upon his return to the States, he hired an exceptional machine-builder, Paul Moody, and together they contrived to reproduce the power looms Lowell had seen. Lowell and his friends, looking for a way to profit further from the money they had accumulated in shipping (a trade made less attractive by England's dominance of the seas and Congress' closing of United States ports in the War of 1812), formed the Boston Manufacturing Company [BMC] and built the first integrated textile factor y in the world in Waltham. Raw cotton went i n one end and cloth came out the

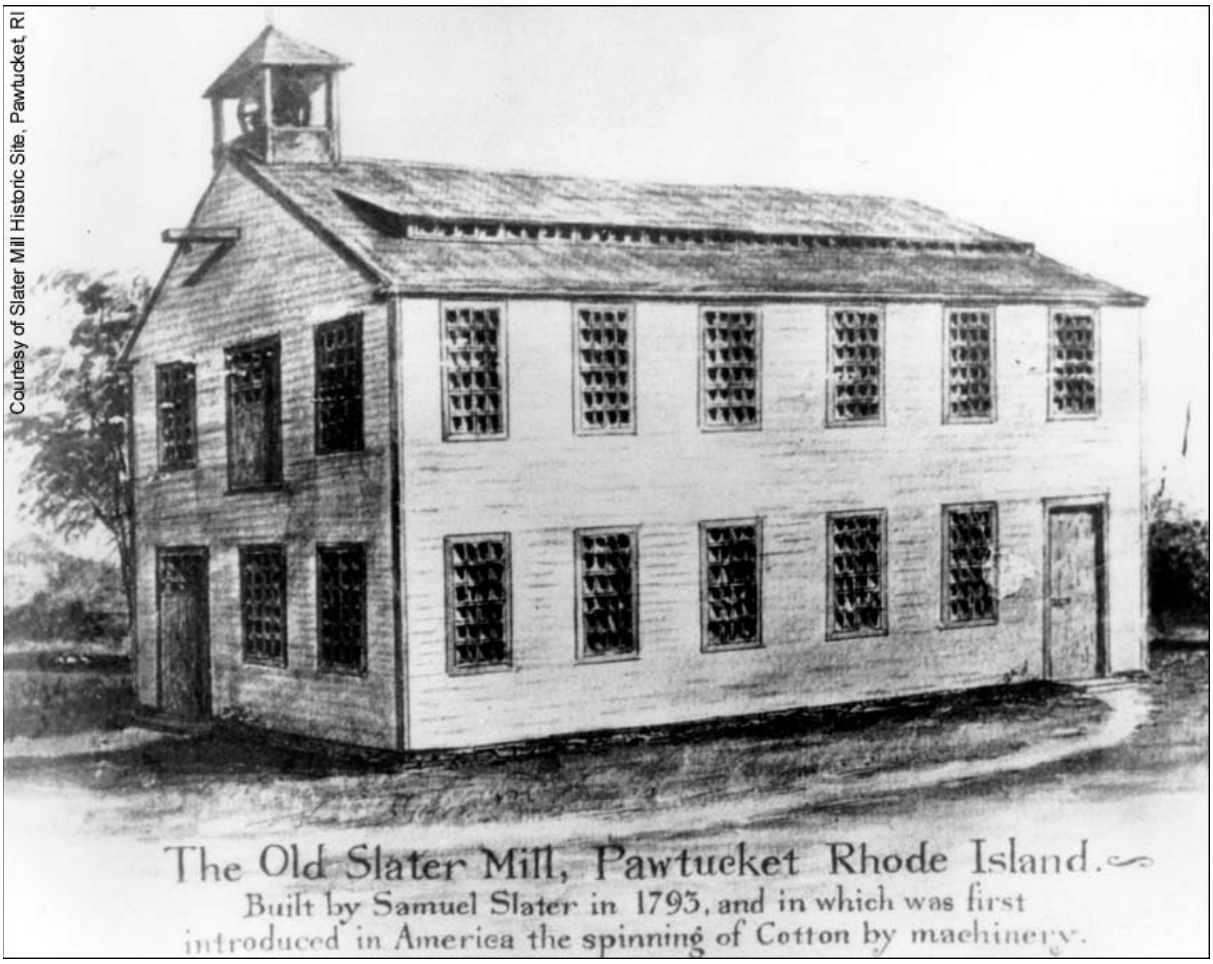


Figure 1. Conjectural drawing of Almy, Brown and Slater's Mill, 1793
Source: Slater Mill Collections

other, with all processes performed by machines. The BMC, a joint-stock company, was itself a novel business organization for this country. The investors, located in Boston, not Waltham, and adept at financial manipulation, not cotton production, viewed the project as an opportunity to make money, not simply to serve the Commonwealth's needs. They repeated the pattern that had worked for Slater, duplicating English factory organization to create a profitable enterprise. Even more than in the earlier instance, the system, as well as the implements, made the corporation a success.

Their effort provides a good example of the Industrial Revolution. The headings in their ledger book indicated their task: Land and Water Power, Buildings, Machinery, Labor, and Administrative Supervision. In the words of George Sweet Gibb, "How successfully these factors could be combined by unpractised men to turn out an unfamiliar product on equipment not yet invented was far from clear." [6] In a factory to be peopled with workers not yet present or trained, he might have added. But in any case, as the ledger shows, labor represented simply another commodity in this scheme.

Waltham worked. They reinvented the power loom, improved other machines, and devised "stop- motions" to halt machines automatically when they malfunctioned and required attention. Every aspect of cloth production was to be reduced to its simplest elements, and each worker to attend just one such element. Every development aimed at reducing the amount of skill required of the operatives. Indicative of the intent of the BMC, the chosen style of production utilized the water- frame rather than the mule. Labor was not to intrude through skill to interfere with investors' control.

Thirty miles of cloth per day flowed from the mill. As cloth spewed forth, profits poured into the investors' coffers. The factory was repeatedly enlarged and soon the power available from the Charles River could support no more expansion.

C. Development of Lowell

The same small group of mercantilist- investors looked for a suitable site for further development. Paul Moody "found" the Pawtucket Falls of the Merrimack River in East Chelmsford (Figure 2). Here, in the same community that years before had given land to a weaver in order to assure itself the availability of his skill, was a thirty- foot drop in the mighty Merrimack River, enough power for ninety or more mills the size of Waltham's. Despite the presence of farmers and a few small mills on nearby streams or utilizing a bit of the river's power with wing- dams, no one recognized the value of the falls to investors: "So unconscious was America of the value of its water power that Jackson with very little difficulty succeeded in acquiring a majority of the stock of the Locks and Canals Company and title to the key farmlands."[7] Land purchased for $20 an acre was valued at $4300 a year later, in 1821. A natural resource of great potential for the entire society was sold and monopolized for the benefit of a select few, indicating the identity between the capitalists' economic outlook and the state's political stance.

The effect on labor was enormous. No factory labor force stood ready to provide the essential human element to the Waltham/ Lowell mills. Furthermore, the bad press of English textile factories, the "dark Satanic mills" of the romantic poets, had prejudiced the Yankees against the idea of factory work.

But the BMC began with a plan. Rather than pay high wages, sufficient to draw employed males away from their occupations, they would attempt to attract an unskilled female labor force, for whom the only widely available occupation paying cash wages was domestic service, a subservient position none too popular among the young women of rural New England. Farm life had taught



Figure 2. "Pawtucket Farms", 1821, that part of the town of Chelmsford that would become Lowell
Source: Lowell National Historical Park (LNHP), Museum Collections LOWE 3946

them to work and not to fear it. If they would come, they could do the job.

Andrew Ure described the crux of the problem facing the early industrialists in 1835, when he wrote:

The main difficulty did not, to my apprehension, lie so much in the invention of a proper self-acting mechanism for drawing out and twisting cotton into a continuous thread, as in the distribution of the different members of the apparatus into one co- operative body, in impelling each organ with its appropriate delicacy and speed, and above all, in training human beings to renounce their desultory habits of work, and to identify themselves with the unvarying regularity of the complex automaton. To devise and administer a successful code of factory discipline, suited to the necessities of factory diligence, was the Herculean enterprise, the noble achievement of Arkwright. Even at the present day, when the system is perfectly organized, and its labour lightened to the utmost, it is found nearly impossible to convert persons past the age of puberty, whether drawn from rural or from handicraft occupations, into useful factory hands. After struggling for a while to conquer their listless or restive habits, they either renounce the employment spontaneously, or are dismissed by the over lookers on account of inattention.[8]

Women were not only the cheapest available workers, they might also accept the new discipline with less of the resistance born of craft traditions anticipated from men. In any case, new attitudes were to govern human relations, and only the establishment of a new work discipline could answer the owners' needs. Their task was two-fold: to attract the workers and to teach them a new way of work, a new way of life. Their responses to the two needs dovetailed, with many measures serving both ends.

To attract their female workforce, by appealing to them with cash wages, escape from rural farms, or whatever other unknown motives combined to draw them to this truly "new world," and by nullifying the fears excited in them and their parents by ideas of immoral English factories, and once attracted, to extract the maximum value from their labor, the owners developed a system to control them, to supervise their every waking hour. Boardinghouses with matrons were provided, and their cost deducted from the meager wages (some $3 per week, a fraction of that paid men). They built a church, Episcopal, like the resident agent (and unlike the workers), and required attendance and support. Gradually stores, a library, schools, and eventually a hospital were added. Since they located in a sparsely settled region, they were able to create a complete social matrix to serve their interest: profit.

The Boott Cotton Mills was founded in 1835 by John Amory Lowell, Abbott Lawrence, Nathan Appleton and other Boston investors.

The owners of the mills named them in honor of Kirk Boott (Figure 3), the man they had selected to carry out the establishment of cotton manufacture in Lowell from the buying of the land to the supervision of the construction and operation of the first corporation, the Merrimack. American-born, English- educated (Rugby, Sandhurst), he served under Wellington in the Peninsular Campaign before returning to the States. His very conservative, heirarchical disposition is reflected in his planning of Lowell and is commented upon by nearly every historian.

The first church in Lowell, Queen Anne's, was named for his wife, made Episcopal, his religion, and supported by the employees. He consistently represented the owners' narrow interests, opposing support of local schools, Jacksonianism, or any other measures which could impinge on profits. Words such as imperious, aloof, and domineering are generally associated with both his character and his outlook on society.

Boott's house had to be relocated in order that the Boott Cotton Mills could occupy the spot. Boott died in 1837.

While the various corporations at Lowell served the same small group of capitalists, the cooperation could not completely eliminate competition, however slight. In May, 1836 a writer complained to Amos Lawrence that while at present "water, girls, and men [are] plenty," these conditions would continue only until "about July and August, when the demand for girls to supply the Boott Mills will probably sensibly affect us."[9]



Figure 3. Kirk Boott, 1790-1837. Portrait by Chester Harding
Source: LNHP, Library Collections, Illustrated History of Lowell and Vicinity, Courier- Citizen Company, Lowell, Mass., 1897. P. 228

D. Position of Labor

Labor represented a major factor in the BMC plans, as the ledger heading underlined. They dealt with it as rationally, and as dispassionately, as they did with any other factor in their equations. The City of Lowell reflected not a utopian humanitarian effort but the operation of economic calculations. Nathan Appleton wrote that company housing "secures an excellent class of work[ing] people which tells materially in the prosperity of the company."[10] He saw the entire organization as an entity, not a scene of human endeavor: "We are building a large machine I hope at Chelmsford."[11] Factory, housing, all was a construct of and for the BMC, whose interests it was designed to serve.

Henry Miles, a primary defender of and apologist for the Boston investors, extended the logic to justify complete control:

> *The productiveness of these works depends upon one primary and indispensable condition-- the existence of an industrious, sober, orderly, and moral class of operatives. Without this, the mills in Lowell would be worthless. Profits would be absorbed by cases of irregularity, carelessness, and neglect; while the existence of any great moral exposure in Lowell would cut off the supply of help from the virtuous homesteads of the country. Public morals and private interests, identical in all places, are here seen to be linked together in an indissoluble connection. Accordingly, the sagacity of self- interest, as well as more disinterested considerations, has led to the adoption of a strict system of moral police.* [12]

Miles' justification for this pervasive social control indicates the, at best, lack of respect (at worst, contempt), for the workers on the part of management. The superiority of that class is evident in its ability to define and regulate both "public morals and private interests" in its own interest. They assumed that these people who had survived for generations would suddenly develop habits of "irregularity, carelessness, and neglect." They proclaimed that for them to require 24-hour control of "private morals," necessary to make individuals part of Ure's "complex automaton," simply served "public interest." Despite their intense interest in the outcome, their struggle to maximize profit, they alone retained the objectivity to define how most of the population could best serve "public" interest by adopting a new way of life which concentrated wealth in the hands of a few owners.

A Lowell mill-owner could be frank about the utility of providing schooling for his employees:

> *"I have found the best educated to be the most profitable help; even*

those females who merely tend machinery give a result somewhat in proportion to the advantage enjoyed in early life for education; those who have had a good common school education giving as a class invariably, a better production than those brought up in ignorance.

I have uniformly found the better educated as a class possessing a higher and better state of morals, more orderly and respectful in their deportment, and more ready to comply with the wholesome and necessary regulations of the establishment. And in times of agitation on account of some changes in regulations or wages, I have always looked to the most intelligent, best educated and the most moral for support, and have seldom been disappointed. For while they are the last to submit to imposition, they reason; and if your requirements are reasonable, they will generally acquiesce, and exert a salutary influence upon their associates; but the ignorant and uneducated I have generally found the most turbulent and troublsome, acting under the impulse of excited passion and jealousy."[13]

Once the enterprise of textile production lost its basic purpose of fulfilling society's needs and became first and foremost a source of profit for a few, it required new techniques and motivations to inspire the workers to perform the owners' tasks. Educating the workers to a supposed identity of goals, a context for "reason," helped predispose them to accept a discipline serving capitalists' interests, as this owner recognized.

The workers were seen by the owners not as people like themselves, but as a commodity to be managed. Workers who felt that Yankee managers would see them as fellow New Englanders were naive. They were not even seen as a permanent workforce, for the intention was to keep them working for only a few years, after which it was presumed they would return home, or at least leave, part of a constant self-renewing pool of inexperienced, docile, unorganized labor. In fact, Miles realized the potential danger of a workforce of local residents who might come to object to their treatment:

Employing chiefly those who have no permanent residence in Lowell, but are only temporary boarders, upon any embarrassment of affairs they return to their country homes, and do not sink down here a helpless caste, clamouring for work, starving unless employed, and hence ready for a riot, for the destruction of property, and repeating here the scenes enacted in the manufacturing villages of England. To a very great degree the future condition of Lowell is dependent upon a faithful adhesion to this system; and it will deserve the serious consideration of those old towns which are now introducing steam mills, whether, if they do not provide boarding-houses, and employ chiefly other operatives than resident ones, they be not bringing in the seeds of future and alarming evil. [14]

Miles admits there exists no identity of interests between owners and workers. He only hopes to avoid English-style disruptions by employees who recognize their exploitation at the hands of the investors. The distance between the two groups is made evident by the degree of paternalism, so thorough that it left no significant decisions, day or night, to the workers.

The similarity in status of cotton mill labor to the equipment was made plain by two mill owners cited by Henry K. Oliver in his report to the Massachusetts State Senate:

> *In 1855, when visiting the various establishments there [Fall River], I inquired of the agent of a principal factory, whether it was the custom of the manufacturers to do anything for the physical, intellectual or moral welfare of their work-people. The reply was so surprising that it took firm root in my memory: "We never do," he said, "and as for myself, I regard my work- people just as I regard my machinery. So long as they can do my work for what I choose to pay them, I keep them getting out of them all I can. What they do, or how they fare, outside of my walls, I don't know, nor do I consider it my business to know. They must look out for themselves, as I do for myself. When my machines get old and useless, I reject them and get new, and these people are part of my machinery." Akin to this was the reply of an agent at Holyoke to another official who visited his mill. He affirmed that he used his millhands as he would use his horse: as long as he is in good condition and renders good service, he treats him well; when not, he gets rid of him as soon as possible, and what becomes of him is no affair of his. He said that having noticed that the hands manifested some languor in the early part of the day on account of rather spare breakfasts, he tried the experiment of working them without any, and so secured an additional three thousand yards a week, and only discontinued the plan from the opposition of the other mills and the landlords. His operatives were mostly of the lowest class, and among them were 130 children under fifteen years of age, many of whom had never attended school.*[15]

Given such assessments, the owners' realization of the truth of Ure's charge, that shaping labor to the new factory system represented their foremost task, becomes clear. They utilized every avenue, every institution, to mold a new workforce amenable to the needs of capital. These owners reveal their use of paternalism simply to further their own end: they control the workers' lives, whether breakfast or schooling, but they deny any concomitant responsibility for their fate. The distance from this situation to that of the "commonwealth" approaches the immeasurable.

E. Nature of Work

The other major aspect of this great revolution was the change in the nature of the work itself. For the first time in history, people worked at a pace set relentlessly by machines. Spools whirled or lays beat, and someone had to tend the spinning frames or looms constantly, without let up. Work, furthermore, was part of the larger system Ure described, and labor had to move at the pace the factory dictated. There existed no separation between these people and the machines, which in combination produced profit for the owners. Instead of the confines and labor of the farm, the requirements of social needs, a system dominated by the requirements of capital shaped work and life itself. Machinery and buildings were expensive; their pace controlled life within the factory where profit reigned. People had to learn a new way of life. A degree of freedom previously available to all people was lost to most. And it was not simply a question of pace. As noted, these workers were accustomed to intense labor. But now labor was changed in every significant way.

After the Industrial Revolution, powered machinery was used to strip workers of the craft pride and sense of accomplishment which had been theirs when they produced something through their own efforts, despite the labor and tedium involved. The workers' sense of accomplishment was further reduced by the specialization of the factory system as devised by the BMC and its followers. Each part of the production process was broken down into smaller and smaller segments, each of which required less and less skill, and no one of which could be said to produce a finished product. This careful and extreme division of labor freed the owners from the need for skilled operatives (whether handweavers or mulespinners), permitted them to utilize a short- term workforce, and minimized the opportunity for labor to "interfere with" or exert and have control over, the boss' system (and their own lives).

The intention, and result, was to develop "labor-cheapening" machinery, capital- saving, not labor-saving. The investors devised every aspect of their factory system to minimize the workers' role (skill, independence, responsibility, creativity) and cost. They produced coarse cloth, such as mattress-ticking, for which their comparatively crude machinery was suited. Similarly, they avoided woolens. Thus they escaped the need for skilled help (e. g. mulespinners, finishers, etc.) required for fine goods and wool cloth.

Instead, they segregated tasks until they could be learned quickly, diminishing drastically the ability of their employees to bargain over wages or conditions, or to affect production. The machine-tenders were to be easily replaceable.

The emphasis on stop-motions exemplifies this intent. These mechanical devices stopped a machine in the case of malfunction, just as an operator would. By using the stop- motion, however, the owner reduced the employee's responsibility and skill, and therefore his/her role in and potential control over production. An individual then could tend more machines and be more easily replaced, a perfect combination.

As time went on, hours of work increased, the number of machines tended went up (the stretch- out) as did their operating speed (the speed-up), while the piece-rate, and real pay, went down. Owner motivation received further expression when in the late 1840s and 1850s the onslaught of famine in Ireland provided ample supplies of labor lacking even the alternative of return to a farm. The speed-up and stretch-out continued to be the order of the day. Boardinghouses and other amenities were gradually abandoned. Now economic necessity made efforts to attract labor superfluous. The system's nature was still more clearly revealed.

F. Fruits of Development

The developments described were a great success for their owners, reaping immense profits; and not made without opposition. In connect ion with the first point, it is worth noting that Lowell became the model for a whole series of similarly planned cities: Lawrence, Holyoke, Springfield, and Chicopee Falls, in Massachusetts; Manchester and Nashua in New Hampshire; Biddeford and Lewiston in Maine, et cetera. The system worked. Corporate planners came from all over the country to study the model.

And the model was simple. The BMC investors' operations were based on high capital investment; large mills with integrated processes; simple materials for which there were wide markets and which could be produced with minimal skills; absentee ownership; and local social control. They were prepared to change the face of civilization, to "improve" it. And change it they did. People now view the world from the perspective they established.

The profits from Lowell and the other cities enabled them to alter the course not only of local industrial history, but also of national development, through the many-faceted enterprises they controlled from 1815-1860: textiles, railroads, insurance companies, banks and more, giving them dominance of the New England economy and influence in Pennsylvania, New York, and the mid- west through banks and railroads and through the example of their success. This closed club of large investors enjoyed political power as well, serving on the state and national level and supporting other candidates, such as Daniel Webster, willing to adopt their views.

Given legislative monopolies for railroads, creating them in textiles by founding series of companies with non-competing products, and near monopolies in other areas, they became millionaires. Edward Everett, a friend, wrote in 1863: "Without the aid of William and Nathan Appleton and Abbott Lawrence, no new venture could be launched in New England." [16] Nathan Appleton alone was involved in thirty-one textile companies.

What had begun as an esoteric novelty developed into a political and social experiment in management and control without parallel. Gibb, the business historian, in 1950 compared the new system to an older one: "This was a pattern of feudalism in which the mill was the castle and the agent was the bailiff. Some would have said that, on the one day in the week when he visited the mill, the treasurer was the Lord High Executioner. The position of the unskilled or semi-skilled laborer in Lowell was one of considerable economic and social subservience." [17]

Work rules imposed the owners' idea of order on the job, forbidding merriment, reading, singing, drinking, meetings, leaving work, gambling, in other words, all the things people had traditionally assumed as part of their daily life and work, and all these things that people assumed they were competent to consider for themselves.[18] This type of control even aimed at controlling intelligence, whether of the textile process beyond the assigned tasks, or of a machinist's invention, which as early as 1820 was assigned to the company by contract. Capital's monopolization of the intelligence of and the control over production, along with the diminished autonomy and cost of labor, equalled maximum surplus labor value, and therefore profit.

Opposition was continuous, and occurred on every level of society. Ralph Waldo Emerson, for one, saw something amiss in the BMC's plans to enlarge the power system for Lowell:

> *An American in this ardent climate gets up early some morning and buys a river; and advertises for 12 or 1500 Irishmen; digs a new channel for it, brings it to his mills, and has a head of 24 feet of water: then, to give him an appetite for his breakfast, he raises a house; then carves out within doors a quarter township into streets & building lots, school, tavern, & methodist meeting house -- sends up an engineer into New Hampshire, to see where his water comes from &, after advising with him sends a trusty man of business to buy of all the farmers such mill privileges as will serve him among their waste hill & pasture lots and comes home with great glee announcing that he is now owner of the great Lake Winnipiseosce, as reservoir for his Lowell mills at Midsummer.* [19]

Emerson plainly resented the arrogance that believes the rich can possess nature and its resources. The Indian-named lake represents the communal resource of earlier times, now made a millpond for Lowell. Emerson, used here to represent the widespread opposition to the development of industrial capitalism in "intellectual" (read "publishing") circles, continued his expression of disapproval of these capitalists:

> *They are an ardent race and are as fully possessed with that hatred of labor, which is the principle of progress in the human race, as any other people. They must & will have the enjoyment without the sweat. So they buy slaves where the women will permit it; where they will not, they make the wind, the tide, the waterfall, the steam, the cloud, the lightning, do the work, by every art & device their cunningest brain can achieve.*[20]

The resentment stems from the belief that some need not labor, that "progress" means their triumph, through purchasing natural resources or human labor.

Workers protested in parallel terms. They rejected a system in which they could only participate by selling their labor-time, in which they gained no stake in the product of their exertion, as they always had previously, even under feudalism. They complained that they were enslaved, made "wage- slaves" by a system which reduced their position to that of automatons, undivided in treatment or role from the machines they tended, comparable to the chattel slaves of the South.

The Lowell model represented the extreme extent of this development. Owners played no part in production, most workers had little skill and less responsibility. They not only worked as part of the factory's mechanical system, but they gave up control of their life outside the factory gate as well.

Claims of utopianism, idealism, of concern for the well-being of the workers contrast sharply with reality. In both Lowell and Lawrence Irish workers and their families lived in the most miserable shanty towns, even sod huts, and without public services. As the century "progressed," immigrant worker housing in Lawrence, for example, was among the country's worst. While many travelers admired the neat new cities and the clean air of water- powered industry, others noted the age, pallor, and sadness of the workers, recording that the "nuns of Lowell, instead of working sacred hearts, spin and weave cotton. "[21] America's 66 hours per week in 1870 exceeded England's: the former "satanic mills" of Britain had had a 10-hour a day law since 1847.

Strikes hit these companies as early as 1820, and were continued despite the social disapprobation of such conduct by women. They knew how they were being used. Sarah Bagley, one of their leaders, noted that inmates in prison in Massachusetts worked two hours less per day than she, and had more opportunity to use the library than did Lowell workers. She observed to an incarcerated forger, "'You might have selected some game equally dishonest, that would… have made you looked up to as a man of wealth. You might have performed some 'hocus-pocus' means of robbery, without forgery, and passed as an Appleton, a Lawrence, or an Astor in society.'"[22] But knowing a situation, protesting it, did not include the ability to alter it.

Despite protests, these female workers had few alternatives. Only domestic service, seen as a subservient position, offered alternative employment at similar wages. Otherwise, the return to a failing farm economy which did not adequately support its participants awaited. Still, as dividends stayed high and wages were cut in order to pay for worn-out machinery, the Yankee women voted with their feet. The famines in Ireland provided their replacement.

The basic pattern did not change. Strong and independent labor continued to be seen as the enemy and a low-skilled, transient, divided workforce the defense. Workers were purpose fully divided by sex, by nationality, by status. Profit came from the surplus product of labor, and by maximizing their dominance the Boston Associates maximized their profit at the expense of a way of life, of life itself for many. The death rate from respiratory illness among Massachusetts farmers in 1870 was 4%, among Lawrence workers, 70%! One mill had 1000 accidents in five years.[23] In the words of Emerson, again, "'The ways of trade are grown selfish to the borders of theft, and supple to the borders (if not beyond the borders) of fraud.'"[24]

The response of one Lowell worker, Amelia Sargent, remains an unfulfilled prophecy : "'We will soon show these drivelling cotton lords, this mushroom aristocracy of New England, who so arrogantly aspire to lord it over God's heritage, that our rights cannot be trampled upon with impunity. '"[25] Perhaps Sargent erred when she said "soon," but some later developments give cause to wonder if her expectations were unfounded. In fact, if the "we" in her statement meant Yankee women, her statement rings true, for they soon left Lowell's mills. She simply had not anticipated the ease of their replacement after Ireland's potato famines and ensuing international developments.

What she recognized was the extent of the change she and her fellow workers endured. Massachusetts had moved far from a commonwealth of mutual responsibility and effort in which all

shared in both the product of labor and the deprivation of hard times. Now the ruling class concentrated its control while denying any responsibility. Products and decisions belonged to them. To labor went small wages for long hours.

As noted at the outset, textiles helped set a pattern of industrial development for the United States. The pervasiveness of its patterns of organization can be seen in Frederick Taylor's adoption of identical tenets as "Scientific Management." The continuance of the pattern and the potential fulfillment of Sargent's threat, appear in two situations: After 1900, northern states began to require employers to take some responsibility for the workers through the social welfare legislation associated with the Progressive Movement. The textile industry moved away, to the South, which lacked such an ideology and its onerous burdens. There they repeated the pattern of development that had worked before, but which they were unable to perpetuate in the North.

ENDNOTES

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5. See, for example, Raphael Samuel, "Workshop of the World: Steam Power and Hand Technology in mid- Victorian Britain, " History Workshop Ill (Spring 1977), pp. 6-72.

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7. Ibid., pp. 65- 66.

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12. Rev. Henry A. Miles, Lowell, As It Was, And As It Is (Lowell: Powers and Bagley and N. L. Dayton, 1845), p. 128.

13. Report of the Special Commission on the Hours of Labor and the Condition & Prospects of the Indus trial Classes (Boston : Wright & Potter, State Printers, 1866), p. 13.

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15. Massachusetts Senate, Report of the Hon. Henry K. Oliver, Deputy State Constable, Specially Appointed to Enforce the Laws Regulating the Employment of Children in Manufacturing and Mechanical Establishments (Boston: Wright & Potter, State Printers, 1868), p. 23.

16. Gregory, p. 196.

17. Gibb, p. 70, p. 89.

18. Paul E. Johnson, A Shopkeeper's Millenium: Society & Revivals in Rochester, New York, 1815-1837 (New York: Hill & Wang, 1978), describes the religious revivals of the early nineteenth century as serving "not the needs of 'society' but of entrepreneurs who employed wage labor" [p. 137). Similarly, he describes drinking as part of the ''pattern of irregular work and easy sociability sustained by the household economy" [p. 57) preceding the factory system.

19. Merton M. Sealts, Jr., ed., The Journals and Miscellaneous Notebooks of Ralph Waldo Emerson, X (Cambridge, The Belknap Pres s of Harvard University Press, 1973), p. 102.

20. Ibid., pp. 102-3.

21. Michael Chevalier, Society, Manners and Politics in the United States: Being a Series of Letters on North America (Boston: Weeks, Jordan and Company, 1839), p. 143.

22. In Hannah Josephson, The Golden Threads: New England's Mill Girls & Magnates (New York: Duell, Sloan, & Pierce, c. 1949), p. 252.

23. Donald B. (Chapel Hill: Cole, Immigrant City: Lawrence, Massachusetts, 1845-1921 The University of North Carolina Press, c. 1963), pp. 75- 76.

24. Josephson, p. 116.

25. Helena Wright, "Sarah G. Bagley: A Biographical Note," Labor History, 20 (1979), p. 409 and Note.

II. FORMS AND STRUCTURES OF TEXTILE INDUSTRY

The evolution of the physical form, structural systems and construction techniques that would proliferate at Lowell as part of the phenomenal expansion of the cotton textile industry during the first half of the 19th century can be traced to two sources. First is the late 18th and early 19th century development of the frame and the stone mills in Rhode Island, especially when considered along with the parallel experiences in Great Britain, and the pioneering work of such millwrights as Richard Arkwright. The second source, not unexpectedly, is the design and construction of the second mill at Waltham by the Boston Manufacturing Company in 1815- 1819.

A. The Rhode Island System

While Massachusetts was active in the production of woolens, most of the cotton manufacturing carried on in this country prior to the War of 1812 took place in Rhode Island and neighboring towns of southern Massachusetts and eastern Connecticut. However, although of great significance to the development of the textile industry in the United States as a whole, their importance to the architectural development of the mills at Lowell is somewhat limited to technological innovations.[1] Usually referred to as the "Rhode Island System," these mills borrowed heavily from the then standard English patterns, especially that of spinning in a factory and "putting-out" the spun yarn for weaving, either at workers cottages that clustered around the mill or to outside sources such as the Lippit Mill which contracted its weaving to inmates of the Vermont State Prison.[2]

The early spinning mill was housed in a variety of building types, the design of which was almost always based on contemporary domestic and light industrial vernacular forms, often unrelated to the manufacturing activity they contained. Occasionally, a new mill use was installed in an existing structure: Stephen Jenks & Sons reused an 1811 musket factory in Central Falls as a cotton Mill; Alan Bissell and George Palmer Jr. converted a 1795 snuff factory in Exeter into a cotton mill.[3]

Slater Mill in Pawtucket (Figure 1) is typical of the early Rhode Island mills constructed for the processing of cotton and exemplifies the use of traditional forms and techniques to satisfy the building requirements of the evolving industry. Carl Condit described this process:

> *The adaption of the heavy timber frame to industrial building came with the construction of Slater Mill in 1793 three stories high, with a shallow attic under a gable roof. All floor, roof and wind loads are carried by an unbraced frame of massive columns and beams roughly square in section. The whole structural system is simply an expansion of the basic New England frame to the size necessary to support a three story mill.*[4]

The 1793 section of Slater Mill is two and one-half stories in height, rectangular in plan, 43' x 29 '. It initially had a gable roof with trap- door monitor. The original structure was added to in 1801 (a 57' west wing) and between 1812 and 1817 (a 40' east wing) with a final change, a stair tower, occurring between 1823 and 1835. The distinctive bell tower, is documented as in place at the south elevation by 1812, but may not have been original. The mill has stone foundations and piers at the intermediate columns, timber sills, wall columns, longitudinal girders, floor beams and roof rafters, and a plank floor. The vertical wall sheathing and weather boards are nailed to the sill and plate, eliminating the need for studs. This system had been in general use throughout New England from the mid-17th century, used in the construction of the entire spectrum of building types, from the smallest cottage to rope- walks and barns, and with the addition of an end wall cupola, to town halls and meeting houses.

Other early mills in Rhode Island repeated the Slater Mill timber frame construction, including the second structure at Centerville Mills in West Warwick, a three story building put up in 1807, and the Lippett Mill, a three and one-half story, 106' x 34' structure erected between 1809-1810. Importantly, the Lippit Mill has a full length clerestory monitor and an inset end-wall Federal style cupola over the northeast entrance.

The small frame spinning mills were gradually replaced in Rhode Island at the turn of the century by somewhat larger structures of either rubble stone or coarsed granite ashlar construction. Hitchcock states: "The earliest stone mills of the first quarter of the century remain almost as domestic as the first wooden mills, and cognate in character with the other architecture of the Early Republic, except that they are simpler and solider."[5] He further describes their construction:

> *Solid mills were built, usually of masonry after 1810, because they represented a large investment and as a partial protection against the very serious danger of fire. Of course the interior structure was of heavy timber, not unlike that in earlier barns and meeting houses, to carry the weight of the machinery.*[6]

Perhaps the most important of the early stone mills is the 1810-1811 Wilkinson Mill, built by Oziel Wilkinson next to the Slater Mill in Pawtucket. As constructed, it was three and one-half stories tall and had a monitor roof. A brick end-wall tower with belfry was added c.1840.[7] Also of note are the 1813 three-story, 80′ x 36′ Georgiaville Mill in Smithfield, with its trap-door monitor, open belfry and stuccoed rubble walls,[8] and Crompton Mills, West Warwick, a three- story, 117′ x 33′ stone mill dating from 1807.[9] Anthony Mills, in Coventry, combined timber frame and stone in the construction of a six-story mill in 1810, the lower three floors in stone, the upper three frame.[10] *

While the heavy timber frame with wood shingle or weatherboard siding and the stone mills with their massive granite walls were, as mentioned, of limited relevance to the design, construction and use of materials of the mills to be erected beginning in 1823 in Lowell, a number of features derived from the "Rhode lsland System" bear mention. First, the location of all of the early mills was determined: "…with reference to the water power, and the particular development of the power in hand,"[15] with the design reflecting " limitations that were imposed by the type of water wheel in use when the mill was actually constructed." [16]

Second, once the site and method of power transfer had been s elected by someone familiar with the harnessing of the available water power, the design of the mill itself was entrusted to:

> *…professional architects or gifted amateurs preoccupied with, or guided by, fundamentally stylistic and formalistic concerns, but with pragmetically-motivated millwrights and business- minded entrepreneurs, seeking practical answers to crucial technical and economic questions.* [17]

Richard Candee, describing early mill villages in Rhode Island expands on this theme and the use of the vernacular: "Buildings erected for manufacturing companies were the products of carpenters and masons working from contracts that often reflected the owners' familiarity with buildings in other nearby factory communities." [18]

* (Mills of comparable design and construction in the Merrimack Valley built before the War of 1812 are rare. An inventory[11] completed in 1978 listed only four, all of which worked with wool: A one-story frame, 40′ x 12′ c. 1800 structure converted to a woolen mill in 1802 by James Scholfield at North Andover; an 1812 two story brick satinet mill at Amesbury, now the site of the Hamilton Woolen Company (built by Paul Moody and Ezra Worthen, who were to play prominent roles in the development of Lowell)[12] and a second small woolen mill at the same site built in 1813,[13] and; a two- story shingle-on-frame cotton and woolen mill built in Andover by the Abbott brothers in 1814, which used king and queen post trusses to support its gable roof.[14])

Third, the floor area and volume of the early mills was directly affected by the available power and the limits imposed by the dependence on the use of "…horizontal line shafting, which transmitted power from the water wheel's vertical main drive shaft to individual machines at each floor the first factories were necessarily kept short because the cumbersome line shafting and pulley system was too inefficient to permit otherwise." [19]

While the length of the early mills reflects the constraints of the line shafting and pulley system, the width was limited by a dependence on natural light to illuminate the interior work areas. Solutions to this problem included the raising of ceiling heights and the use of tall vertical windows at the peripheral walls, with the attic-level lit at first by dormers or their combination into a trap-door-like monitor, and by the turn of the century by full-length clerestory monitors. (The Allendale Mill retained the design of the dormered clerestory when it was built in 1822, while the Lippit Mill was ahead of its time when it introduced a continuous clerestory monitor in 1810.)

Theodore Sande has completed an interesting comparison of the floor sizes of 214 mills constructed in Rhode Island between 1790 (the start of the cotton mill as a building type in this country), and 1860, at which time the "modern automatic cut-off steam engine" was in general use, resulting in the whole-sale replacement of earlier water wheels with turbines.[20] The analysis showed that the range of sizes of the mills built between 1790-1800 was only 33'-47' x 26'-30', with a median plan of 40' x 28 '. During the period beginning in 1800 and continuing through 1840 the range increased to 40'-175' x 25 '-50 ', with a median size of 82' x 40'. With improvements to shafting and power take- offs, the length of mills built between 1840-1850 was expanded to as long as 300' (median of 102'), yet the width remained at a median of only 44 ', indicating the persistent lack of satisfactory artificial lighting despite the introduction of gas in the 1850s to replace candles and oil lamps.[21] The Sande study, while based on Rhode Island examples, can be applied to Lowell where the mills built between 1820-1830 "have been nearly of a uniform size, 150 to 160 feet long, by 45 feet wide, four-stories high, or three, with a finished attic." [22]

Sande also discusses the use of belfrys and towers at the early mills, a feature that would not reach full development in New England until the construction of the second mill at Waltham:

> *... cupola and tower... are interrelated. As towers became important, cupolas tended to disappear, because the cupola' s primary function as bell holder was usually replaced by a belfry mounted directly on the tower itself.*

There were two types of tower common to the textile factory: stair and toilet. Stair towers were located on the main entrance side of the mill and were the only means of entrance or egress from the building. They also provided vertical circulation between floors for workers, machinery, raw materials and finished goods. Toilet towers were usually placed on the opposite side of the factory from the entrance tower, and if possible over an adjacent river or stream.

The important point about towers is that they provide one further indication of the textile manufacturers' desire to make the most efficient plan possible. By removing stairs and toilets from the basic rectangle, they were able to acquire unemcumbered interior floor space, allowing utmost freedom for arranging machinery and production flow.[23]

The stair tower became more and more of a separate unit, pulled away from the body of the mill. Its value increased as it also became the primary means of egress during a fire.

B. British Precedents

Concurrent with the development of the mills of the "Rhode Island System," and of a more direct relevance to Lowell (because of the impact they had on the design of the second mill at Waltham), are the early water powered mills built in England during the last quarter of the 18th century. Sir Richard Arkwright had constructed a mill at Nottingham in 1769. He improved the basic design when he built his first water-powered mill at Cromfield in 1771. Arkwright added a second mill to this site in 1777, with both mills coming after he had revolutionized the industry with his development of the water powered spinning frame, patented in 1769. Together with the Bedworth Worsted Mill, Warwickshire (c. 1800) and William Strutt' s mills at Belper, Derbyshire, (the West mill started in 1797, the North mill built in 1808), the Cromfield mills are considered the precursors of what by 1815 would become a clearly definable building type, a structure designed expressly for the manufacture of cotton textiles. Sande, in describing these and similar mills, refers to:

…the strong precedent they set for the Americans...The typical British textile mill of the time was composed of exterior brick or stone bearing walls of approximately two- feet thickness, slow burning timber or partially fire protected wood interior framing and a gable roof with either a continuous monitor or rows of dormer windows; the whole standing four to five stories tall with the attic story also utilized for manufacturing. The interior columns were quite often of cast- iron rather than timber. The roof was usually constructed of either a king or queen post timber truss that supported wood

> *purlins and plank and this was covered with a slate weather surface. In order to maintain clear space for the efficient use of the attic, the lower cord (sic) of the truss was kept as high as possible and a ceiling placed against it, thus creating a cock-loft above the attic floor.*[24]

A number of points mentioned in the above description require amplification, as they have direct bearing on the design and construction of the mills that would appear in this country at the start of the 19th century.

Textile and other mills constructed in England at the close of the 18th century (and even earlier) were almost exclusively built of brick. Not infrequently, the brick structure contained brick floors that usually rested on cast-iron frames of various designs. Brick, and to a lesser degree cast-iron, were the traditional building materials employed in England at that time and their use in mill construction is to be expected. In Rhode Island, however, only 18 of 200 textile mills built between 1790 and 1860 were brick (48 were frame, 21 frame and stone, 1 frame and brick, and 112, or 56% were stone). [25] However, Candee points to the use of brick as the most common form of construction in Northern New England, defined as Maine, New Hampshire, Vermont, and the eastern part of Massachusetts when he states:

> *Of nearly six hundred cotton and woolen mills for which the exterior wall material is known, almost seventy-five percent of the factories in northern New England were of brick and less than ten percent were of stone. In the southern New England states and western Massachusetts, forty percent were built in stone, thirty-six percent in wood, and only fourteen percent in brick.*[26]

Also, Sande, after compiling the statistics on Rhode Island Mills acknowledges that: "At Lowell and the other major textile cities on the Merrimack it (brick) was preferred from the outset." [27]

The term slow-burning timber appears for the first time in this discussion, a technique that was known in England perhaps as early as 1816 (the H. Hicks & Sons New Mill at Eastington, Gloucestershire is thought to have used this construction). It was not introduced to this country until after the initiation of the construction of the first mills at Lowell.[28] Candee places the use of this technique in America as 1826-1828. [29]

Much has been written describing slow burn construction[30], but Pierson provides what is perhaps the clearest definition:

Among the numerous fire-prevention devices developed during the late 1830's was an ingenious method of interior wooden framing. Although exterior masonry walls helped to reduce the fire hazard, they by no means eliminated it entirely. When a fire occurred in the early mills one of the greatest difficulties encountered in fighting it was the rapidity with which the wooden floors burned through and collapsed. The problem centered around the use of conventional floor joists. They were relatively light and thus quickly consumed. They were also closely spaced which created numerous hollow spaces into which it was difficult to get water to fight the fire; moreover, these joists exposed an excessive amount of wood surface to the flames. The American solution to this was practical and it was simple. The joists were eliminated. To compensate for the loss of structural strength, the large transverse beams were increased in size, and the floor, instead of remaining a single layer of plank, was increased to two layers totaling several inches in thickness. The first layer was made up of the heaviest planks running across the beams, the second, of lighter boards extending in the opposite direction. The beams, which were normally spaced about 8 feet apart, continued to be supported in the center by either wooden posts or columns, and at their ends by the masonry walls. The principal advantage of this system was the increased dimension of all its members. It would take a fire considerable time to burn through 14-inch beams and 4 inches of solid floor, thus allowing time to get water to the fire and bring it under control. Furthermore, the recessed firetraps created by the conventional joists were eliminated and the amount of exposed wood surface was cut almost in half.[31]

The mention of "partially fire protected wood interior floors" by Sande refers to the replacement of the earlier system of thin joists and floor boards with heavy timber girders and 3'' to 4" plank floors as proposed in the use of slow burn construction. It should be extended to include the use in England of the iron-frame and the combination of brick arches and vaults resting on iron beams as a method of providing fireproof structural flooring. William Strutt's Belper West Mill (begun in 1793) is usually regarded as the first, multi-storied, iron-framed incombustible building, and the use of brick floors had occurred in "several highly capitalized textile factories (in England) as early as the 1790s.[32] Sande writes, "The British system was known to the New England manufacturers, but they generally thought it too expensive…"[33] and specifically mentions that Slater and Zacharia Allen both knew of this type of construction. He further states that "…the apparent lack of interest in iron structural systems on the part of the New England mill owners is that they had a more than adequate regional timber supply. This gave them a material that, used in larger than traditional framing widths and thicknesses, was not only cheap but relatively safe in its slow-burning characteristics."[34]

The "gable roof with either a continuous monitor or rows of dormer windows" is a reference to what was known in this country as the trap-door roof, where a series of additional rafters were added to the traditional gable roof, usually inset at least one bay to simplify framing. Low windows were installed between the two sets of rafters. However, because of the limited light provided by such narrow bands of glass, the trap- door monitor gave way after 1820 to the more efficient double, or clerestory monitor, and was the norm when the second mill at Waltham and the original buildings at Lowell were put up. This roof form is directly attributable to Arkwright's 1777 mill at Cromford, and was "first employed in America on an 1810 mill in Lippit, Rhode Island (sic. Lippit Mill is in West Warwick).[35] This roof form was constructed by indenting the gable end walls and extending them in their same plane 4-6' above the eaves, adding vertical supports in line with the higher gable, and building a second, higher roof, usually of the same pitch, above the lower roof, from end wall to end wall. "…thus two roughly parallel roof planes were introduced, one rising from the eaves to the continuous window sill, the other from the head of the clerestory windows to the roof ridge."[36]

The clerestory roof virtually demanded the use of either a king post or a queen post truss to create usable floor space in the attic level. This roof form continued in use until the Civil War, when it was gradually replaced by shallow pitched roofs (made practical by the introduction of modern bituminous materials in the 1850s), which evolved soon thereafter into the flat roof with parapet.

The final detail mentioned by Sande in reference to the early English mills is the use of cast iron columns. While cast iron was in general use in Britain, wood columns were often preferred in New England. If cast iron columns were used in original construction they were sometimes replaced by wood at a later date:

> *Occasionally cast iron was used for the interior columns [for pre-1860 New England structures], supporting heavy timber beams, but there seems to have been much debate about the efficiency and safety of the iron. When the Pemberton Mill of 1853-1856 at Lawrence, Massachusetts, collapsed in 1860, its original cast-iron columns were replaced by heavy timber columns.*[37]

The preference for wood rather than iron columns is stated in various insurance reports. An 1882 report mentions the subject but somewhat skirts the issue:

> *The question of using iron posts in place of wood is not treated. On the whole, the judgment of the underwriters favors the wooden posts of sufficient size...and one of the principal advantages of wood*

over iron is that, when the wooden post begins to fail, the weakness usually becomes apparent before it reaches a dangerous point. [38]

C. The Mills at Waltham

The first to improve upon the design and organization of the early New England textile mills by incorporating experiences learned from contemporary English models were Francis Cabot Lowell and his circle of Boston friends. Reacting to economic changes brought about by the Embargo Act of the War of 1812 they sought new and divergent ways to invest their cash reserves:

Impressed by the successes of the textile industry in Rhode Island, they began to see manufacturing as a potential for investment. Unlike the Rhode Islanders, however, who were mechanics and engineers, these Boston men were merchants and bankers with great executive capacity and wide experience in business organization. Their role in manufacturing therefore, was planning, financing, and marketing, plus attention to the social problem associated with the hiring of labor. Technical and operational problems they left to the mechanics and specialists. Out of this came a new type of factory organization which was, in fact, the prototype of the great modern corporation. It was characterized by absentee capital and the concentration of all processes of production-from raw material to finished product-under one management and in one plant. [39]

Organized at Waltham as the Boston Manufacturing Company in 1813, the company almost immediately started construction of their first mill at a ten-foot waterfall on the Charles River. Incorporating a single power loom developed by Lowell after his celebrated rest cure trip to England in 1810-1812, the mill was producing cloth for sale by 1815. [40] This first mill was similar in detail to many of the mills in Rhode Island (with the exception that it had brick exterior walls), with a simple rectangular plan, 90' x 40', four-stories with an attic lit by a continuous clerestory roof, and an octagonal bell-tower centered at the upper ridge pole. As Pierson mentioned, the mill was the first example of the vertically integrated factory in this country, where all operations from spinning to weaving was accomplished under one roof, from "bale to bolt." This system of manufacturing was in full operation in England at the turn of the century (Bedworth Worsted Mills, Warwickshire, c.1800; the aforementioned Belper Mill, c.1808 at Deryshire) and its use there was almost certainly known to Lowell.

With considerable foresight, the mill site was selected with a view towards expansion, where the waters of a major river might support at least a small number of additional factories. (Earlier New England mill concentrations, especially those in Rhode Island,

were severely restricted by the availability of sufficient water to create a head. When it came time to expand, the new mills were located by necessity at separate locations in order to husband the water power.) Despite serious economic problems experienced by most other developers at the close of the War of 1812 and an end to its import restrictions, the Boston Manufacturing Company did choose to expand, a decision prompted by Lowell's lobbying in Washington for new import control: "The famous minimum duty of 6-1/2 cents per square yard on imported cotton fabric was proposed by Mr. Lowell, recommended by Mr. Lowndes, advocated by Mr. Calhoun, and incorporated into the tariff of 1816." [41]

Lowell recognized that the size of a cotton mill was limited by the dependability on line shafting (we have seen that the median length of mills built in Rhode Island prior to 1810 was only 80 feet, and the first Waltham mill 90 feet). With this in mind, he determined that the most efficient way to take full advantage of the water power available from the Charles River was to construct a separate mill to supplement the first. Therefore, he located the second of the Boston Manufacturing Company' s mills, built between 1816-1818, 80 feet down river from the earlier mill, marking "the first time in America that two individual factory units were combined."[42] The mills were built in line, but initially were unconnected. This separation of individual mill structures was to persist until well into the 1840s, when the introduction of wrought-iron shafting, combined with the wide spread use of slow-burn timber framing and brick exterior walls reduced the possibility of a catastrophic fire destroying both mills. At that time the area between the mills was infilled with additional manufacturing space. While it is romantic to speculate that a concern for aesthetics and light and air may have played a part in the decision to separate the two mills at Waltham, and later at Lowell, the control of fire was almost certainly the primary concern until later in the 19th-century when the owners recognized the value of such amenities in attracting and holding a labor force. [43]

The traditional width of 40 feet (the optimum for spaces relying on windows in the exterior walls to provide natural light) was retained at the second mill, but the length was extended to 150 feet. Yet the form, with the by now traditional brick and frame construction, was still basically a simple rectangular masonry box. However, here the box-like appearance was made less severe.

> *…attached to the center of the long side was a narrow wooden tower which rose to the level of the clerestory window and was crowned by a pitched roof and pediment. This seems to be among the earliest appearances of the outside tower, a feature which would become standard in the fully developed nineteenth-century factory. In this case, however, the motivation appears to have been more practical*

than aesthetic: it was on the stream side of the mill and it may have contained primitive toilets on each floor. [44]

In addition to the use of the exterior tower, the second mill at Waltham introduced another feature of crucial importance to the planning of the mills at Lowell, the use of a canal in conjunction with a river. Pierson discusses this feature:

In Rhode Island, where a single mill was served by a single headrace, the building was generally oriented at right angles to the stream. This was logical. The water wheel was almost always at the center of the mill and with the side of the building facing the dam the headrace could be brought directly to the wheelhouse in a straight line. If more than one mill was to be served, however, it was necessary, as at Waltham, to provide a feeder canal, generally parallel to the stream, from which a headrace could flow to each mill. The headrace for each mill fed from a canal which passed behind the mills (at Waltham) on the side away from the river, the tailraces flowed back into the stream. Thus, the respective wheels received their water from the same head with a minimum length of canal and penstock. [45]

While Lowell's decision to group several mills together (an additional mill was constructed later in the 19th- century) into a single manufacturing complex was not unknown in Britain, the application of this principle at Waltham and the resulting requirement of a canal parallel to the river established the parameters of the plan and mill orientation for the development of Lowell. The visual appearance of both Waltham mills would not be materially changed either, for better or for worse. Pierson compares the simplicity of the Waltham mills to "that of the best contemporary architecture in Boston" and credits the owners with being "knowledgeable in architectural matters" including the work of Charles Bulfinch. It must be mentioned, however, that the plain and austere treatment of the exterior of the mills was also the most expedient and the cheapest form of construction, and that the basic concern of most millwrights was utility and a return on investment. Sande refers to the design of mills of this period as stylistically retardataire and cites in a footnote: "Interestingly, J. M. Richards also found this true for similar British structures: 'In many instances the buildings' simple functional character is partly overlaid, but not disguised, by embellishments." [46]

D. Conclusions

With the construction of the second mill at Waltham, the evolution of the physical form, structural systems and construction techniques that would be used at Lowell is complete. The plan is rectangular, 150' - 160' x 40' -50 ', four-stories of open floor space with a clerestory lit gable roof, with brick bearing walls on stone foundations. The structural framing system was timber, in some instances with cast iron columns, with a full height exterior stair tower centered in one of the long elevations. They were either initially built, or planned to be expanded, as a series of similar structures.

ENDNOTES

1. Slater Mill, considered the first cotton spinning mill in America was the first to use the Arkwright water-powered spinning frames; Wilkinson Mill was one of the first to combine steam with water as a power source and one of the first (1819) to produce worsteds.

2. Rhode Island: An Inventory of Historic Engineering and Industrial Sites, HAER, 1978, page 267.

3. Ibid., pp. 43 and 87.

4. Carl Condit, American Building, Chicago, 1968, pp. 41 - 42.

5. Henry-Russell Hitchcock, Rhode Island Architecture, Providence, 1939 as republished by De Capo Press, New York, 1968, p. 42.

6. Ibid., p. 38.

7. Rhode Island, p. 149.

8. Ibid., p. 225.

9. Ibid., p. 265.

10. Ibid., p. 51.

11. The Lower Merrimack River Valley, An Inventory of Historic Engineering and Industrial Sites, MATH and HAER, 1978.

12. Ibid., P · 90.

13. Ibid., p. 1.

14. Ibid., P · 9.

15. Stephen Greene, Motive Power, "NEC MA

16. Ibid., p. 130. "Modifications in Mill Design Resulting From Changes in (Waltham) October 27, 1897, Transactions No. 65, p. 12.

17. Theodore Anton Sande, "The Textile Factory in Pre-Civil War Rhode Island," Old Time New England (SPNEA) Vol. 66 (Summer- Fall 1975), p. 14.

18. Richard M. Candee, "New Towns in Early New England Textile Industry," Perspectives in Vernacular Architecture, 1980.

19. Sande, Textile Factory, Rhode Island, p. 17.

20. Greene, p. 128.

21. Sande, Textile Factory, Rhode Island, p. 15.

22. Hand-Book for the Visitor to Lowell, Lowell, 1848, p. 11.

23. Ted (Theodore Anton) Sande, "The Architecture of the Cotton Textile Mills at Lowell, Massachusetts," 1822- 1860, unpublished manuscript, Lowell University Library Special Collections, 1971, p. 22.

24. Sande, Mills at Lowell, op. cit., p. 7.

25. Sande, Textile Factories, Rhode Island, op. cit., p. 18.

26. Candee, New Towns, p. 36.

27. Ibid., p. 18.

28. Sande (Mills at Lowell, p. 20) states that " the system may have been used in the Merrimack Company' s first mills at Lowell, Massachusetts, in 1822, but surviving records are not clear." Other sources date the use of slow burn construction at 18 27, Bernon Mill, Woonsocket, Rhode Island (HAER Rhode Island Inventory, Candee, p. 45, Sande, p. 20).

29. Candee, New Towns, p. 45.

30. See: Boston Manufacturers Mutual Fire Insurance Company Special Report No. 10, April 1, 1882, and plates published in 1908; Insurance Engineering Experiment Station Report No. V., Slow- Burning or Mill Construction, September 1902.

31. William H. Pierson, Jr., American Buildings and their Architects, (Garden City, New York), 1980, p. 49.

32. Sande, Textile Factories, Rhode Island, op. cit., p. 19.

33. Ibid., p. 19.

34. Sande, Mills at Lowell, op. cit., p. 6.

35. Candee, op. cit., p. 35.

36. Sande, Textile Factories, Rhode Island, op. cit., p. 22.

37. Sande, Mills at Lowell, op. cit., p. 6.

38. Boston Manufacturers Special Report, op. cit., pp. 9, 2.

39. Pierson, p. 59.

40. The importance of Francis Cabot Lowell and his friends has been discussed many times--see Pierson, pp. 59-63; Cowley, pp. 40-41; Steve Dunwell, The Run of the Mill, pp. 30-32; Arthur L. Eno, When Cotton Was King and others.

41. Cowley, Illustrated History of Lowell (Boston and Lowell) 1868, p. 41.

42. Pierson, p. 61. - 41 –

43. See Hitchcock, p. 38.

44. Pierson, p. 61.

45. Ibid., pp. 61-62.

46. Sande, Textile Factories, Rhode Island, Footnote 55 quoted from The Functional Tradition in Early Industrial Buildings, London, 1958, p. 19.

III. ORIGINS AND DEVELOPMENT OF THE BOOTT COTTON MILLS

A. Description of the Mills in Lowell Contemporary with the Founding of the Boott Cotton Mills.

1. Origins

The introduction of the power loom to this country by Francis Cabot Lowell at his Boston Manufacturing Company's mills at Waltham created a need to increase dramatically the scale of manufacturing operations to compensate for the high cost of machinery. Despite careful planning, Lowell and his associates were soon stymied in their effort to expand the three-mill complex at Waltham. The Charles River was simply unable to provide sufficient water power for any additional mills of any size. Much has been written describing the search for a site for a new factory town and the presence of the Pawtucket and Middlesex canals at the Merrimack River at what at the time was referred to as East Chelmsford[1] (Lowell did not become a town until March 1, 1826). It need not be restated here other than to introduce the men primarily responsible for the development of Lowell. John Coolidge mentions the union of Patrick Tracy Jackson (manager of the Waltham mills), Nathan Appleton, (a major shareholder in the Boston Manufacturing Company), and Kirk Boott, "who had been a Boston merchant until the evil days of the embargo" and their efforts to locate a suitable site:

> *After one or two false starts, they heard of a suitable location in the autumn of 1821. This is Appleton's account: 'I was at Waltham one day when I was informed that Mr. Moody* had been lately at Salisbury, when Mr. Ezra Worthen, his former partner said to him, 'I hear Messrs. Jackson and Appleton are looking out for water power. Why don't they buy up the Pawtucket Canal? That would give them the whole power of the Merrimack, with a fall of over thirty feet.' On the strength of this, Mr. Moody had returned to Waltham by that route, and was satisfied to the extent of the power which might thus be obtained, and that Mr. Jackson was making inquiries on the subject.'*[2]

Appleton visited the proposed site and described the trip:

* Mr. Moody was Paul Moody, a machinist and mechanical engineer who collaborated with Lowell in the development of the power loom and the construction of the mills at Waltham.

> *Our first visit to the spot was in the month of November 1821, and a slight snow covered the ground. The party consisted of Patrick T. Jackson, Kirk Boott, Warren Dutton,† Paul Moody, John W. Boott and myself. We perambulated the grounds and scanned the capabilities of the place, and the remark was made that some of us might live to see the place contain twenty thousand inhabitants...*[3]

The Waltham contingent quietly acquired control of the Proprietors of the Locks and Canals on the Merrimack River, (chartered by Governor John Hancock in 1792, and the owners of the Pawtucket Canal) and purchased all water rights and the major landholdings between the canal and the Merrimack (Figure 2). They incorporated as the Merrimack Manufacturing Company on December 21, 1821, with Jackson, Appleton, both Bootts, and Paul Moody as shareholders.[4] Kirk Boott (Figure 3) was appointed treasurer and agent. All quickly recognized the vast potential of the Pawtucket Falls:

> *They decided to monopolize both power and real estate, augmenting their manufacturing profits by organizing new mills, selling them land, and leasing them waterpower. The location was too potent to waste on another one- company town.*

> *The Merrimack Manufacturing Company was reorganized in 1825 to take full advantage of these new investment opportunities. The parent company transferred control of the waterpower, real estate, and machine shop to the Proprietors of the Locks and Canals, a wholly owned subsidiary that had previously administered the Pawtucket Canal. While Merrimack Manufacturing continued to make cloth, Locks and Canals was now free to reap tremendous profits by organizing and outfitting new mills, leasing power and manipulating real estate.*[5]

In addition to his titles at the Merrimack Company, Boott was made agent of the reorganized Locks and Canals when the transfer of the locks, canals and water rights belonging to the Proprietors on the Merrimack River was formalized on January 2, 1826. [6] Boott was responsible for allocating the land to new developers, who were to build their mills along the planned canal system to be constructed by his corporation, and the awarding of "mill powers."‡ Each of the prospective manufacturers was to supply:

> *…its own power generating machinery--Locks and Canals only delivered the water to the mill... besides distributing water for*

† Warren Dutton would become the first president of the Merrimack Manufacturing Company; John W. Boott was Kirk Boott's brother.

‡ A mill power at that time was defined as the water power required to run a mill equal in size to the second mill at Waltham, 3, 548 spindles.

power, Locks and Canals also engaged in other varied activities. It originally built all the mill buildings, dug the canals, installed the penstocks and waterwheels. It set up the Lowell Machine Shop which built all the machinery for textile manufacturing and processing, and which spun off as a separate enterprise in 1845.[7]

2. The Canals

The first concern of Locks and Canals, however, was the completion of the canals, needed before any mills could be put into operation or the machine shop could find customers for its textile machinery. The evolution of the canal system (Figure 4) that supplied the water power to the mills at Lowell is thoroughly documented[§] and need not be more than summarized here.

The Pawtucket Canal, a "nine-thousand foot waterway had been built by the Proprietors of the Locks and Canals on the Merrimack River...to provide a route around the falls for rafts carrying timber and other northern products to the sea at Newburyport."[8] By 1821 the Pawtucket Canal was supplanted for commercial use by the Middlesex Canal (finished in 1803), which branched off the Merrimack River a mile upstream from the falls. The Merrimack Manufacturing Company immediately enlarged the by then secondary Pawtucket Canal and planned for the construction of the new Merrimack Canal which would directly serve their mill site. The completion of this canal was followed by the construction of the Hamilton Canal serving first in 1825, the Hamilton Manufacturing Company and, in 1828, the Appleton Manufacturing Company. The Lowell Canal, providing water for the Lowell Manufacturing Company was built in 1828, followed by the Lawrence Canal (Lawrence Manufacturing Company) in 1830 and the Western Canal (for the Suffolk Manufacturing Company and the Tremont Mills) in 1831.

The Eastern Canal, built for Boott Cotton Mills, was completed in 1836, with the Massachusetts Cotton Mills also drawing water from it beginning in 1839. The Boott penstock was constructed to improve the flow of water in 1846. It was enlarged in 1848 and modified in 1873, 1889, and 1906.

The final canal to be built by the Proprietors was the Northern Canal, the largest of all. Designed and supervised by James B. Francis as a much needed feeder canal to supplement the overtaxed Western and Lawrence Canals, it was completed in 1848.

§ See Canals and Industry, Pat Malone for a detailed description of their construction.

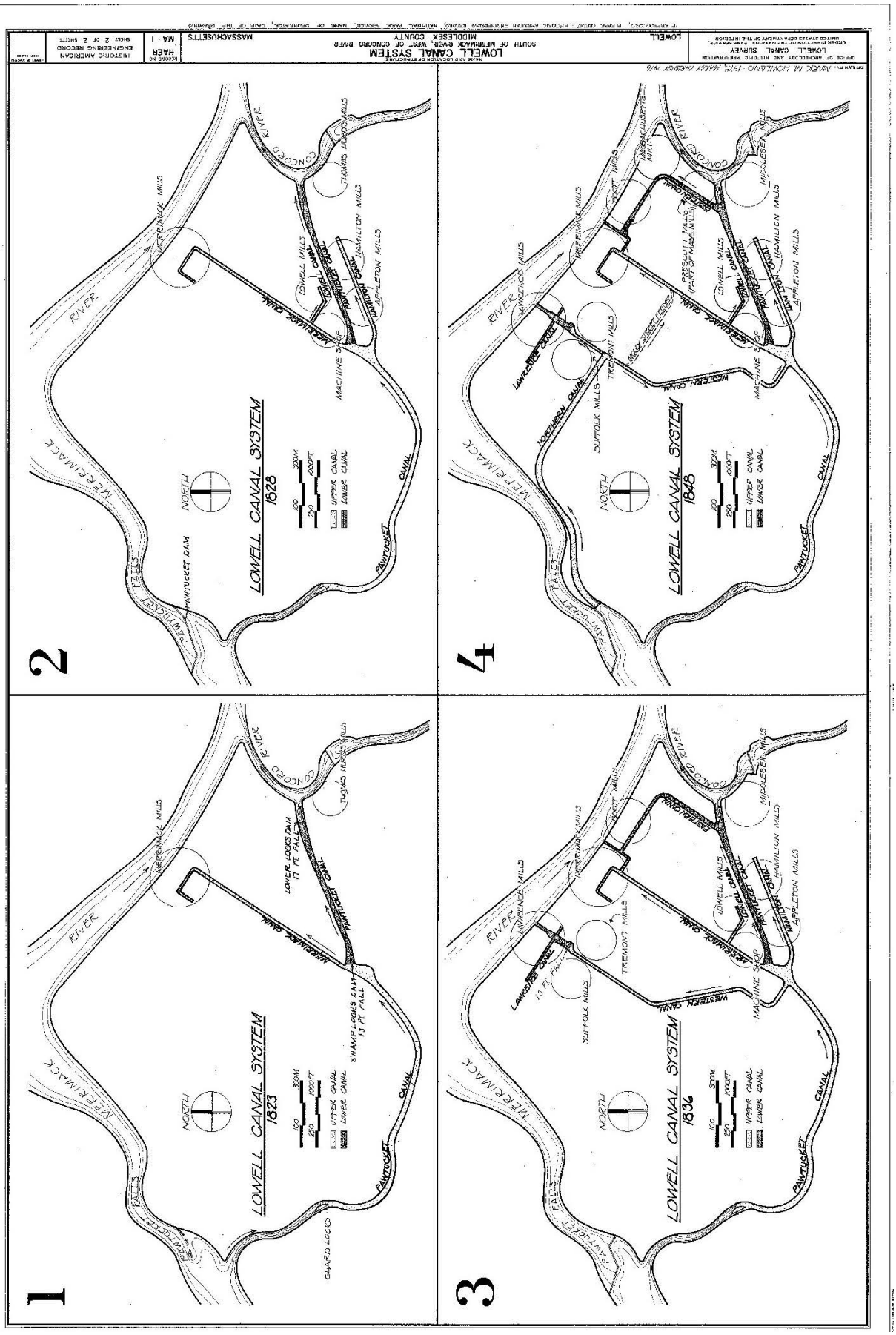


Figure 4. The Lowell Canal System, 1848, with all canals completed
Source: Historic American Engineering Record (HAER), National Park Service, MASS, 9-LOW, 8-(sheet2 of 2), 1976

3. The Town Plan

Concurrent with, and subservient to the construction of the canals, the plan for the town of Lowell was evolving. When the Eastern Canal was completed in 1836:

> *…twenty-six textile mills, two print works, and the machine shops of Locks and Canals were operating with power supplied by the Merrimack River. The nine mill complexes on the system produced 49,413,000 yards of cloth that year and employed almost 8000 workers out of a total population of 17,600. Within the city, canals and the mills they powered were the dominant features of the urban landscape. Corporate housing, small businesses, and private homes were built only where they did not interfere with the routing of power canals and the production of textiles. The first priority in the development of Lowell was to bring water power to the best mill sites.* [9]

The canals not only brought water power to the mills, they also dictated the plan of the early factory-sponsored town. The limits of development were determined by the Merrimack River at the northern edge, and the Pawtucket Canal which ran from just above the rapids at Pawtucket Falls south and west to create a diamond shaped parcel of land 3/4 of a mile at each of its four sides (Figure 2). The diamond was bisected in a roughly east - west direction by a road leading west from the Pawtucket Bridge, just below the falls, to a bridge across the Concord River at the east, 750 feet south of its confluence with the Merrimack (this road then continued on to Salem and Boston). Much of the pre- 1822 east-west road was incorporated into the present day Merrimack Street. The area north of this road, to the river, was set off for the mills and mill housing. The land south, except for a large tract along the eastern third of the Pawtucket Canal, between it and what would become Hamilton Street by 1828 and the site of the Hamilton, Appleton, and Lowell mills, was left to the initiative of private enterprise who would develop the remainder of the town.

According to many accounts, Francis Cabot Lowell,[10] had developed a conceptual plan for a new industrial community based on the notion that the "plant could no longer exist apart from the community and that it was now a responsibility of industries to create the towns in which they were to be located." [11]

According to Coolidge, Lowell:

> *... conceived of the town [at an as yet unselected site] as made up of two distinct groups, the employees and the citizenry. All that had to be done was to designate two zones, one for the corporation, and*

one for the bourgeoisie...

That was the problem. The most straightforward solution was a scheme of ribbon development. A great road would be built following the course of the river about a quarter of a mile away. This road was to serve two functions: it would be the backbone of the community, with shops, public buildings and parks clustered around; it would also divide the property into two distinct portions. The land between it and the river would be reserved for industry. The land away from the river would be given over to the bourgeoisie. [12]

As agent of the Proprietors of Locks and Canals, Boott was charged with the responsibility of building a town. "As the town's planner, architect, and chief engineer, Kirk Boott had been primarily concerned with the proper planning of mill sites and housing for the workers and supervisors; in this work, he was most painstaking. In planning for the rest of the city, Boott was almost neglectful." [13]

The resulting plan was not predicated on a concern for the welfare of the inhabitants or their social, recreation, or transportation needs, but was simply the result of "a limited dream of limited men desiring maximum profit on a long term investment…the plan showed no awareness of the organic community relationships that are the heart of a true city." [14]

Coolidge convincingly states the real concerns of the investors:

At Lowell the factories were conceived first. They were planned as normally as possible, and when they were finished, the town was arranged to fit into the area left over.

Accordingly, the Merrimack River bank was saved for manufacturing about three quarters of a mile above the mouth of its tributary, the Concord. Another obvious site for factories was on either side of the Pawtucket Canal, below the Swamp Locks.

The next consideration was the location of the housing. The best place for it was right behind the mills, and that is where it was put in the ideal scheme. At Lowell likewise land was earmarked for housing in back of the band of property held for plants…There remained the matter of laying out the streets… The land set aside for the Corporation constituted a great F-shaped area. The highways were related to this area in the most unfortunate way imaginable. The main traffic arteries converged upon the one space surrounded on three sides by Corporation property.[15]

The street pattern within the original factory town continued to expand throughout the 19th century, but the mill sites had been allocated and for the most part built upon by 1835 (Figures 5, 5A) when the Boott Cotton Mills came into existence. The year 1835 also marks the completion of the last determinant of the plan, the initiation of service by the Boston and Lowell Railroad. Started in 1832 by Patrick Jackson and financed by the mill owners, the Boston and Lowell was followed three years later by the Nashua and Lowell Railroad, the Lowell and Lawrence Railroad in 1847 and the Salem and Lowell Railroad in 1850. (The success and growth of the railroads as prime movers eventually caused the closing of the Middlesex Canal in 1852.)

4. The Mills

The first mills to be built in what would become Lowell were those at the Merrimack Manufacturing Company at the head of the Merrimack Canal, where the canal turned to the northwest and run parallel to the river, then made a hairpin turn to the south. Merrimack mills in 1822 consisted of five cotton factories (Figure 6). Three of the cotton mills were sited in a row parallel to and between the river and the hairpin turn of the canal. The two other original mills were placed at right angles to the row and the river. A printworks was constructed southwest of the western of the two perpendicular mills. The mills, "each about twice the size of the second mill at Waltham, from which individually they did not differ greatly" conformed to a description offered in the Handbook for Visiters to Lowell published in 1848. "The cotton mills, as heretofore built, have been nearly of a uniform size, 150 to 160 feet long, by 45 feet wide, four-stories, or three, with a finished attic, capable of containing from 6,000 to 8, 000 spindles."[16]

The first Merrimack mills were brick,¶ 156′ x 45′ with a basement that housed the 30 foot breast wheels** and steam boiler, three upper stories and a finished attic lit by a continuous clerestory. Patrick Jackson and Kirk Boott have both been credited with the design of the mills, but in reality they were simply a variant of the first and second mills at Waltham, incorporating the bell tower and cupola

¶ Cowley, Illustrated History of Lowell, p. 45, writes: "The bricks used in building the mills of this and the succeeding manufacturing corporations were chiefly from Bedford and Merrimack in New Hampshire."

** Boott visited the mill on September 4, 1893, and wrote in his diary, "After breakfast, went to the factory, and found the wheel moving round his course, majestically and with comparative silence. Moody declared that it was 'the best wheel in the world.' Appleton became quite enthusiastic. In the afternoon, he spent an hour looking at the wheel, after which returned home by Andover." (William Bagnall, "Sketches of Manufacturing and Textile Establishments in the Eastern United States," typescript in the possession of the Museum of American Textile History, North Andover, Ma., p. 2157, diary of Kirk Boott [diary has disappeared].). *2016 HSR Update Note: The date for Boott's visit in the first sentence of this footnote is inaccurate since Boott died in 1837.*

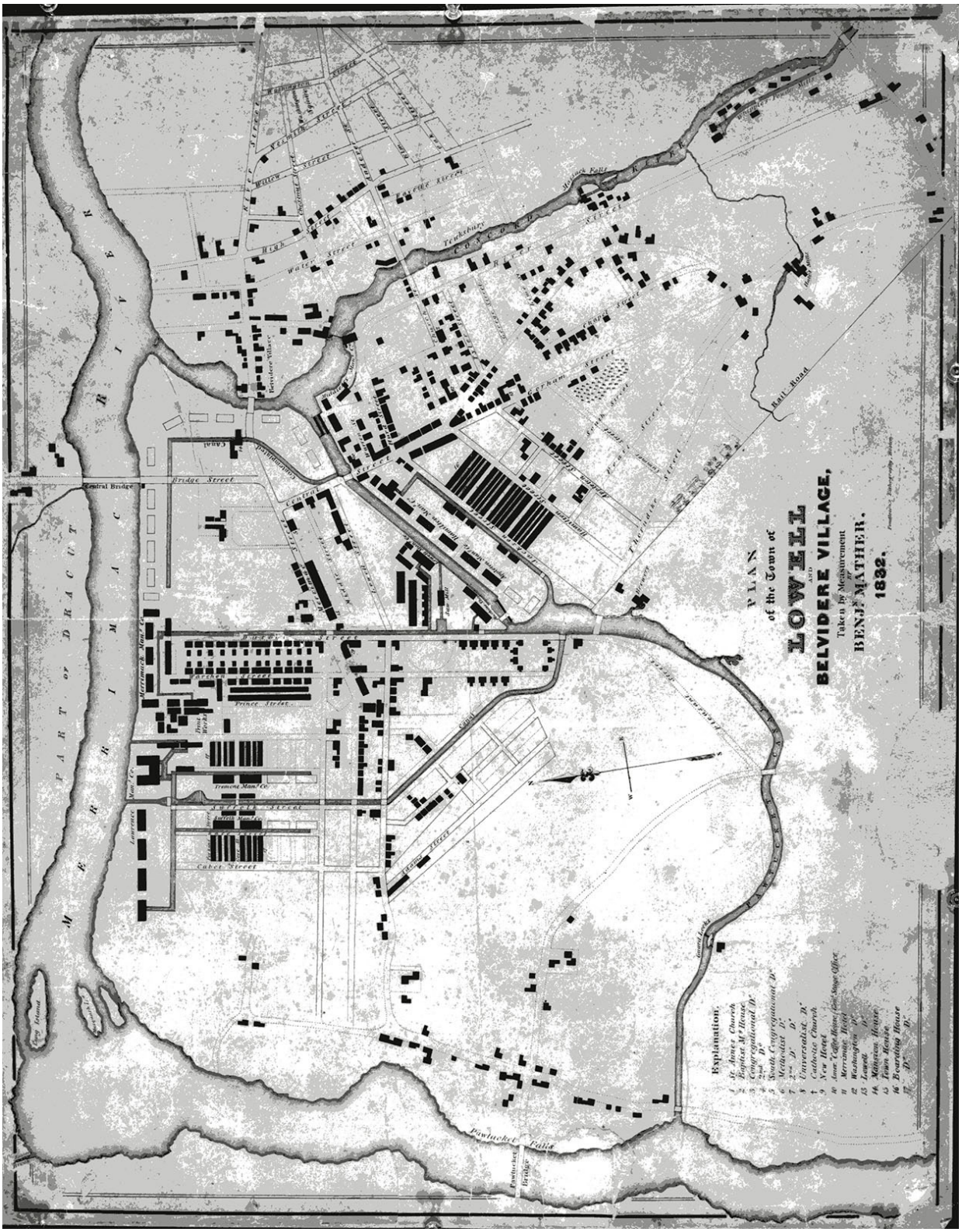
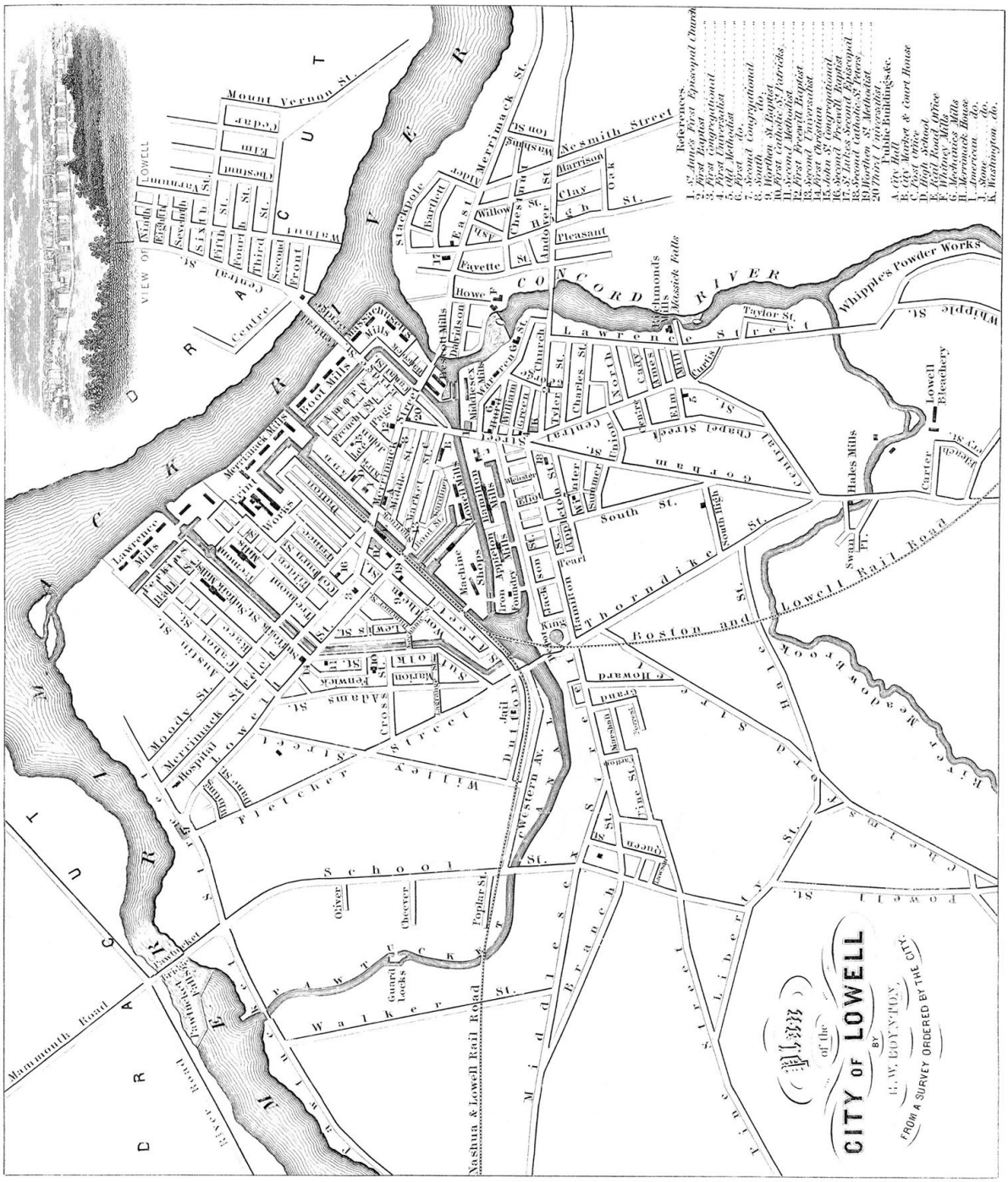


Figure 5. Lowell and Belvedere Village, 1832
Source: LNHP, Museum Collections, LOWE 14442



III. City of Lowell - 1845 - by G. W. Boynton

Collection of the Lowell Historical Society

Figure 5A. City of Lowell, 1845
Source: LNHP, Museum Collections, LOWE 14443

from the first and the projecting stair tower centered in the long facade from the second.

Except for the lack of rooftop cupolas, the other four early mills of the Merrimack Corporation were identical in design to the first. Picker houses were built in front of and separate from each mill after the No. 2 mill burned in January, 1829. (The remaining two structures of the original row of three were burned in 1855 and rebuilt. At the same time the center structure was demolished and rebuilt to match the flanking mills.) The clerestory monitor roofs were removed sometime after 1835, to be replaced with a simple gable roof with full length dormers, raising the upper level to a full story in height. According to Coolidge, "It simplified and added greatly to the impressiveness of the mill buildings." [17]

Mill housing was constructed west of the canal and a Counting House, or office, and various other accessory structures were placed directly south of the row of three mills. In various forms and with only minor changes, this pattern was to obtain throughout the development of Lowell--an exception would be the last complex to be put up, the Massachusetts Cotton Mills (1839). By 1848 Merrimack Manufacturing Company consisted of six mills, the sixth (Figure 7) "a very large mill, 350 feet long lately built. "[18]



Figure 6. Merrimack Manufacturing Company, c.1850.
Source: LNHP, Museum Collections, LOWE 1039

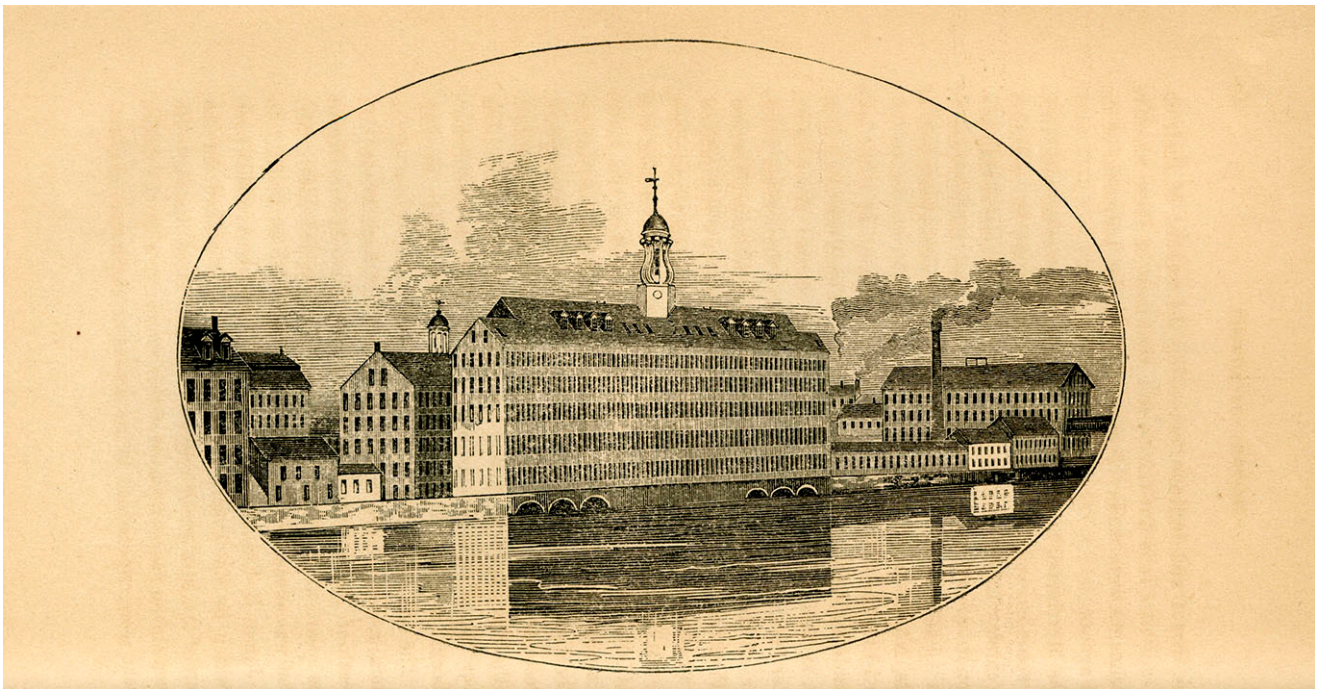


Figure 7. Merrimack Manufacturing Company Mill No. 6, c.1848
Source: LNHP, Museum Collections, Library Collections, A History of Lowell, by Charles Cowley, 1868, p. 48

The Hamilton Manufacturing Company with their charter granted in 1825 was the next to be developed. Situated south of the original Pawtucket Canal, (between it and Jackson Street) Hamilton Mills constructed three structures of the traditional size and design, the first in 1826, the second in 1827, and the third in 1830. By 1848 "they have filled in the space between two of the old mills (75 feet) with extensions front and rear, and have erected a large mill 320 feet long... (and an) excellent print works for the manufacture of calico."[19] Four other mills and an addition to the original No. 2 mill had been constructed at Hamilton by 1883, completing the complex. [20]

The Appleton Manufacturing Company, incorporated in 1828, built two mills southwest of the Hamilton mills in that year, added a third in 1846, a fourth in 1861, and a fifth in 1873. Like the Hamilton mills, they had filled in the space between the first two mills by 1848. Lowell Manufacturing Company was also chartered in 1828 and immediately started construction of their facilities across the Pawtucket Canal from the Hamilton and Appleton mills. The first of the Lowell Manufacturing buildings was a five-story, 240' x 54' mill, followed by a somewhat smaller mill to house the just patented Bigelow Power-Loom (for carpets) in 1842, a larger one-story mill that covered almost an acre, in 1848, and a 364' x 66' three-story mill in 1884. Middlesex Manufacturing Company, the only mill in Lowell to work exclusively with wool, was chartered in 1830 and was developed at the eastern terminus of the Pawtucket Canal at

the Concord River, the site of the early Thomas Hurd Mill (1818). They constructed two mills in 1840, by 1848 had four, and in 1884 built a 375' x 56' six- story mill.

Also in 1830, three separate companies were organized by Amos and Abbott Lawrence, newcomers to the Lowell investment scene--the Tremont, the Suffolk, and the Lawrence. The Tremont Mills and the Suffolk Manufacturing Company straddled Suffolk Street at the upper part of the Western Canal, below the Lawrence Canal where perpendicular feeder canals were constructed to run southward to the new mills. Each company had two mills with separate picker houses and cotton warehouses by 1831, with the space between the mills infilled by 1834.[21] Their neighbors to the northeast, the Lawrence Manufacturing Company had built four mills of the standard size and design, arranged in a row parallel to and between the Lawrence Canal and the Merrimack River, and a large "U"-shaped mill between the row of four and the Merrimack Mills to the east.

Boott Cotton Mills was incorporated in 1835 (discussed below). The final addition to the manufacturing scene was the Massachusetts Cotton Mills, incorporated in 1839. They built four 150' x 45' mills, (the traditional size), four stories high with a basement and attic. The four mills were arranged in an "L" - shaped row east of the Boott Mills and Bridge Street, between the northern leg of the Eastern Canal and the confluence of the Merrimack and Concord Rivers. A connector mill was constructed in 1852-53. All four mills had been linked by similar constructions by 1862. In 1872 a 79' x 116' wing was added to the southern mill. Finally, in 1911, an eleven-story reinforced concrete storehouse was constructed to complete the Massachusetts Cotton Mills as originally conceived. Prior to this, however, the Prescott Mills with a large spinning mill and a weaving mill located between Merrimack Street and the Pawtucket Canal at the Concord River was merged with the Massachusetts mills in the 1840s.

Fire protection in the 1830-40s was provided by a system of force pumps connected by underground mains in each individual mill yard, following the example set by the Merrimack Company after their No. 2 mill was destroyed by fire in January, 1829. In 1847-48 the individual yards were linked by a ten-mile integrated system, which was further improved when the deadend pipe lines were connected to form a continuous loop in 1853. Perforated pipe sprinklers were first experimented with in 1845 at the Suffolk picker house, and by 1852 they had been installed at other picker houses throughout the town. By 1859 all picker houses were sprinklered to comply with provisions established by the mill owned Mutual Insurance Company. All mill buildings were provided with similar sprinkler devices as a matter of course from 1863 on, pre-dating the Boott No. 6 mill.

The Lowell Gas Company was established in 1849, providing the mill agents the opportunity to convert from oil lamps to wall mounted or suspended gas lighting, a change quickly made in the interest of fire safety and economy. The final innovation that affected the design of the Boott mills, especially Mill No. 6, occurred in 1855, when the Merrimack demolished and replaced one of its original mills: "here the octagonal turrets were placed at the corners, and the rich cornice was carried all about the whole structure". [22]

5. Conclusions

The mill buildings constructed at Lowell prior to the four built at the Boott Cotton Mills in 1836- 39 did not differ to any great degree from the composite of the first and second mills at Waltham developed in the first quarter of the 19th century, the composite used as the model for the mills put up in 1823 by the Merrimack Manufacturing Company. The obvious exception is the elimination of the cupola centered at the ridge of the clerestory monitor or "double-roof." The "typical" mill structure was a simple rectangular box, with four-stories (five if the dormer lit attic is counted) of uninterrupted open floor space served by an exterior stair tower attached to the middle of the long facade. As the size and volume of the neighboring mills expanded later in the century, so did those constructed at the Boott. Perhaps the most important visual changes were the addition of connectors between the original 150' x 45' mills and the replacement of the clerestory monitor roof with a dormered gable design.††

Other elements that contributed to the design and construction of the Boott Cotton Mills were also either in place by 1836- 39, or were adapted at the Boott as they occurred. Steam heat was in limited use at the Merrimack Mills from the start (1823). By 1826 the Proprietors of Locks and Canals had insisted that all buildings built on land controlled by the corporation were to be of brick or stone, and roofs were to be covered with slate or some other incombustible material.[23] Fireproof construction (the heavy plank floor and timber frame system) was, according to a letter written in 1832 in use at the Suffolk, Tremont, and Lawrence mills at that time.

John Reps, in The Making of Urban America, reproduces comments on the visual appearance of Lowell at the time the Boott Cotton Mills were established.

> *Foreign visitors, such as Michael Chevalier in the mid 1830's, came away impressed both by Lowell's rapid growth and by its character. As Chevalier wrote,*

†† The use of connectors was introduced to Lowell around 1845 and became common practice thereafter.

'The town of Lowell dates its origin eleven years ago, and it now contains 15,000 inhabitants... At present it is a pile of hugh factories, each five, six, or seven stories high, and capped with a little white belfry By the side of these larger structures rise numerous little wooden houses, painted white, with green blinds, very neat, very snug, very nicely carpeted, and with a few small trees around them, or brick houses in the English style... All around are churches and meeting-houses of every sect... Here are all edifices of a flourishing town in the Old World, except the prisons, hospitals, and theaters.' [24]

B. Development of the Boott Cotton Mills‡‡

1. Origins

Named for Kirk Boott, (Figure 3) the first agent of the Merrimack Manufacturing Company and the reorganized Proprietors of the Locks and Canals, Boott Cotton Mills was chartered on March 27, 1835 "for the purpose of manufacturing cotton and woolen goods in the town of Lowell,"[25] and authorized to "acquire such real estate as may be necessary."[26] In 1835, the Boott purchased a 5.7 acre site bounded by the Merrimack River on the north, Bridge Street at the east, French Street at the south and Kirk Street and the Merrimack wasteway at the west from the Proprietors of the Locks and Canals[27] (Figure 8). Power for the mills was to be provided by the Eastern Canal, constructed in 1835 by Locks and Canals for the anticipated Boott construction (and later used by the Massachusetts Cotton Mills, 1839):

Water flowed down the upper level of the Pawtucket Canal, produced power in upper level mills by dropping thirteen feet through their wheels, discharged into the lower level of the Pawtucket canal, continued down the Pawtucket and the Eastern Canals to the Boott Mills, and dropped a final seventeen feet through their wheels.[28]

Boott Cotton Mills leased nine mill privileges from the Proprietors of the Locks and Canals in 1835, a mill privilege at this particular location being the right to draw 45.5 cubic feet per second from the waterway.

‡‡ Much of this section of the report is drawn from two sources: Lowell National Park and Preservation District Cultural Resources Inventory, Shepley, Bulfinch, Richardson and Abbott; Inventory Forms and Research Report for Boott Cotton Mills (undated); and The Mill as a System, A Report to the National Park Service, Lowell Historic National Park, Draft, October 18, 1983.

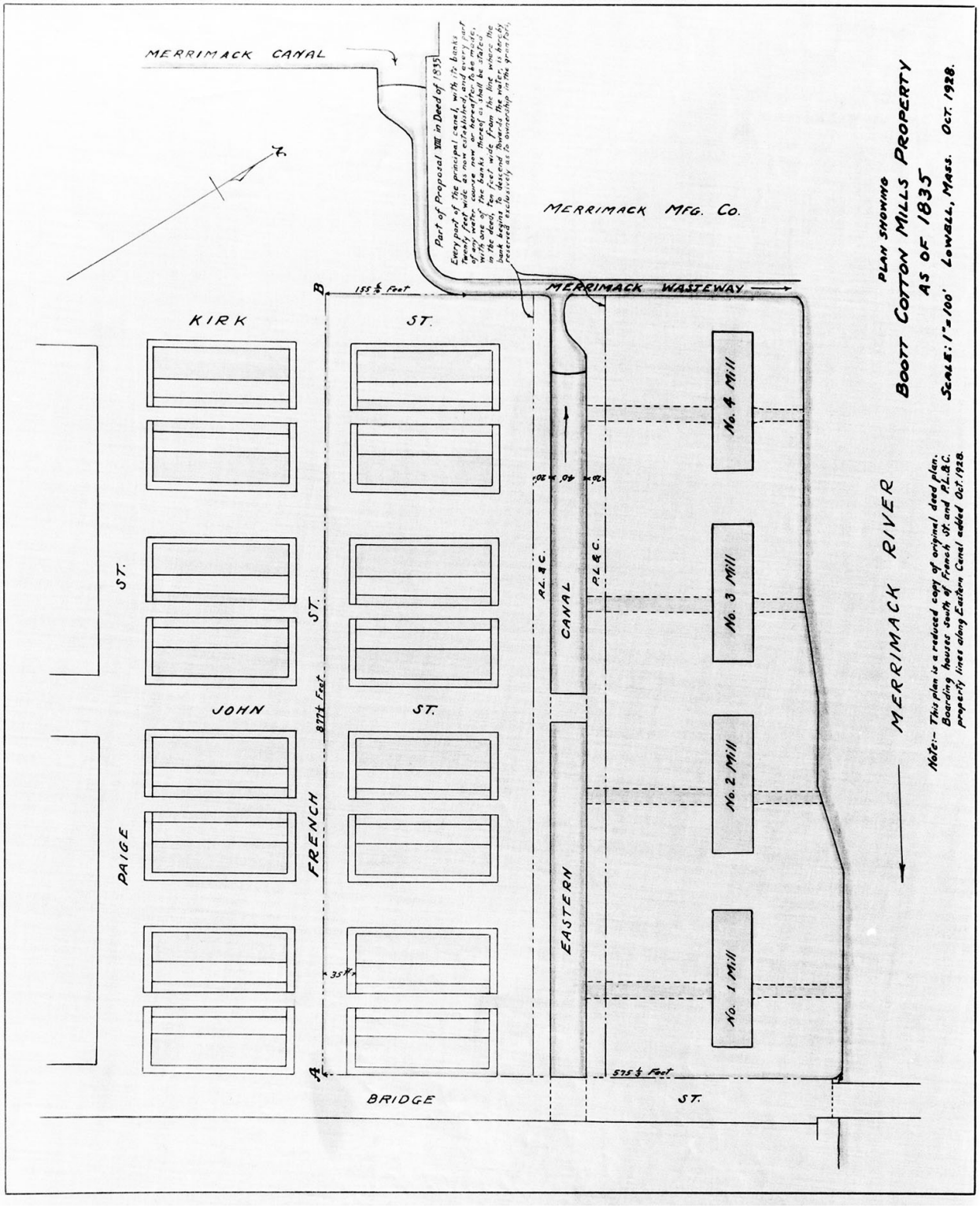


Figure 8. Early Plan of Boott Mill yard, 1835. Shows Mills 1 through 4 with eight rows of company owned boarding houses
Source: LNHP, Museum Collections, Proprietors of Locks and Canals Collection (L&C), Plan Number 153-025

2. Mills One through Four

Construction of Mills #1 and 2 was begun by Locks and Canals (who were also the designers), in June 1836,[29] while Benjamin French was agent at the Boott Cotton Mills. Mills #3 and 4 were completed by 1839.[30] The first four mills were all of approximately the same size, 157' 10" x 45' 6", and were arranged in a parallel row between the Eastern Canal which turned at right angles along Amory Street and bisected the company site, and the Merrimack River. All four mills were four-stories high with gable roofs, measured 19 x 4 bays, and constructed of brick laid in common bond, 7:1 (seven rows of stretchers to one row of headers). A projecting, square gable roofed stair tower of the same height was located in the center of the south facade of each mill, with freestanding gable roofed, two story picker houses situated at either side of the tower.

The four mills were provided water power by four brick barrel-vaulted underground raceways that ran perpendicular to the canal. It is likely that the water turned 17' diameter wood and iron breast wheels that would have been set into the cellars of each mill (Figure 9). By 1848, two 9'-4" Francis center vent turbines had been installed at the Boott, but the breast wheels at Mills 1 through 4 probably remained in operation until 1857 when six 7' -8" Boyden outward flow turbines were installed, replacing all breast wheels. [31] A "View of the Boott Cotton Mills at Lowell, Mass." (Figure 10) appearing in the May 29, 1852 edition of Gleason's Pictorial shows thick smoke belching from tall chimneys, one at each of the end walls of Mills #2 and 3, probably indicating the presence of furnaces to heat the individual mills. [32]

Sometime after 1835 (and if the Gleason view is accurate, after 1852), and before the early 1860s full length dormers were added to the roofs of all four mills, as shown in an unlabeled view of the mills (Figure 11), dated as c.1862 by the presence of a square plan smokestack to the rear of Mill No. 1 and the existence of the connectors between the two pairs of original mills. This view, supplemented by a c. 1865-80 stereoptican "Views of Lowell Mass. and Vicinity" (Photograph 14) shows the four-story tall connectors with the present day square tower and belfry tower replacing the original centered stair towers. The connectors were added c.1863-65 and are 75' long, 94 '-97' deep.[33] The wood frame dormers creating the fifh floors were replaced c.1880 by the existing full story masonry construction. In 1880 a five- story, "L"-shaped, flat roofed brick addition was appended to the west end of Mill No. 4. The south section of the addition measures 52' x 68 ', the rear which returns along part of the north wall of the original No. 4 structure, 90' x 28' - 31'.[34]

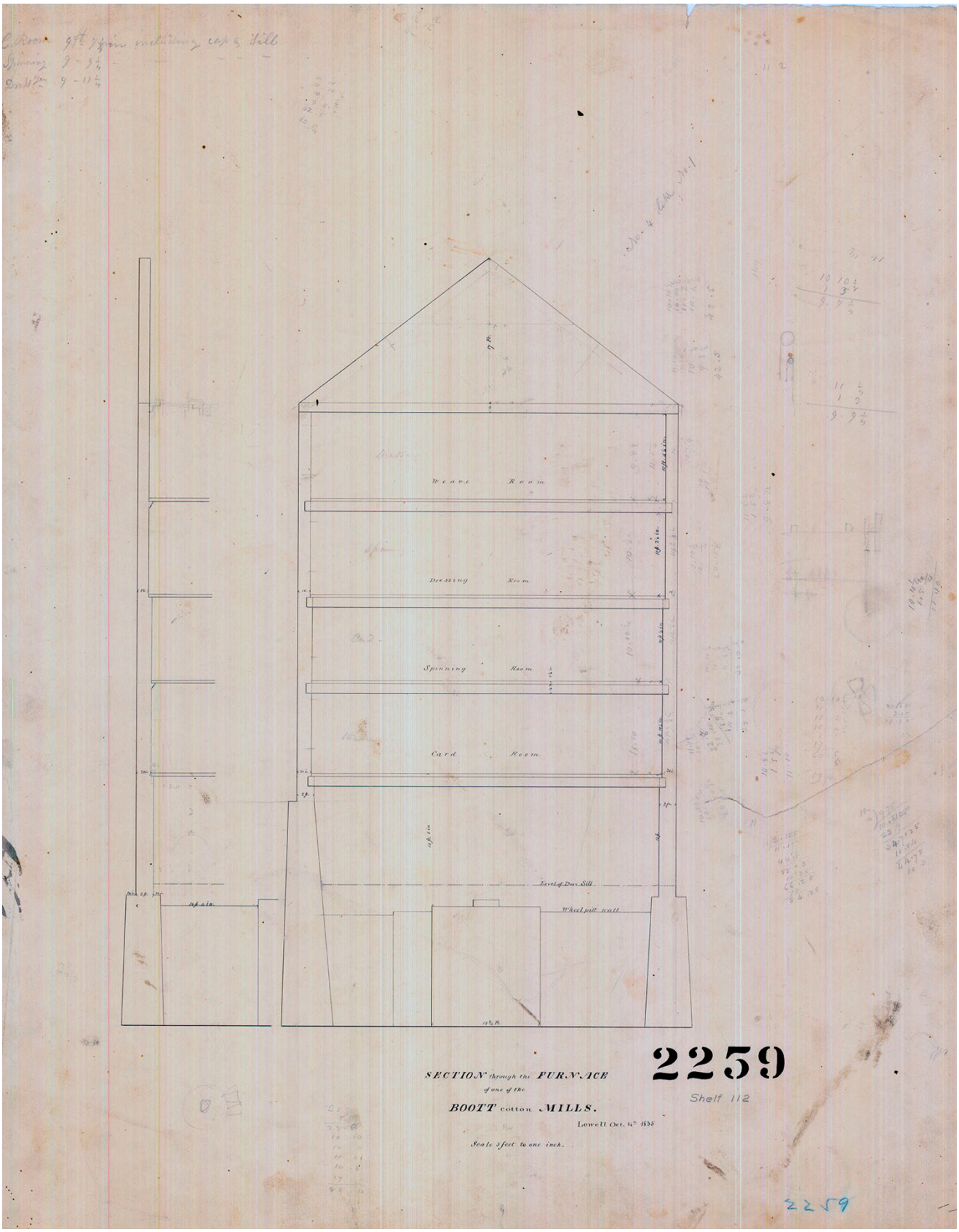


Figure 9. Section Through the Furnace of one of the Boott Cotton Mills, 1835
Source: University of Massachusetts, Center for Lowell History (UML,CLH), Proprietors of Locks and Canals Collection (L&C), Plan Number C112-2259

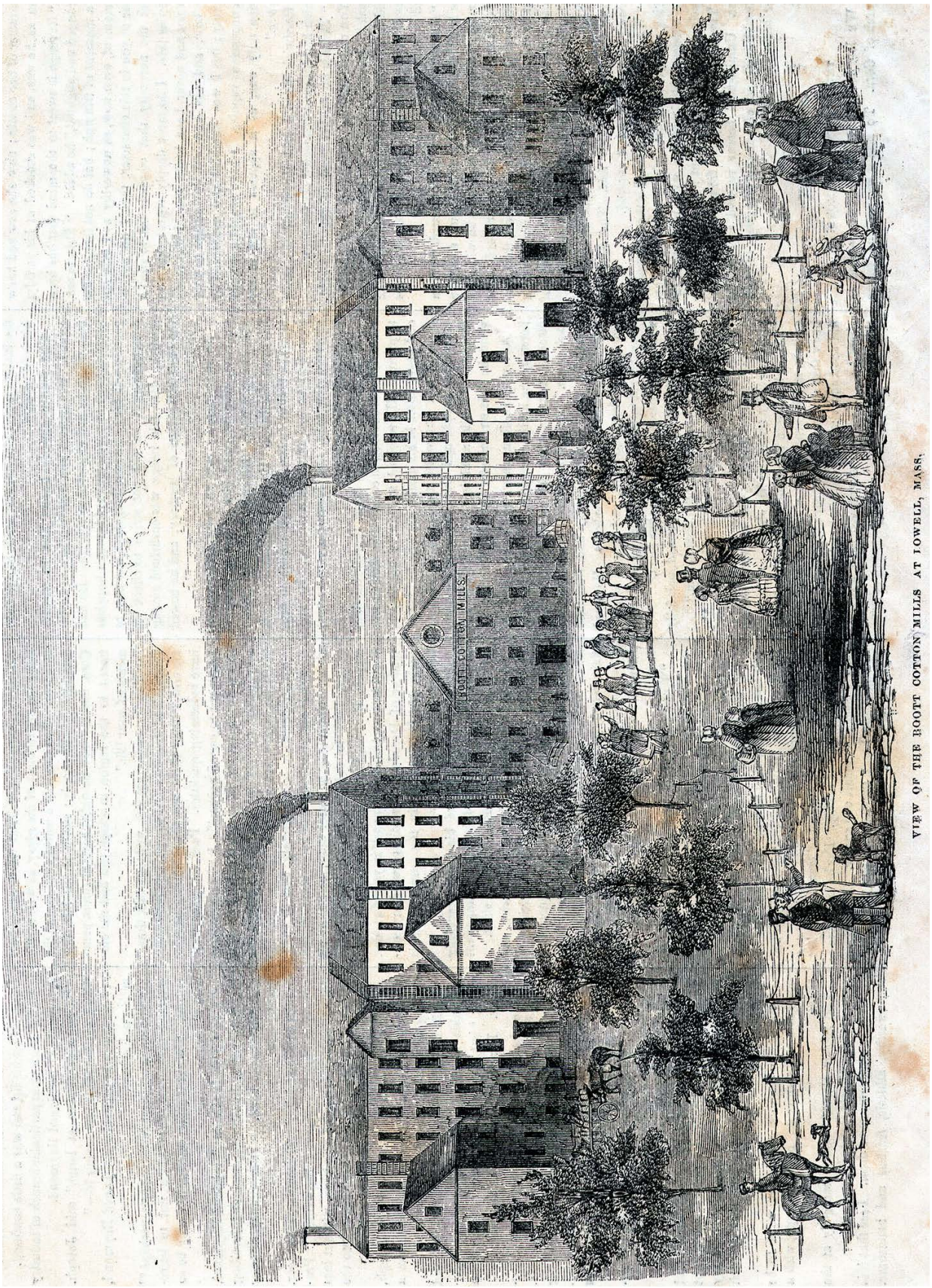


Figure 10. "View of the Boott Cotton Mills at Lowell Mass." from Gleason's Pictorial, dated May 29, 1852
Source: LNHP, Museum Collections, LOWE 4636

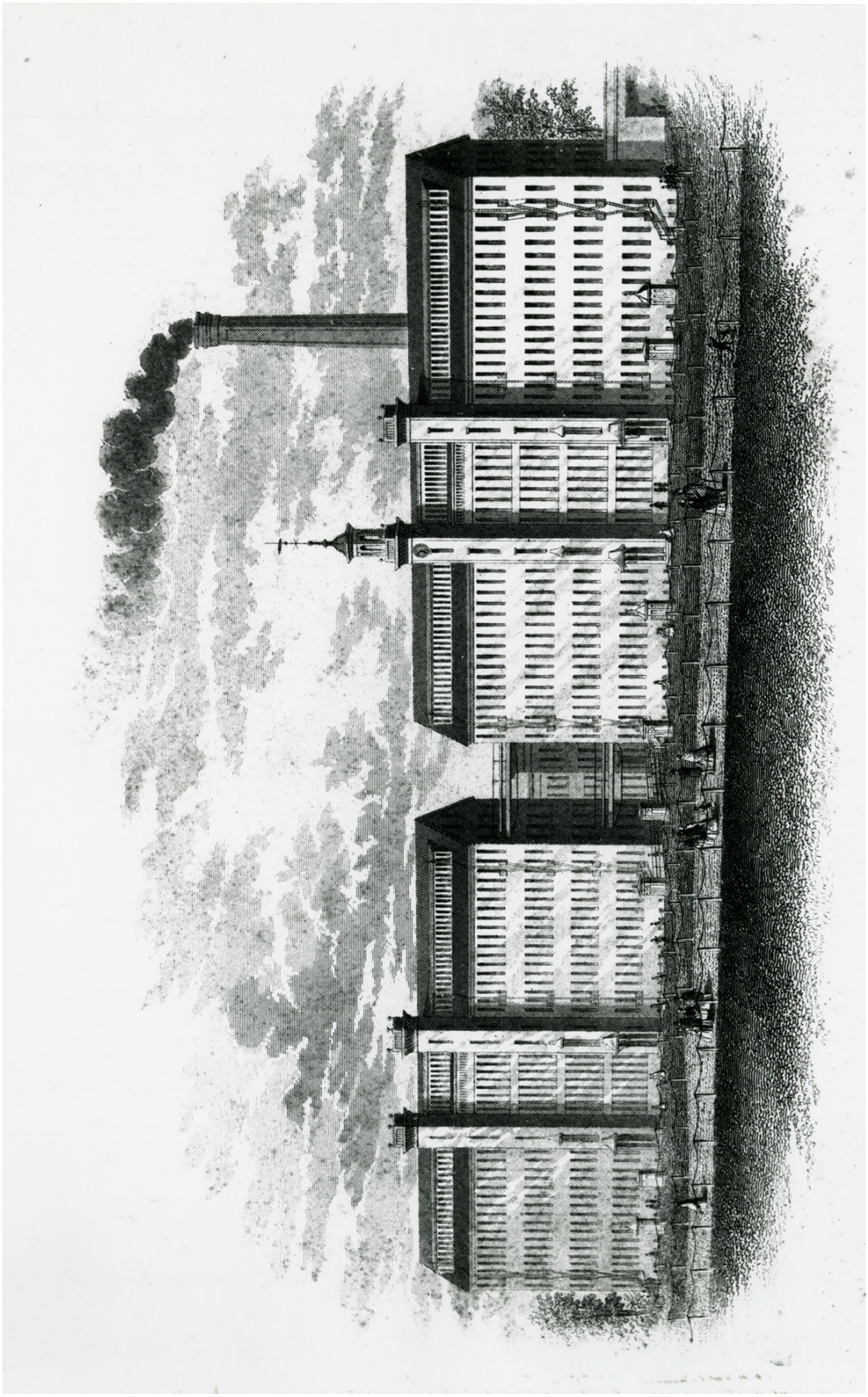


Figure 11. Unlabeled view of Boott Cotton Mills, between 1865 and 1881
Source: UML, CLH, Lowell Historical Society Collections (LHS)

3. The Counting House and Outbuildings of the First Period.

Concurrent with the 1835-39 construction of the four original mill structures, a Counting House (or mill office) and three smaller brick structures of undocumented use were built along the north edge of the canal. Thought by some researchers to have been a cotton storehouse, a repair shop and storage structure, the smaller structures are no longer extant. [35] However, the footprints of two appear in a "Plan of the Massachusetts Cotton Mills" (Figure 12) prepared in 1839.[36] These two structures were demolished prior to the construction of Mill #6. The Counting House remains.

4. Mill Housing

The first unit of the Boott Cotton Mill housing was constructed between 1836-1839. The initial eight rows, each with eight housing units, were situated at the four blocks south of Amory Street and the canal, north of French Street between Bridge Street at the east and Kirk Street at the west. Arranged perpendicular to the canal on the north- south axis, each row was 150±' x 36 ', 18 bays long, three stories tall with dormer lit gable roofs (Figure 13). Twenty four additional units were constructed in the 1850s, all similar in design to the first rows, between French and Paige Streets at George and John Streets.

5. Mill #5

A new weaving mill, Mill No. 5 (the central section of the three parts that make up today's No. 5 mill) was built in 1847- 48. As originally constructed, the brick, gable roof mill was three stories, 500' x 46' 8" and had a Greek Revival four bay wide central projecting pavilion with a large centered bull's eye window in the pedimented gable (Figure 14). The pavilion also had a full width granite tablet with BOOTT COTTON MILLS in raised letters. The existing square towers that now flank the central pavilion, and fourth floor were added prior to 1872. [37]

In c. 1860 a freestanding 150' x 50' picker house was built in the northwest corner of the mill yard.[38] By 1870 it was raised to four-stories to match the height of the west end of Mill No. 5 West, to which it was attached in 1880. The original mill was lengthened by a twenty foot connector at that time. The east part of Mill No. 5 was extended north towards the river in 1882-83 when the riverbank was redefined, with a four-story addition.

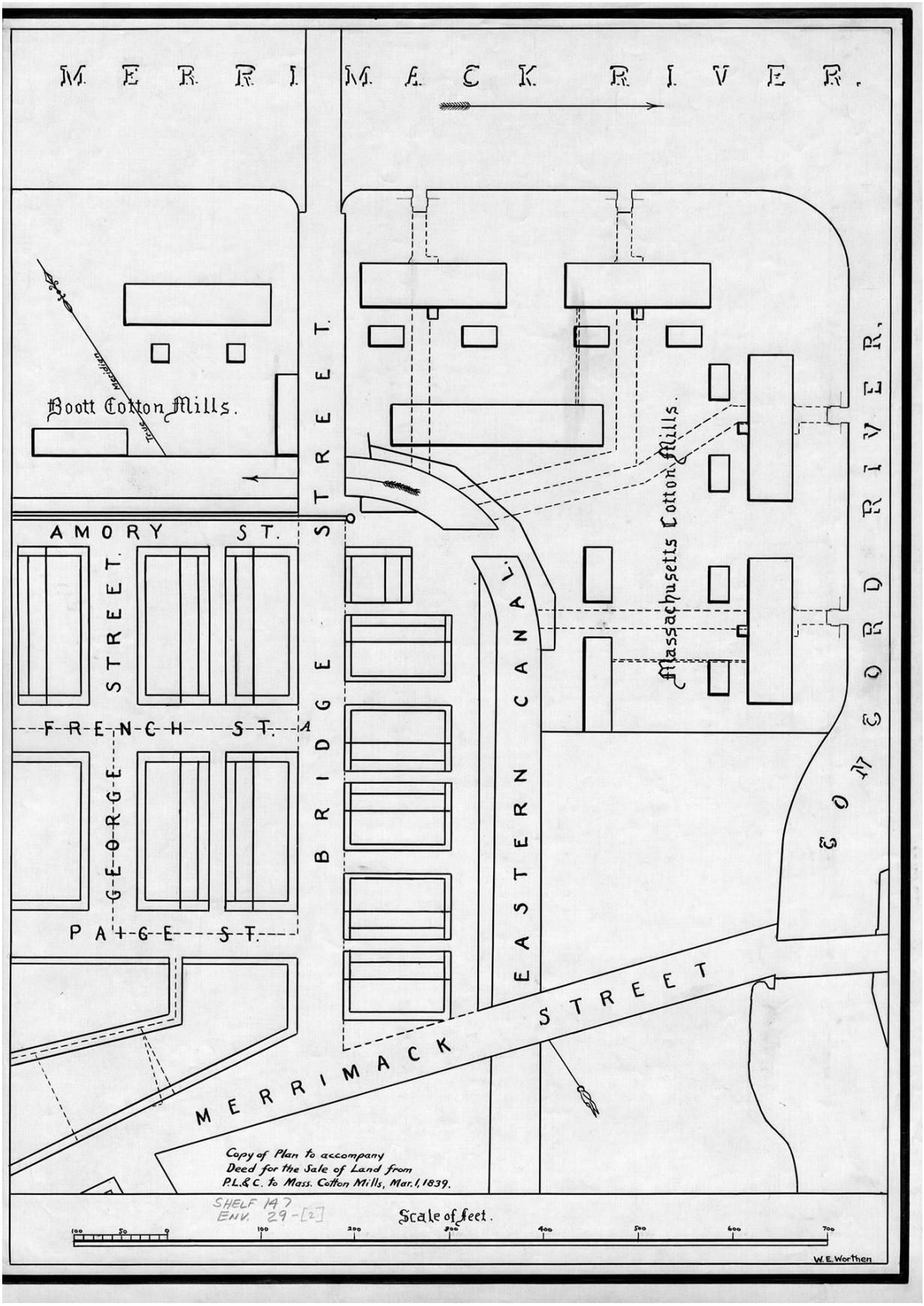


Figure 12. Plan of the Massachusetts Cotton Mills, 1839
Source: LNHP, L&C, Plan Number 147-29[2], folder 2 of 8

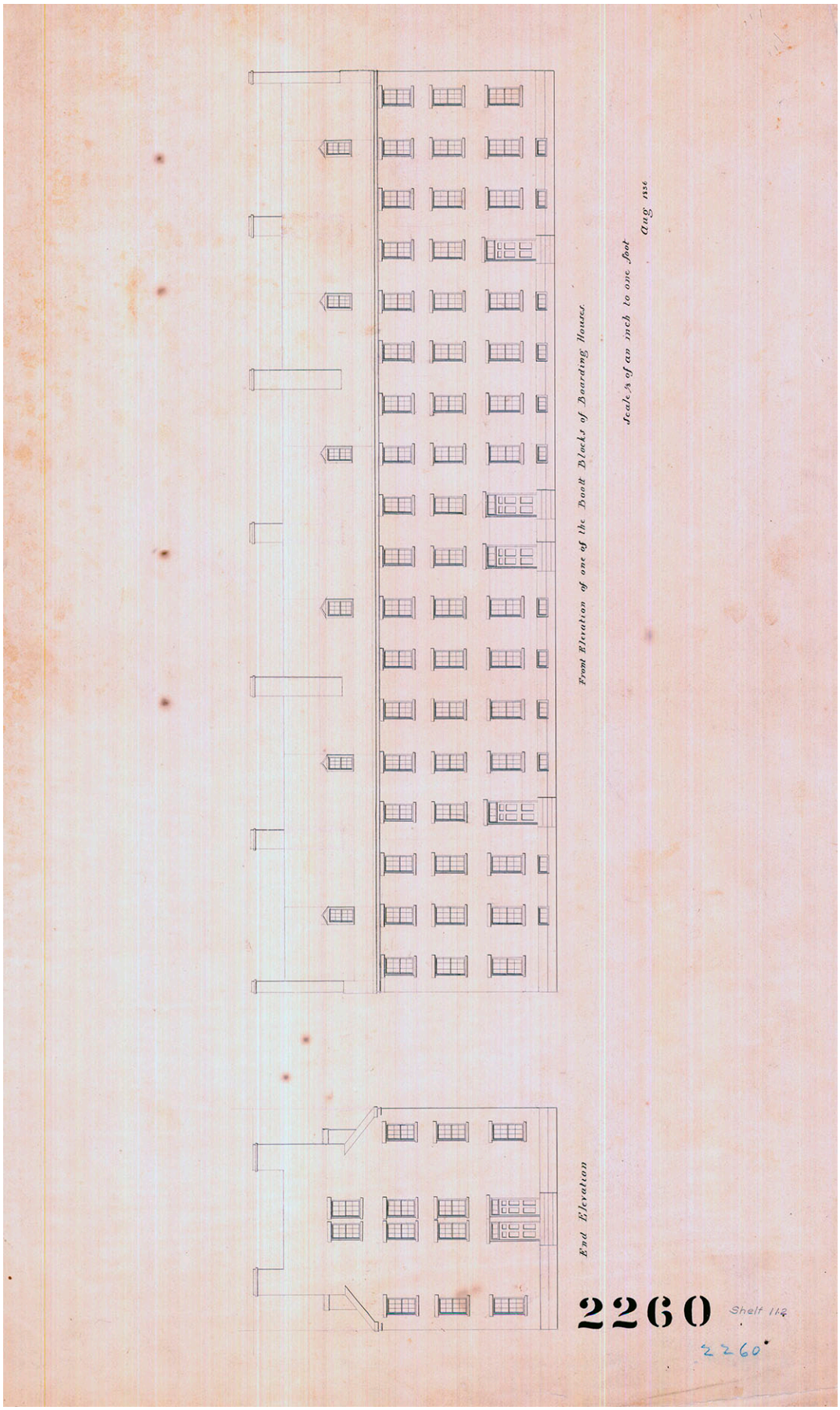


Figure 13. Front and End Elevations of one of the Boott Blocks of Boarding Houses, dated August 1836
Source: LNHP, L&C Plan Number C112-2260

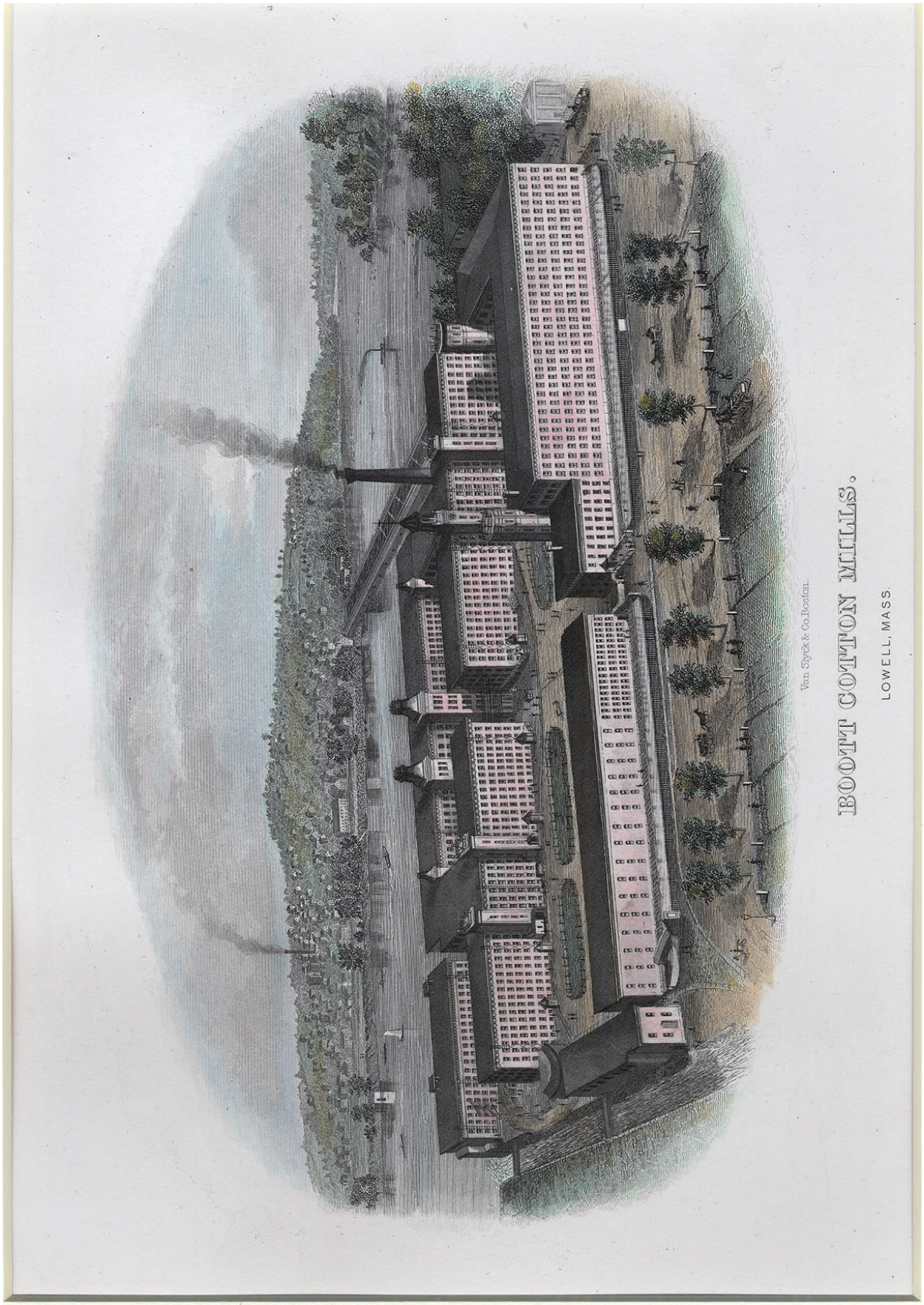


Figure 14. 1878 view of Boott Mills, from Hill's Lowell Illustrated
Source: LNHP, LOWE 15281

The Shepley, Bulfinch, Richardson and Abbott report describes additional structures thought to date from the pre-civil war period:

> *Other buildings dating from this period, but not extant, are a rectangular plan structure (perhaps a cotton storehouse) which stood at the corner of the Eastern Canal and the Merrimack Wasteway (now the site of the No. 9 Mill- Picker House); a small rectangular plan building at the west end of the No. 5 Mill (demolished 1860-61); and an L-plan structure at the yard's northeast corner (on the site of the No.7 Mill), perhaps an early boiler house and fuel storage shed.*[39]

6. Cotton House and Mills #8 and 9

A three-story, 408' x 45' brick Cotton House was constructed in 1865 along the canal, west of the Counting House and across the mill yard from Mills No. 3 and 4. Originally 48 by 5 bays, the Cotton House was serviced at the north elevation by a railroad spur at the second level (removed in the 1880's). A three-story addition, 24 feet deep was put up along the entire north wall of the Cotton House in 1900, at which time it appears that the building was divided at the interior into what is known today as Mills No. 8 and 9. At this time a fourth floor was added and a former picker house (c. 1880), four-stories tall, 125' x 40' in plan was incorporated into the west end of Mill No. 9.

7. Mill #6

Mill No. 6 was constructed in 1871- 72. Designed in two sections, the east part, running along Bridge Street measures 113' 8" x 73' 5" (14 by 8 bays) and the west part, along the canal, 237' 9" x 48' 2" (29 by 6 bays). Both sections of the "L"-plan structure are five-stories.

8. Mill #7

Construction of the #7 mill and the connector mill between Mills #6 and 7 in 1876- 78 completed the development of the Boott Cotton Mills within the original manufacturing site. The connector runs along Bridge Street. 92' x 23' in plan. Originally two-stories tall, it was raised to five stories in 1886[40] to match the height of Mill #6. Like the first floor of Mill No. 6, the first floor of the #7 connector was blind for its entire 11 bays. A door has been subsequently let into the south bay, most likely when the coal pocket entrance at Mill #6 was enlarged in 1927- 28. The door enters the coal pocket.

The #7 mill (like the connector originally two stories high) was raised to four-stories in 1882 when the northern three bays were

added to the first eleven. The addition is the result of the expansion of the riverfront land by 25 feet in that year as mentioned in the discussion of Mill #5.[41] At this same time, a new power house was built at the southwest part of Mill #7, incorporating most of the earlier boiler house, furnace room and coal pocket, and an octagonal plan chimney replaced the earlier square one.

9. Cotton Storehouses

Cotton Storehouse No. 1 was constructed on the site of former Boott Mill housing (units 57-64) at Kirk, Amory, and French Streets between 1879 and 1881. Six- stories high with a flat roof, the brick structure measures 158' x 80' in plan. Cotton Storehouse No. 2, a 151' x 45' structure, is along the east wall of No. 1. Two stories tall, it was built in 1900. The earliest Cotton Storehouse, No. 3, measures 151' x 36' and was originally units 49-56 of Boott Cotton Mill housing, built 1835-39. It was raised to six- stories from the original three between 1889 and 1896.

10. Power Supply

As mentioned above, the four mills constructed 1836- 39 were powered through underground raceways running perpendicular to the canal into the cellar of each of the mills. In 1847-49 Mill No. 5 was powered by two 9' - 6" Francis center-vent turbines, one at either end of the mill, the raceways passing under the No. 2 and No. 3 mills. The four original mills were converted to turbine power in 1857 when six 7'8" Boyden outward flow turbines were installed. A Warren turbine was added in 1860. The two center vent turbine wheels that powered Mill No. 5 were replaced in 1874-78 by two 6' diameter turbines: "It is possible that the two original raceways to the #5 Mill were replaced around this time by two raceways which pass beneath the Counting House between the #2 and #3 Mills and beneath the central section of the #5 Mill."[42]

Prior to this change, a 6 '-8" Swain turbine had been installed at a one-story wheel house located at the southwest corner of Mill #4. Later the turbine was moved to the basement of the 1880 addition to #4. The Boott Penstock which provided additional water drained from the Merrimack Canal was rebuilt in this same period to increase its efficiency.

Steam power was introduced to supplement the water powered turbines in 1873 when a 440 horsepower engine was installed, presumably at the area now occupied by Mill #7. By 1878 a 1000 horsepower Corliss engine was in place.[43] The combined use of steam and water for power continued as late as 1932, at which time

''5/8ths of the power at the Boott Mills was produced by steam, and the remaining 3/8ths by water."[44]

A report prepared in 1902 by Walter E. Parker, (an engineer employed by the Boott then and in subsequent years to assess the physical plant) states that the Boott leased 17.87 mill powers in that year, calculating that at 65 horsepower per mill power, they had 1161 horsepower at their disposal, and "The wheels are large enough [23 feet] to give about 1500HP more, or a total of 2657.85HP if it is deemed wise to use surplus water… there are nine wheels, all in fair condition, and with a fall of 23 feet will give… [a total of] 2657.85HP."[45]

Parker closed with the comment that "in the event of a reconstruction of the Mills itself their location and style make them [the wheels] of doubtful value."

Such value was academic, however, because in 1923 a 1700 horsepower "hydro-electric unit" was put in place at the river side of the No. 5 West Mill. [46] The last improvement to the new water powered electric system occurred in 1947, when three 33" Leffel turbines (482.3 horse power) were inserted into the ground floor of the connector at Mills #1 and 2.[47]

ENDNOTES

1. See John Coolidge, Mill and Mansion, Russell & Russell, New York, N. Y., 1967, p. 19- 21; John W. Reps, The Making of Urban America, Princeton University Press, Princeton, New Jersey, 1965, p. 415; Steve Dunwell, The Run of the Mill, David R. Godine, Boston, 1978, pp. 34-42.

2. Coolidge, Mill and Mansion, p. 20.

3. Patrick M. Malone, Canals and Industry, Lowell Museum, Lowell, p. 2.

4. Arthur L. Eno, ed., Cotton Was King, New Hampshire Publishing Company and Lowell Historical Society, Lowell, p. 73.

5. Dunwell, Run of the Mill, p. 39.

6. Eno, p. 73; Book 6, page 211 of the South District Middlesex North District Registry of Deeds.

7. Ibid., p. 78.

8. Malone, p. 2.

9. Ibid., p. 6

10. Reps, Coolidge, Charles Cowley, Illustrated History of Lowell, r evised edit ion, Boston and Lowell, 1868, et al.

11. Reps, p. 415.

12. Coolidge, p. 23.

13. Eno, p. 99.

14. Dunwell, p. 37.

15. Coolidge, pp. 24- 25.

16. Handbook for the Visiter to Lowell, D. Bixby & Co., Lowell, 1848, p. 18.

17. Coolidge, p. 47.

18. Handbook, p. 11.

19. Ibid., p. 12.

20. Frank B. Hill, Lowell Illustrated, Lowell, 1884, p. 73.

21. G. W. Boynton, Plan of the City of Lowell, 1845.

22. Reps, quoting from Michael Chevalier, Society, Manners and Politics in the United States, Boston, 1839, pp. 128-29.

23. Proposals of the Proprietors of the Locks and Canals on Merrimack River for the sale of mill powers and land at Lowell in the County of Middlesex, Massachusetts, Boston, 1826, pp. 17- 18.

24. Coolidge, p. 101.

25. Chapter 74, Acts of 1835, General Court of the Commonwealth of Massachusetts.

26. Chapter 53, Acts of 1825.

27. Middlesex County Deeds, Southern Registry, Book 349, p. 458.

28. Shepley, Bulfinch, Richar dson and Abbott, (SBRA) Cultural Resources Inventory, Lowell National Historical Park and Preservati on.

29. Lowell Directory, 1836.

30. Ibid., 1838.

31. SBRA, p. 7.

32. Gleason's Pictorial, May 29, 1852, No. 22, Vol II, p. 1.

33. SBRA, p. 12 and Inventory form for Mill No. 1, (Mill No. 1).

34. Ibid., Inventory form for Mill No. 3.

35. Ibid., p. 13.

36. Plan of Massachusetts Cotton Mill, November 1839, Middlesex County Deeds, Southern Registry, Record Book 405, end page.

37. SBRA, Inventory form for Mill No. 5.

38. Ibid.

39. Ibid., p. 10.

40. Ibid., Inventory form for Mill No. 7.

41. Chapter 89, Laws of the Commonwealth of Massachusetts.

42. SBRA, p. 17.

43. "Local Historical & General (Scrapbooks)", University of Lowell Library, Special Collections, v. 1, p. 85. Article clipped from New York Herald, May 1, 1878.

44. SBRA, p. 19.

45. Report on the condition of the Boott Cotton Mills, Lowell, Mass., 1902, Watler E. Parker, p. 14.

46. Locks and Canals Photograph 2016 "Boott Cotton Mills 1700 H.P. Hydro-Electric Unit Outside of Courtyard Power Hous e, 9/12/1923."

47. Locks and Canals Photograph 3225, July 3, 1947, "Guides and Draft Tubes of 33" Lef fel Type 2 Wheels for Boott Mills."

IV. TEXTILE TECHNOLOGY AND PROCESS: COTTON PROCESSES, BALE TO BOLT, AS PRACTICED AT THE LOWELL AND BOOTT COTTON MILLS

The cotton process belies its image as a simple sequence of acts performed by unskilled labor. It includes several discrete steps: buying cotton, then opening, carding, drafting, spinning, twisting and ·winding, weaving, and finishing it. Each step requires skillful supervision and work of varying complexity. Coordination of the many processes is crucial.

In 1845 Henry Miles described the standard procedure of an early Lowell cotton mill in Lowell, As It Was, And As It Is:

> *The cotton purchased by agents at the South, and shipped to Boston, is brought to Lowell by the railroad, and deposited in storehouses ready for use. When wanted, it is wheeled by the yard hands to the carding-room, which is on the first floor of the mill. Here the bales are opened, and the cotton from different bales is well mixed together, in order to give the whole a more uniform appearance. It is then made to pass through a machine called the "whipper", by which it is beaten and thrown into a light state. Passing through another machine called the "conical willow", it comes out still more opened and cleansed, and is ready for the "picker". The picker rooms are two small buildings standing a few feet removed from the mill, and are made fire proof, in order to guard against ignition, which is liable to ensue from the great rapidity of the machinery. The cotton, laid on to a strip of cloth or leather called an "apron", is drawn into the picker when it is thoroughly opened and freed from lumps and dust, and then, passing through the "lapper, " it comes out in sheets, nicely wound round a wooden cylinder. These laps are then taken to the card room, and are applied to the backs of cards. They go through two processes of carding, the first by the "breaker", after which the cotton passes through the " lap- winder" or "doubler", by which it is wound again on the lap, and then through the "finisher", by which the carding process is completed.*
>
> *Thus far only male hands have been employed, as the work is both laborious and disagreeable. The cotton is now taken by female operatives who carry it first through the "drawing frame", by which the fibres are laid in one direction, and are brought together in a rope- like form, then through the "double- speeder", which twists this into a coarse "roving", and then through the "stretcher", which still further draws the roving out. In this stage it is packed in boxes,*

and by means of the "elevator" it is taken up into the spinning room above. In the carding room there are two overseers, three hands employed with the pickers, two grinders to keep the cards in order, five persons employed in stripping the cards--all of the above being males. There are likewise in this room eight females attending the drawing frames, about a dozen more employed upon the speeders, together with three or four spare hands, who are employed by the day, the others being paid by the quantity of work got off. Wages of the drawers will average one dollar sixty- two and a half cents per week; speeder hands about two dollars per week. In this case, and throughout this chapter, when wages are given, the net earnings are meant exclusive of board.

From the carding room we pass up to the spinning room. The spinning frames in Lowell are all "throstles", both warp and filling. A large mill will soon be completed, where mule spinning will be adopted, and this will be the first and only one of the kind in the city. In a Lowell spinning room about sixty girls are employed, including both warp and filling spinners, and four or five spare hands. In the room there are three male overseers, and one man to distribute roving. Spinning is light and easy work compared either with weaving or attending the speeders, but requires more skill than drawing. The pay for this work is graduated accordingly, averaging about one dollar and seventy-five cents per week.

On the speeders, throstles, warpers, and dressers, there are clocks, which mark the quantity of work that is done. The clocks are made to run one week, at the end of which the overseer transfers the account to a board which hangs in the room in the sight of all the operatives. From this board the monthly wages of each operative are ascertained.

The filling is now ready for the weaver; but the warp undergoes yet further preparation in what is called the "dressing room". Here the yarn is warped off from the spools upon section beams. These beams are then transferred to the dresser, who sizes, and brushes, and dries the yarn. The yarn on eight of these beams is then transferred to a loom beam, the ends of the yarn being drawn in through the harness and reed. This is done by hand, and it is the first and only hand process in the manufacture of the fabric.

Warping is regarded as hard work, as it requires constant standing, and reconnecting the threads, which are perpetually running off, or are breaking between the spool and the beam. The pay is made out for so many thousand yards wound on a section beam, and will average two dollars and twenty-five cents per week. These wages are made high solely on account of the hardness of the work, which in other respects is not difficult, and requires no rare skill. For the

same reason the various processes are so arranged, that the warpers will not be required to work as many hours as the other operatives, they being frequently permitted to leave the mill some hours before the rest. Dressing is paid higher than any other process, because it demands peculiar skill and judgment. This also is female work, and the average pay for it is from two dollars and fifty cents, to three dollars and fifty cents per week, while from five to six are occasionally earned by the most skillful hands. In the dressing room are usually three overseers, from six to eight dressers, from six to eight warpers, and from six to eight drawers-in. Drawing-in is light and easy work, the operative sitting all the time by her window. The pay, being piece work, will vary according to dexterity, but will average from two to three dollars per week.

We now come to the weaving room, where the materials before prepared are put together in cloth. There are two weaving rooms to each mill. In each room are two or three overseers, and a boy to distribute the filling. In both rooms there are from one hundred and thirty, to one hundred and forty weavers employed. Paid by the piece, their wages will vary according to diligence and skill, but will average from two dollars, to two dollars and a quarter per week. In the mills which make the finer kinds of cloth, superior skill is required, and wages will average somewhat more. When woven, the fabric is carried to the cloth room. Here are employed one male overseer, and a number of girls, varying from ten to twenty-five, according to the kind of goods made. The cloth is trimmed, measured, folded, and recorded. It is then either baled, or delivered to the print works. Beside the hands above enumerated, each mill has two watchmen on duty day and night, who relieve each other at intervals of six hours each. Each room likewise, has one woman, generally Irish, who does nothing but keep the room clean, by constant washing, scrubbing, and sweeping. [1]

Miles' account lays out the primary processes of the mill and also presents the view of one friendly to but not involved in the operation. No work done for piece rates can accurately be called "easy," and drawing-in, while quiet and clean, was subject to the same time pressure as other jobs. However, this account provides an adequate outline of the basic steps in the process and suggests certain areas of skill and strength. Some aspects of the process had changed by the time of the building of Mill No. 6, particularly in terms of scale, sophistication of machinery, especially in spinning, and the breakdown of jobs according to sex.

The purchase of cotton took place away from the mill, a function of the Treasurer and the Boston office. He chose among several basic American types of fiber for those suitable to the mill's intended production. Prices fluctuated widely and cotton could be bought as futures, as well as in existing bales, so this aspect of the business

played a major role in the mill's profitability. Length of staple, diameter, and the character of the fiber, its relative silkiness and strength, contributed to determining its I price and suitability for a given product.

The cotton as it came from the farms is ginned to remove the seeds, graded according to its quality, and compressed into bales of some 800 lbs. before it was shipped north. When the bales arrived at the factory they were put into storage, by category, and drawn upon as needed for particular production runs. The bales were then opened, to allow the cotton to " relax" and resume its normal condition, and mixed in order to minimize the differences between batches. Mixing took place as cotton from different bales was spread in horizontal layers on the floor, then taken in vertical sections for insertion to the initial processing machines. Since the cotton still contained considerable foreign matter, the purpose of these machines, whether bale breakers, openers, or willows, was to begin to separate the cotton from the dirt and leaves as well as to break apart the clumps of fiber (Photograph l).

Cotton from these first opening, mixing, and cleaning stages moved to the pickers, which continued these operations and began to form the fibers into a continuous sheet of as even a weight per volume as possible. All the machines associated with these steps operated in similar ways. The cotton was fed into them on a moving feed apron of cloth or wooden slats. It then passed through contiguous feed rolls which released the fiber into a series of chambers in which it was acted upon by whirling arms containing increasing numbers of teeth as the material was opened up. The openings in the surrounds of these chambers allowed foreign matter to be blown out by the winds created. In each successive stage, the machines were breaking up smaller clumps of cotton and expelling smaller particles of dirt and, ultimately, dust.

Cotton moved through the first, or breaker, picker and was formed into a sheet or lap as it was delivered (Photographs 2 and 3). Several of these laps were then fed into the intermediate and finisher pickers. This introduced doubling, which would continue through the process and by which the products of one machine were combined with others from that or like machines in order that through the law of averages the thicker places in one product would combine with the thinner places in another, leading to an evener product being delivered at each stage. At the same time, each machine in the series drew out, drafted, or attenuated the materials fed into it more than its predecessors, preventing the product from increasing in size as it moved through the mill. Despite the many doublings which occurred, and they amounted to thousands, the degree of drafting was such that the product of the machines diminished in size steadily as it moved through the mill. For example, if three picker laps were fed into one card, it drafted them by a ratio of

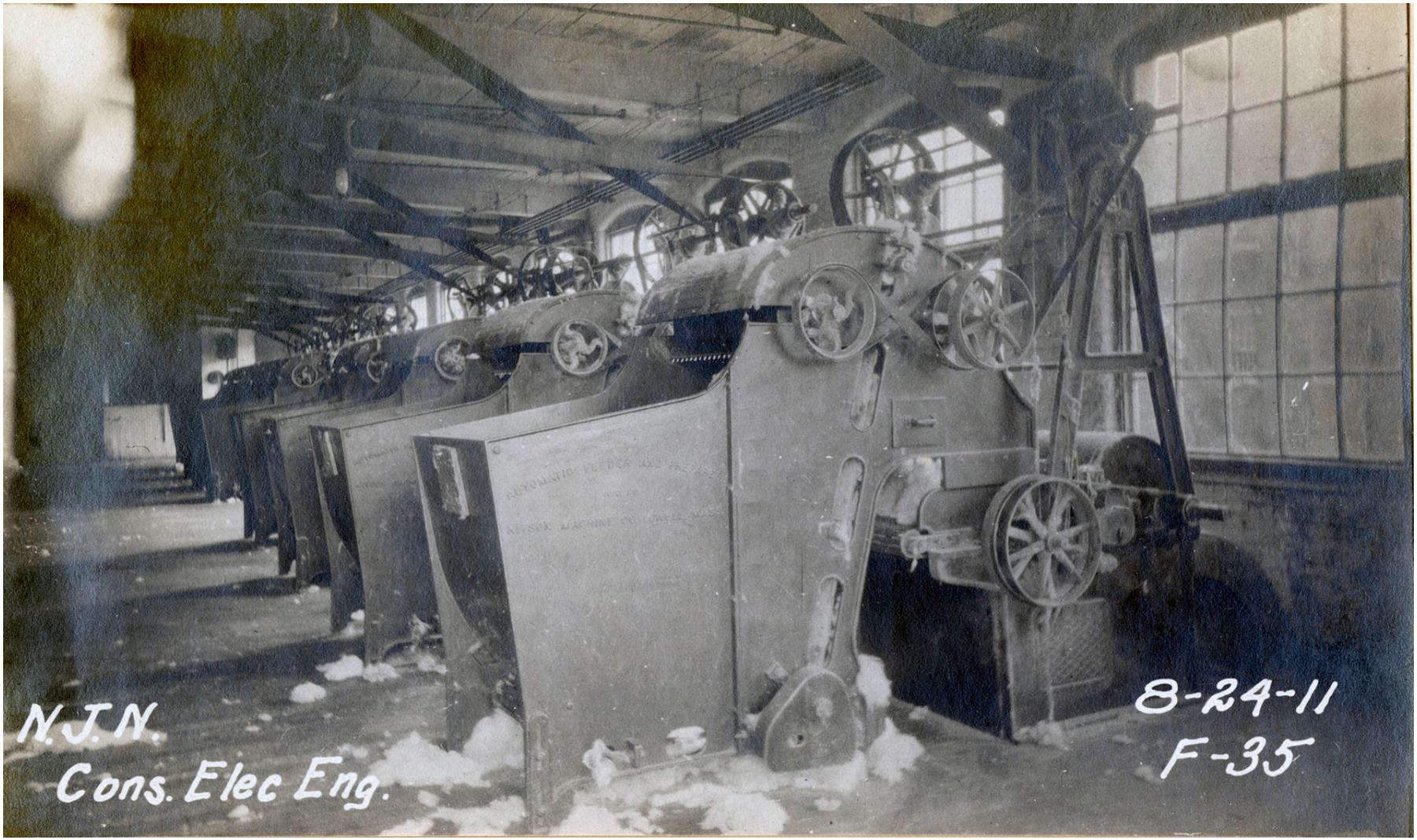


Photo 1. Feeder, preparer, & opener in mill#9-4, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

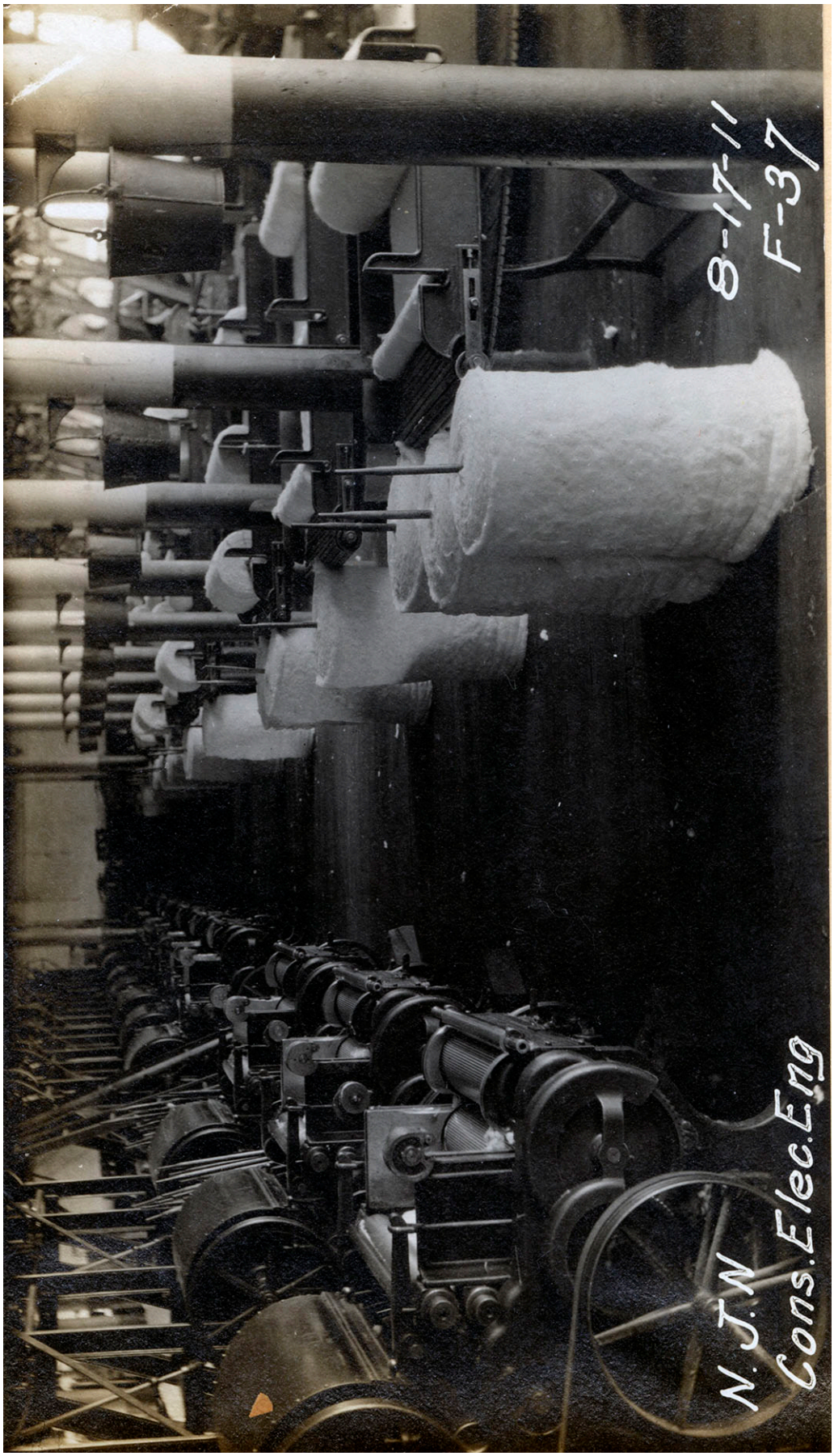


Photo 2. Feeder, preparer, & opener in mill#9-4, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

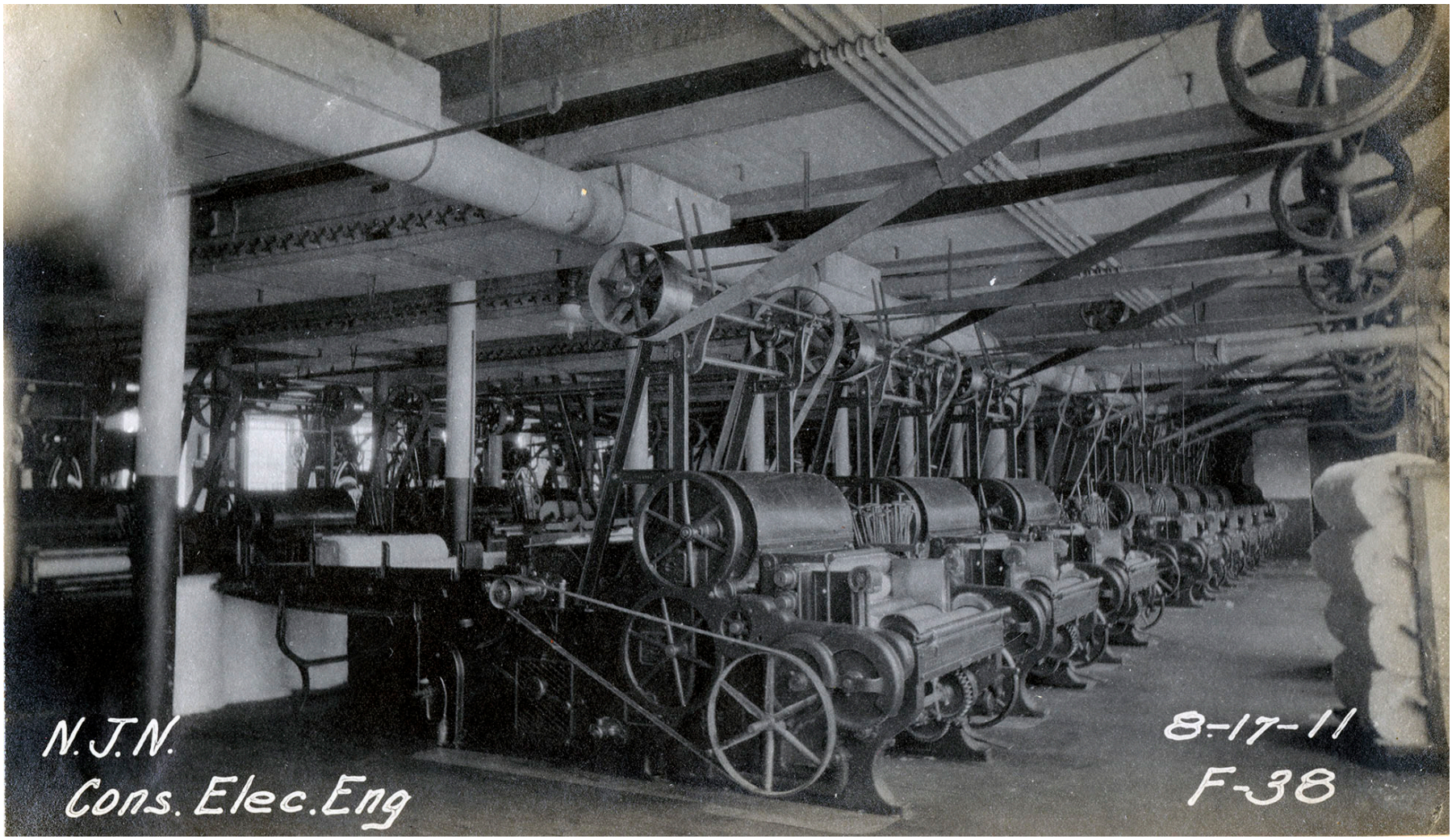


Photo 3. Pickers in mill #9-3, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

at least 3:1 and produced a lap no heavier than one of those fed. Similarly, if 12 ends entered a roving frame together, drafting of more than 12:1 produced a subsequent product doubled (12 times), but also diminished. In addition to the effect of doublings, various feed mechanisms and eveners also strove to detect and compensate for inequalities of materials feeding into machines.

After the cotton moved through the several pickers, it went to the card room, entering the mill proper for the first time (Photograph 4). Cotton manufacturers learned early that the whirling metal parts of the opening apparatus were prone to causing sparks upon hitting various foreign matter, stone or metallic, in the cotton, and that the cotton dispersed in the air within the machines would ignite nearly as easily as the dust of a flour mill and therefore separated the picking from the rest of the mill.

The lap created by the final picker moved to the carding department where the removal of impurities and the separation of clumps of fiber continued and where the parallelization of the cotton began. Instead of whirling arms holding a number of teeth, the machine now employed a revolving cylinder completely covered with a wire-brush-like material known as card clothing. From the feed, the cotton moved onto this cylinder, where it was carried around to encounter flats, or bars parallel to the surface of the cylinder and also covered with card clothing. As the cotton moved between the points of the two arrays of card clothing the fibers were disentangled and laid parallel. After moving through a series of these machines it was drawn off as a sliver, a rope-like amalgam of parallel fibers.

The slivers from several cards, up to 12, were then combined in a through, or railway, and conducted to a railway head which combined the several slivers, automatically adjusting its drafting to compensate if one or more slivers did not arrive, thus evening out the slivers and drafting them through a series of rolls turning at increasing speeds in order to reduce the final product to a size smaller than that of any one of the card's sliver. The drafting performed by these series of paired rollers turning at increasing speeds also helped lay the fibers parallel.

The sliver from the railway head moved to a series of drawing frames which repeated the action of the railway head, combining and drafting a number of slivers (Photograph 5). The number of these frames related to the fineness of the mill's production. They offered the last major opportunity to even out the product of previous machines.

Once the cotton left the drawing frames, it was clean, parallel, and even, but the sliver was much too large to be drawn and spun into yarn. At this point the cotton moved through a series of speeders

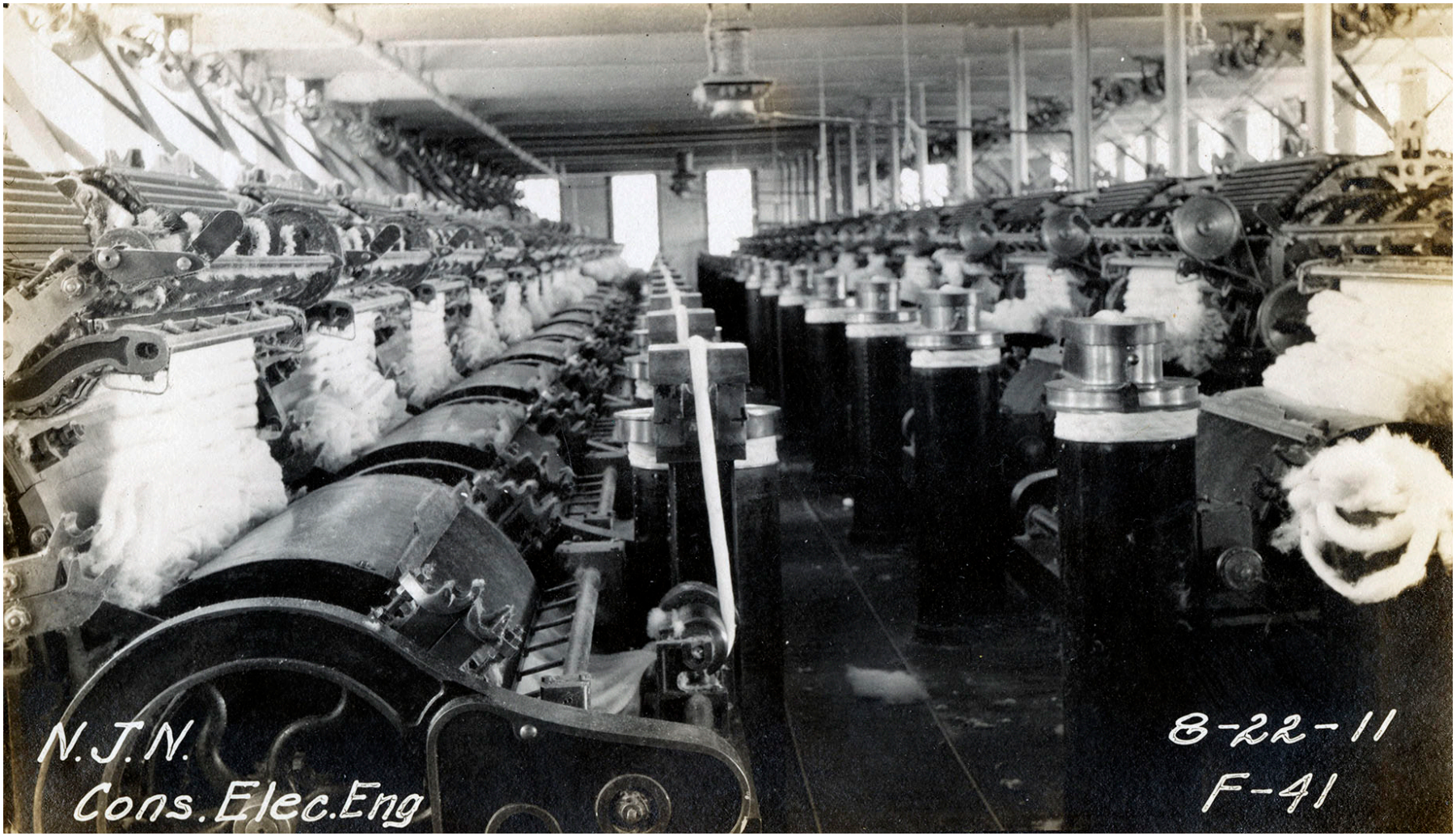


Photo 4. Cards in mill #5-2 west delivering sliver to can coilers, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

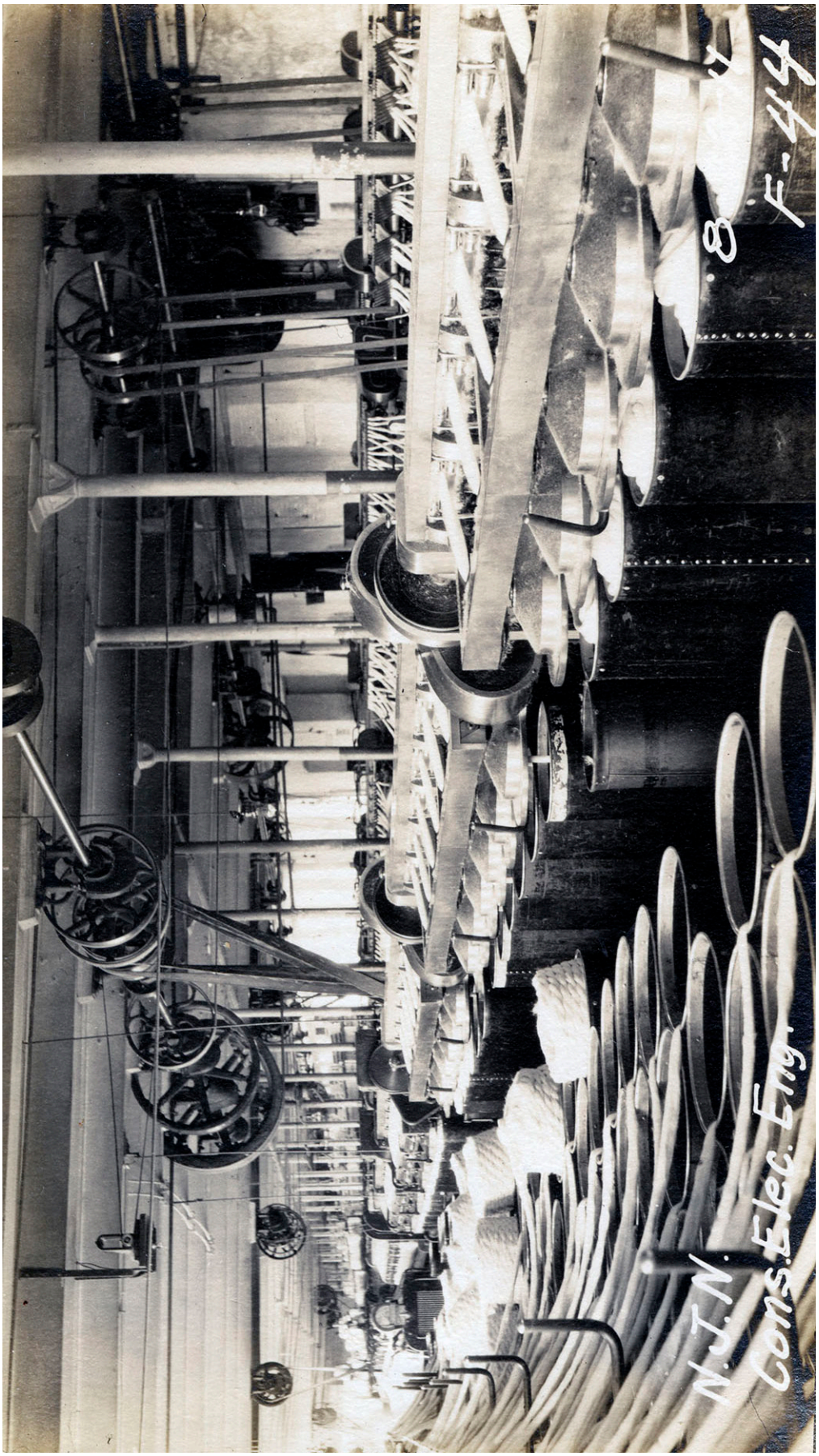


Photo 5. Slivers entering & leaving drawing frames in mill #5-2 West, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

or, later, fly frames where renewed doublings produced improved evenness and substantial drafting reduced the material into roving, a smaller but still essentially untwisted form. Terminology in this area was not precise, but speeders tended to be designated coarse, intermediate, and fine, while the (chronologically) succeeding fly frames were slubbers, intermediates, and roving frames (Photographs 6 and 7). Each of these machines received slivers or rovings of cotton, drafted them between rolls to reduce the size and increase evenness, twisted the product slightly and wound it onto a bobbin. A difference in speed between the delivery of the roving and the bobbin on which it was wound produced a twisting effect which helped hold together the steadily diminishing product. A bobbin and flyer arrangement, similar to that sketched by Leonardo da Vinci, but increased in speed and simplicity of operation, accomplished this twisting and winding process. The accumulation of the roving on the bobbin had to be precisely regulated in order that the package formed would readily unwind as it was drawn into the next stage of manufacture.

The fine roving produced by these machines, the product of thousands of doublings and sufficient drafting to have reduced the cotton to a point where the next step could provide sufficient draft and twist to result in yarn, moved to the spinning rooms where it was spun on either ring frames (Photograph 8) or self-acting mules (Photograph 9). These machines continued the drafting process but for the first time introduced substantial amounts of twist.

The ring spinning frame took roving placed on bobbins in its creel and attenuated it through a series of rollers before allowing it to pass through a traveler, or steel clip, which spun around a ring within which a bobbin accumulated the yarn produced. Because the bobbin and the traveler revolved at different speeds, the roving received a predetermined amount of twist. The bobbins revolved on spindles, the construction of which played a major role in the technological advances of the period. On ring frames, the actions described occurred continuously: drafting at the top, spinning at the ring, and accumulation on the bobbin.

The same results could also be accomplished on a mule, a spinning machine which also drafted, twisted, and built a package, but in an entirely different manner. The mule required more skilled labor (and was therefore avoided in Lowell's early years) but produced better yarn from a given stock and used less power. As in the ring frame, the roving was creeled at the top of the machine and passed through drafting rollers. However, instead of the continuous process of the spinning frame, the mule employed a carriage, holding many whirling spindles, which ran away from the creel as the drafted roving was delivered. As the carriage moved away, the roving slipped off the tops of the inclined spindles rather than accumulating and was thus twisted, or spun. Once the drafting

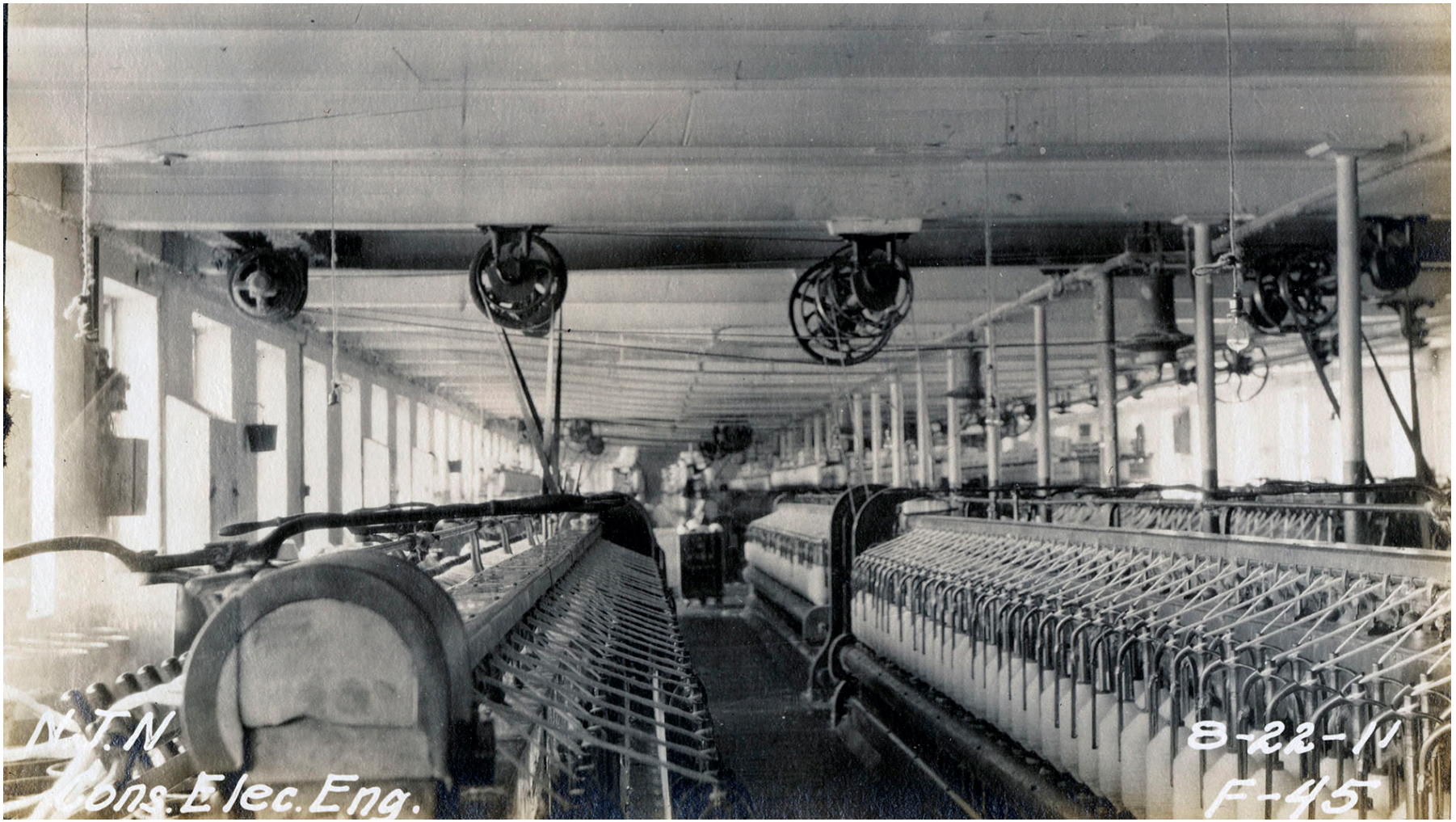


Photo 6. Slubbing frames in mill #5-2 West, 1911.
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

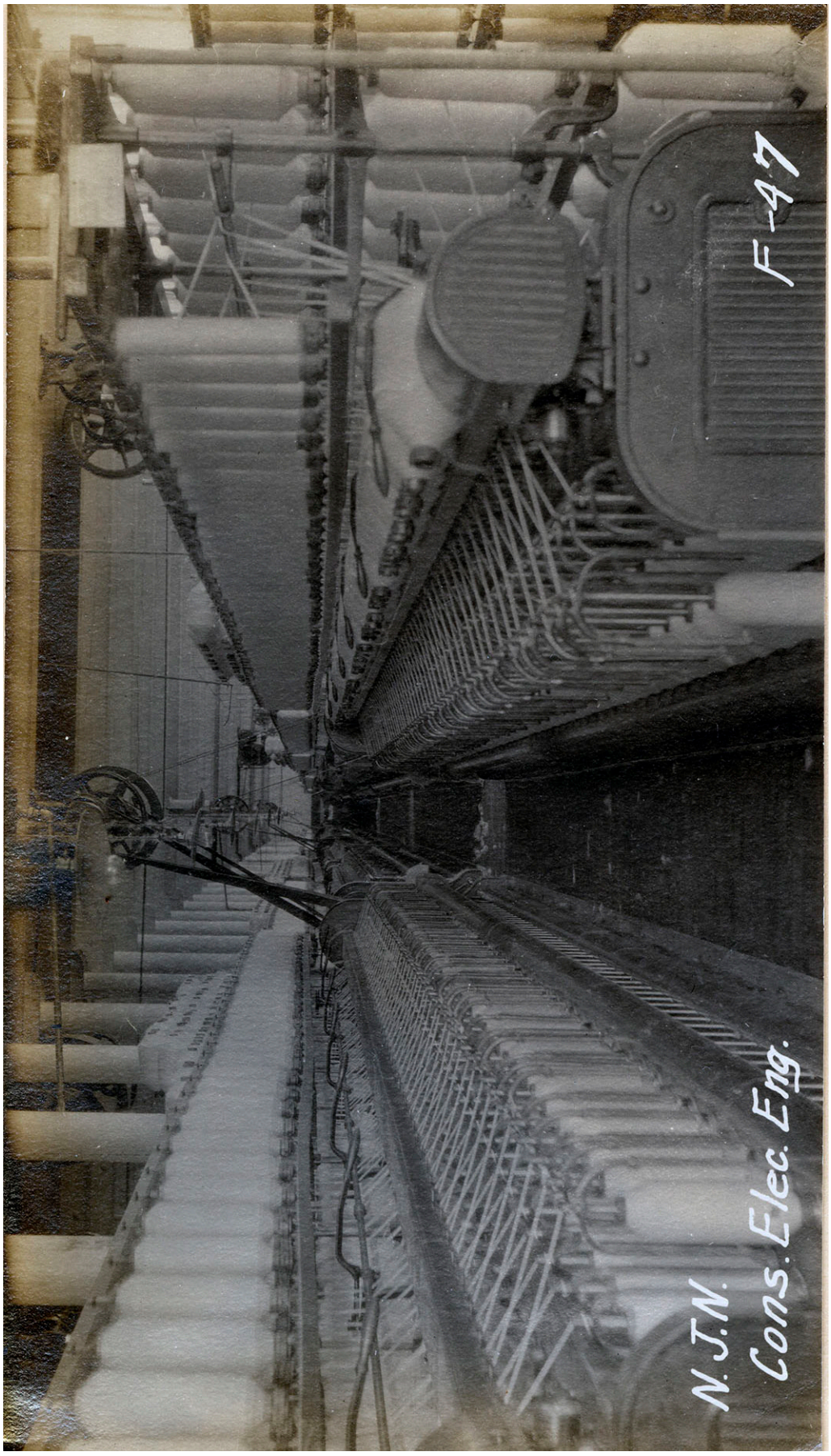


Photo 7. Roving frames in mill #8-2, 1911.
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

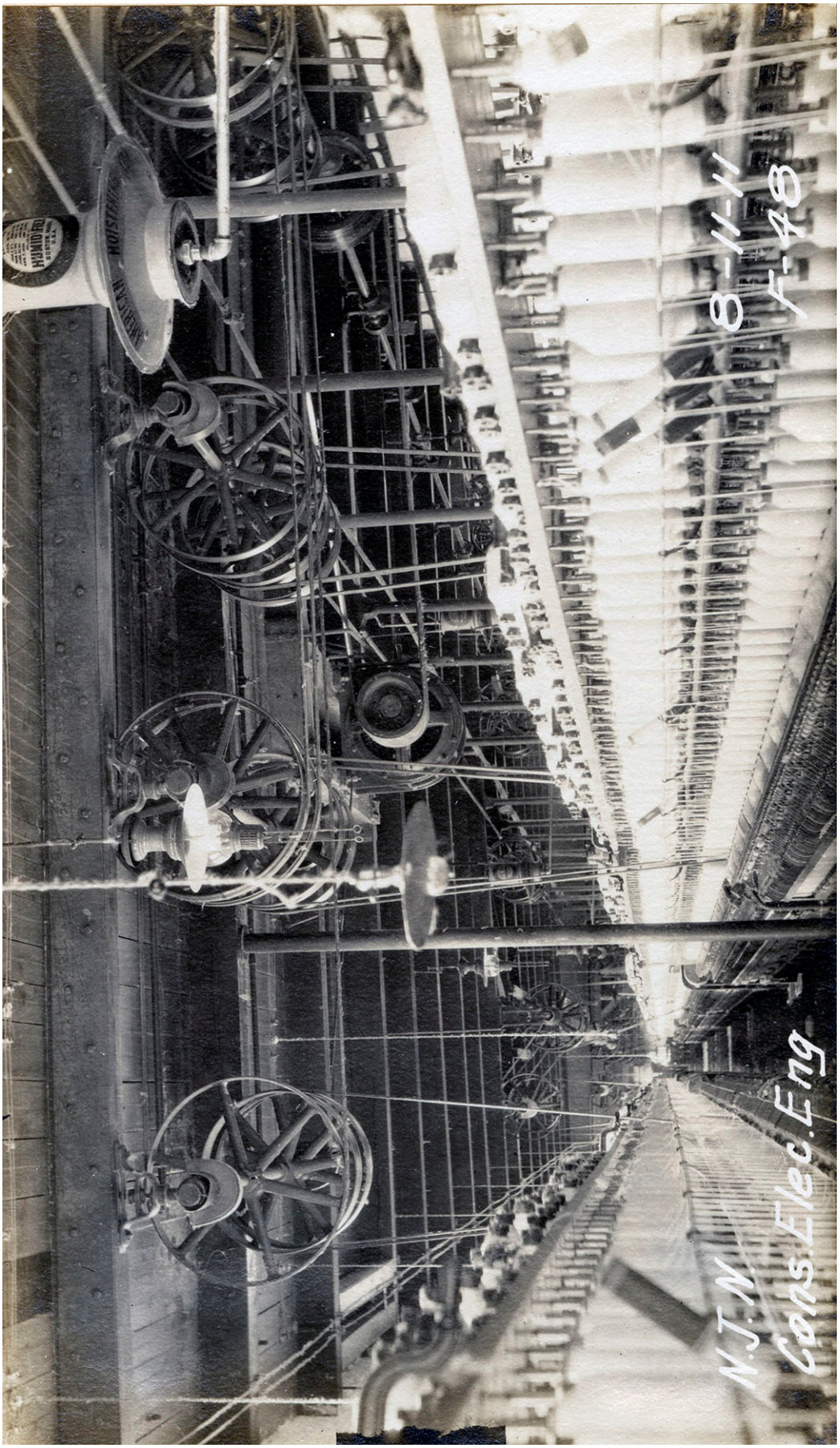


Photo 8. Ring spinning in mill #5-4 West, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery



Photo 9. Mule spinning in mill #4-4, 1911.
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

and spinning cycle was completed, the delivery stopped and the spinning of the spindles continued, putting the desired amount of twist into the yarn, after which another shift in the machine's drive halted the spinning and initiated the winding- on motion which applied the yarn just made to the bobbin as the carriage ran back to the head of the machine to resume the operation. Because the yarn made on the mule had a softer, loftier construction manufacturers continued to use it for the weft, or filling, yarn after adopting ring frames to produce the hard twisted warp yarns.

Once the yarn was produced, it moved to package-changing machines to prepare it for ensuing operations. Warp yarns were wound onto large spools from which they were drawn through a dressing operation which coated them with starch to stiffen and protect them from the harshnesses of the weaving process. After dressing, they were wound onto warp beams, several thousand at a time, perhaps several hundred yards long, before placement at the back of a loom. Weft yarns were twisted together, or plied, on a machine much like a spinning frame, but with no drafting, to produce evener and heavier filling for the cloth.

All the processes described thus far combined to produce yarn. For some mills, that ended the operation. For a cloth mill such as the Boott, all that represented preparation for weaving, an interlacing of these yarns to produce fabric (Photograph 10). The power loom which accomplishes this task utilized five basic motions both simultaneous and intermittent. In part because of the timing involved and also on account of the fact that these were not all rotary motions, as in spinning, the invention of the power loom followed that of powered spinning.

The threads, or ends, were interlaced at a 90 degree angle. The many ends wound on the warp beam at the back of the loom were brought forward through individual heddles, groups of which are held in the harnesses, then through a comb-like device, the reed, held in the beater, before being wound onto the take- up beam parallel to the warp beam but in the front of the loom. A let- off motion allowed the yarn to unwind from the back as a take- up motion drew it to the front. A harness, pattern, or shedding motion raised and lowered different harnesses, forming an opening, or shed, between the warp threads through which the picking motion sent the weft, or filling yarn, wound on a bobbin in a shuttle. The weft yarn went back and forth through the new shed formed for each pick, or passage, and was thus interlaced with the warp. After each pick the beater moved forward and the reed beat the weft against the edge, or fell, of the cloth. In addition to these five basic motions, there were several stop- motions often, and over time increasingly, used: the protector motion stopped the loom if the shuttle failed to reach a shuttle box after each pick, thus protecting against a smash, which would be produced if the shuttle remained in the shed when

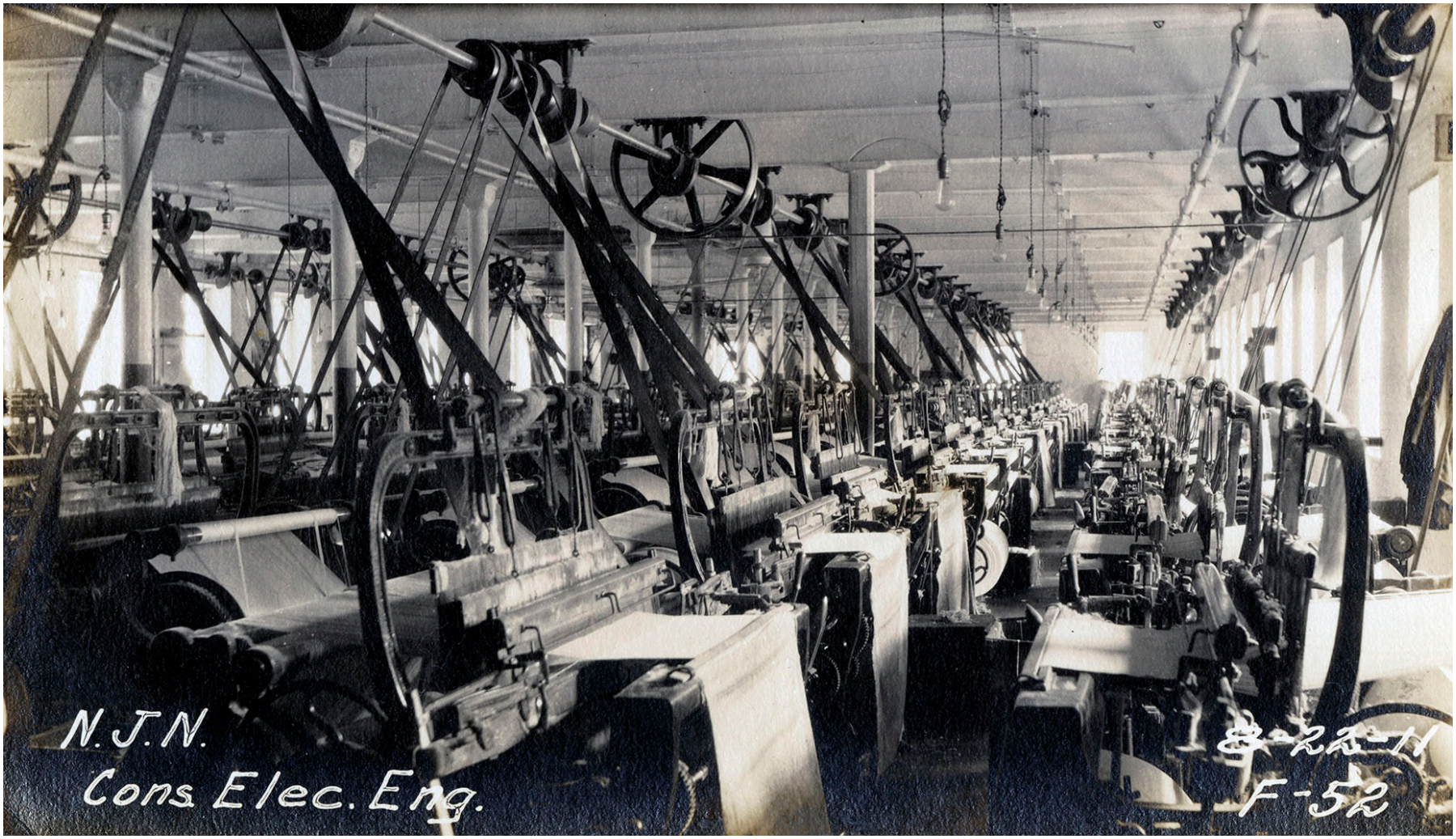


Photo 10. Duck looms (not-automatic) in mill #3-2, 1911.
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

the beater came forward. Warp and weft stop motions halted the loom for broken threads. The automatic bobbin- changing motion, introduced to the Boott in 1901, will be discussed below.

Once produced, the cloth may still need finishing. In the bleaching department, the boiling-out process removes dirt and impurities, while the bleaching process whitens the material, removing natural color from the cotton. When producing corduroy, the pile is cut as part of the finishing process. After finishing, the cloth is folded, baled, and shipped.

This summary of operations provides an outline for the processes to be discussed in terms of the operations of Boott Mill #6. All aspects of the process have received numerous book-length treatments, producing a large body of literature for those who wish greater depth of information on any aspect. Throughout the course of the Historic Structures Report each part of the process from carding through weaving will be elaborated.

For further data of a general nature, one can consult The American Cotton Handbook, first published, by a company of that name, in New York, in 1941, and written by G. R. Merrill (of Lowell Textile Institute), A. R. Macormac, and H. R. Mauersberger. Unfamiliar terms are defined in many textile dictionaries, for example, Callaway Textile Dictionary by W. L. Carmichael; George E. Linton, and Isaac Price published by Callaway Mills, La Grange, Georgia.

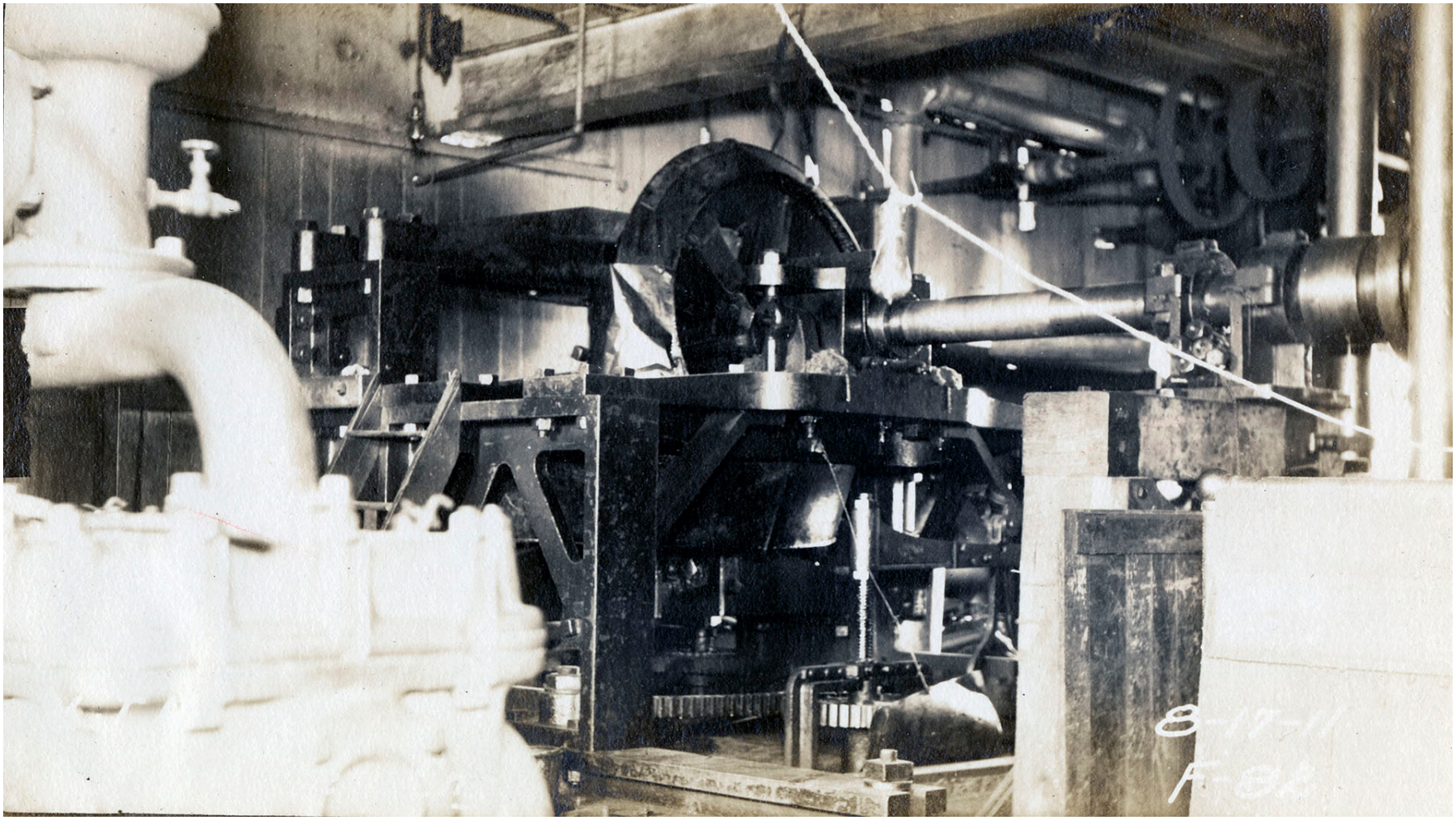


Photo 11. Bevel gear and main shaft carrying power from turbine #2, below, 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

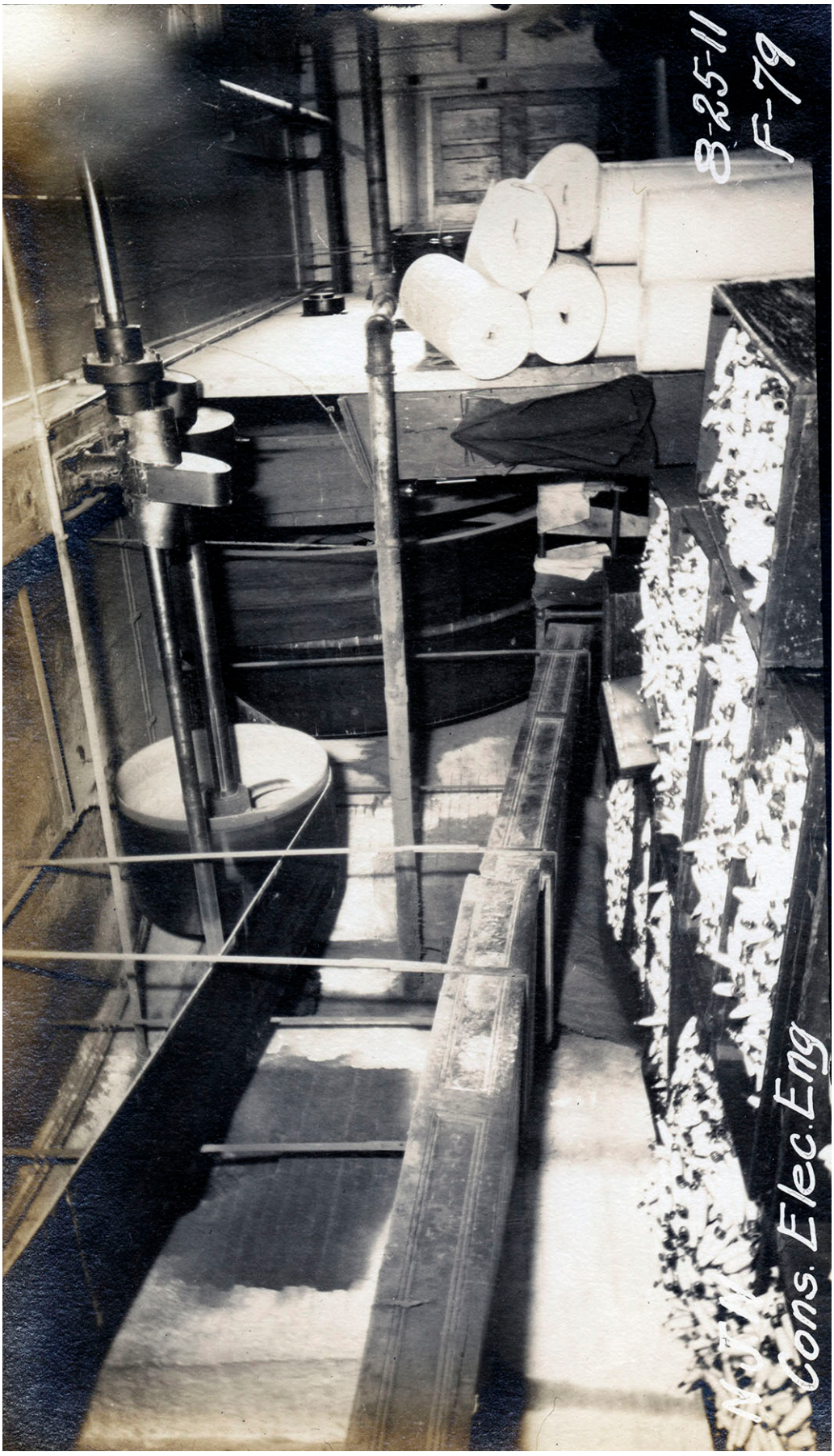


Photo 12. Main belt drive delivering power to Mill #3, 1911.
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

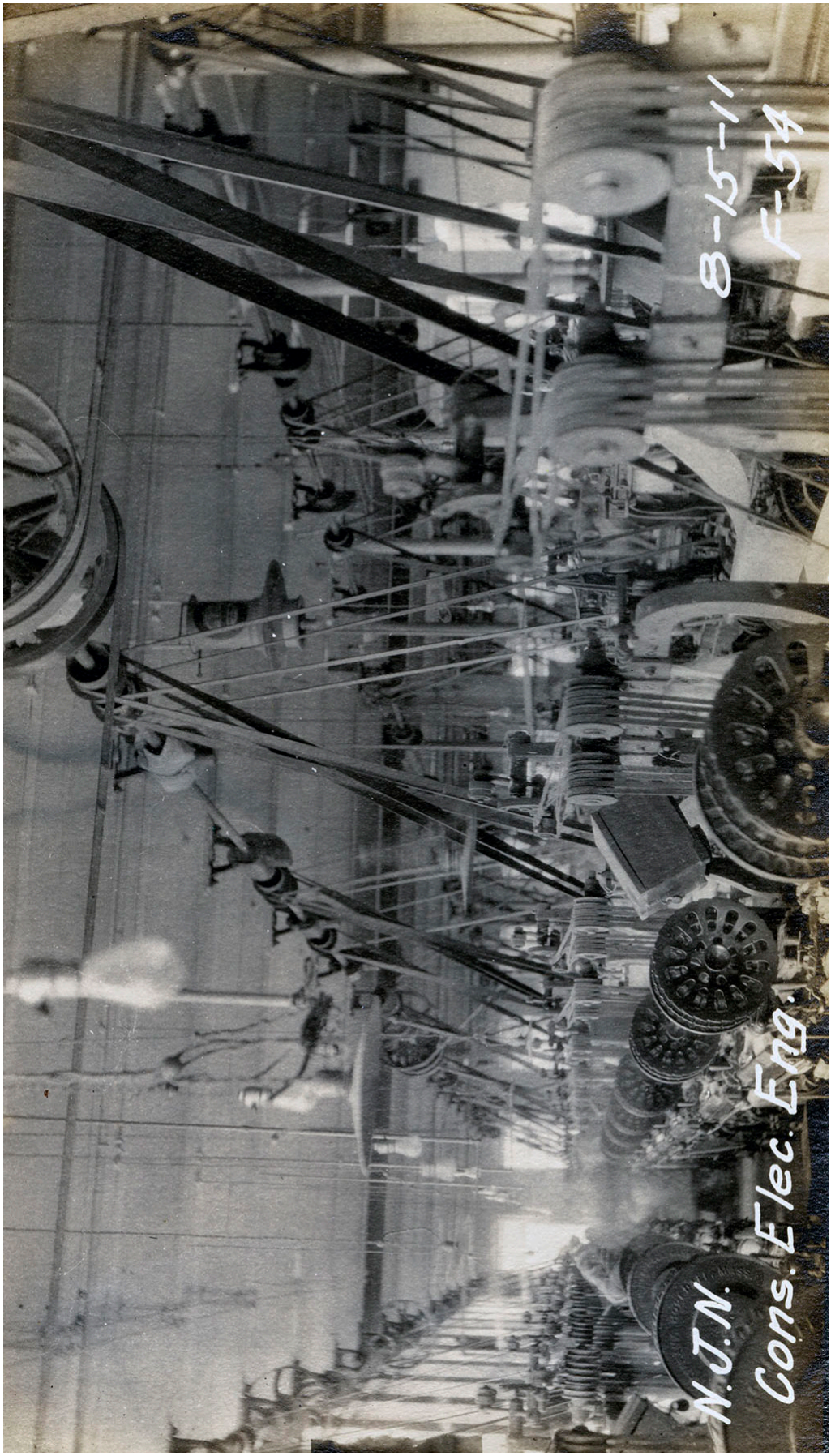


Photo 13. Draper automatic looms in mill #7-3. 1911
Source: UML, CLH, LHS, Lowell Museum (LM) Flather Collection, Box 30, Photos 1-13, interior of Boott Mills, Power Transmission Machinery

ENDNOTE

1. Henry A. Miles, Lowell, As It Is, and As It Was (Lowell: Powers and Bagley and N. L. Dayton, 1845), pp. 76- 84.

V. HISTORY AND EVOLUTION OF THE BOOTT MILLS COUNTING HOUSE, MILL #6, FACADES OF MILLS #L AND #2, AND THE COURTYARD: PHYSICAL ORIGINS TO 1870

A. The Counting House

The Counting House or office of the Boott Cotton Mills was constructed between 1836- 1839, concurrently with the first four mill structures, and most likely in 1836 so that it would be operative when Mills No. 1 and 2 went into production that June.[1] Unfortunately, other than the standing building and partial views made during the late 19th century, little documentary evidence has been located to trace the original design and early changes made to this structure.[2]

Rectangular in plan, 100' x 30' the Counting House as built had a gable roof with a simple boxed wood cornice and flat rakes at the end walls. It was situated along the north edge of the Eastern Canal, at the east side of the John Street bridge that served the courtyard. Two stories in height, it was constructed of common molded red brick laid in lime mortar in American bond, 7:1. The granite walls of the Eastern Canal formed the foundation of the south elevation, while the remaining walls rested on grade. (Rough cut granite and brick foundation walls at these locations are visible in the interior. Mill #6, built in 1871-72 abutted the Counting House at its east gable end wall, with the west tower of the mill partially obscuring the first two bays of the north facade of the office.)

The earliest known view (Photograph 14) of the Counting House was made between 1871 (the start of construction on Mill #6) and 1882 (when the early square plan smokestack was replaced with an octagonal one).[3] This stereoptican photo (confirmed by on site architectural analysis) may be considered as an accurate representation of the original appearance of the south facade and roof of the Counting House. The south wall is shown as being eleven bays long, with ten windows at both floors and an entrance in the extreme west bay, the opening set between the two floors so that it would communicate with the foot bridge along the east side of the canal bridge. The view shows that all windows had 6/6 sash and stone sills and lintels, both features remaining today (much of the sash has been replaced over time, but enough of it remains at both the north and south elevations to substantiate its use). The entrance had a flared metal hood similar in design to that installed at the second floor of the 1863- 65 towers at Mills No. 1 and 2, and may



Photo 14. Stereopticon view of Boott Mill Number 6 and the Counting House, c.1875
Source: UML, CLH, B6456 CN 05

have been installed at that time. Based on comparative analysis, it is more likely that the entrance consisted of a paneled door set into a simple rectangular opening with granite sill and lintel, as shown in a drawing made in 1936 (Figure 25) the opening was altered later.[4] All other original openings had hammered granite lug sills and lintels, a material and technique used at the contemporary mill structures (as well as later). The stereoptican view also showed that the second floor windows at the south wall were provided with louvered shutters, an unlikely feature at a c.1836 vernacular mill office structure.

The gable roof was covered with slate, conforming to the requirements of Locks and Canals and the Mutual Fire Insurance Company. The original fenestration pattern at both long elevations was irregular. Windows at the upper level of the south wall were not in line with those below at the second bay from the east, and the spacing between sets of windows in both walls varied considerably. The north elevation had doors in the fourth through seventh bays from the east and in the west end bay, a possible indication of the use of the first floor as storage and as an employment office, both uses carried on into the 20th century. (The five doors would have provided easy access to the mill yard for employees moving equipment and machinery, while the west door gave direct access to prospective workers.) The room in the west end also gave direct access to the stair that served the second, or main floor. The west gable end wall had a door in the north bay of the first floor, with two windows in the upper level lighting the interior stair. All openings repeated the use of hammered granite as trim.

While no interior description prior to a 1936 plan for remodeling the office [5] has been located, a large vault of fire proof construction of the appropriate period is located at the center of ground floor, inset 6′ from the north wall. Also, sections (Figure 24) prepared as part of the proposed 1936 work detail the timber framing, which from a visual inspection appears to be original.[6] The exterior masonry walls were 16″ thick, with a 12″ brick north- south wall in the first floor dividing the structure into two almost equal parts. The east half had a 12″ x 12″ and a 9″ x 12″ beam spanning the width of the structure, let into pockets at the north and south walls and secured with iron ties. The west section was framed slightly differently because of the stair at the end wall. All cross beams are shown in the section as supported by a combination of 4″ x 6″ timber posts and 3-1/2″ to 5- 1/2″ diameter cast iron columns. It is not possible to determine which, if any, is the original treatment as both wood (Mill #2) and cast iron (Mill #1) columns were used in the 1836 period. Floor joists were 2 x 10′s, 8-20″ on center, sheathed with two layers of 2- ¾″planking, laid perpendicular to each other as the flooring. The ceiling at the second floor is shown framed with 2″ x 10″ joists, the attic braced with 6″ x 6″ cross ties, and the roof consisting of 4″ rafters nailed to 8-1/2″ x 8- ½″ "cross beams" which are used as purlins.

B. The Facades of Mills #1 and #2

As built in 1836, Mills #1 and 2 were identical in size and detailing, and will be discussed here as one. As shown on a "Plan of One of the Boott Cotton Mills" (Figure 15 undated but determined c.1836) each structure was 19 bays long, 4 bays wide, four-stories at the south elevation, with partial cellar, five - stories at the north wall where the full cellar appears. [7] The gable roof was without the, at that time, traditional clerestory monitor. Wall thicknesses were 24" at the cellar, 20" at the first and second floors. 16" at the third and fourth. The brick walls were laid in common bond, 7:1, set in a lime mortar raked flush. All openings were spanned with hammered granite sills and lintels. The double hung sash was 12/12, in wood torus molded casings. The end walls had similar windows in the cellar and the first four floors, with two windows in the gable in line with the second and third bays below. Molded rake boards terminated at short returns of the full length, corbeled brick, cornice that ran front and rear of the mill facade.

Details shown in the c. 1836 plan and section are repeated in a "View of the Boott Cotton Mills at Lowell, Mass." appearing in the May 29, 1852 Gleason's Pictorial (Figure 10). While somewhat romanticized, this view is useful in attempting to corroborate details shown in the earlier drawings. The view and drawings agree on the design of projecting stair-towers at the center of the south elevation of each mill. Four-stories, square in plan, with a pedimented gable roof (shown with a full entablature in the c.1836 drawing), the ridge of the roof is tucked neatly into the mill roof cornice in the c.1836 section, but projects above the roof eaves in the 1852 view. The towers had windows at each of the intermediate levels at the south wall, between the 1st- 2nd, 2nd-3rd, and 3rd-4th, floors reflecting stair landings at these points. The entrance was offset at the first floor, apparently to the west, in both towers. The east and west side walls were blind. While the construction material is not identified in the c.1836 drawing, the stair towers were probably frame, comparable to similar towers at other Lowell mills, particularly those at the Massachusetts Cotton Mills (1839). Also, the towers that replaced the original towers c.1863-65 are frame, and there are no visible scars at the center bays of ether mill that would indicate the removal of masonry construction.

The 1852 view also shows fire escapes leading to ladders at the roof, known to be in use by 1836. It also shows chimneys inset slightly at each gable end wall along the northern slope of the roof. The chimneys do not appear in the c. 1836 drawings, or in "Views of Lowell, Mass. and Vicinity," (Photograph 14), a stereoptican pair made c.1865-88.[8] However, early drawings do call for a furnace at these mills, and they would have required chimneys.

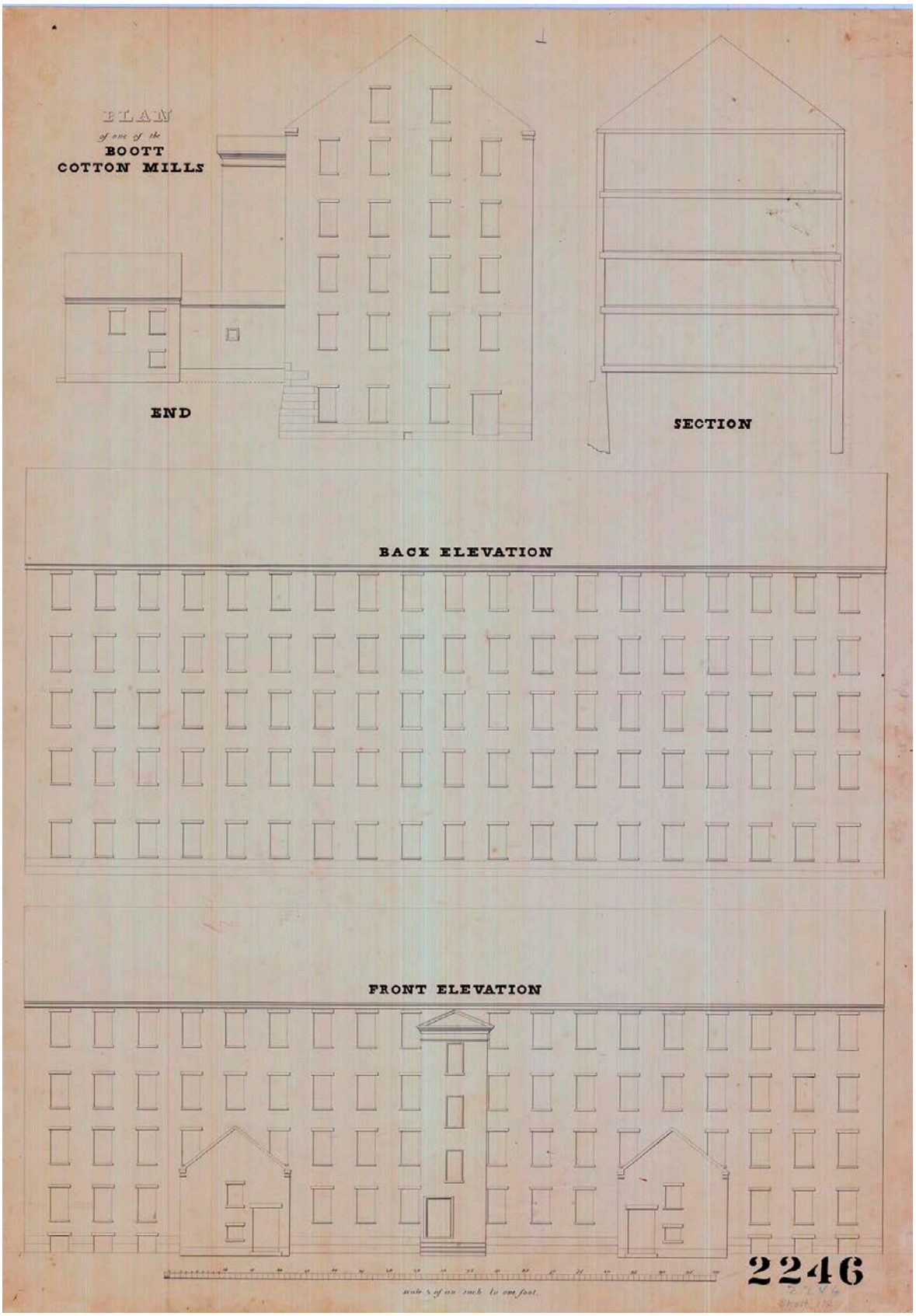


Figure 15. Plan of one of the Boott Cotton Mills, c. 1836
Source: UML, CLH, L&C, Plan Number C-112-2246

The c.1836 drawing and the 1852 view are also slightly at odds with regard to the height of the freestanding picker houses that were appended to the fifth bays from either end of both mills. The drawing shows the square plan (21'± to a side) picker houses as one and one-half stories with a simple gable roof, two windows at the second level, one at the first in the side walls. The later view shows the picker houses as two stories tall, with the ridge of a pedimented gable end wall reaching the top of the windows in the third floor of the mill. There is a window in the gable and four windows at both levels in the side walls facing towards the tower, two in the opposite side walls. Both graphics show windows at each of the two interior levels at the front, and a loading door in the bay closest to the tower. Because of the high risk of fire associated with the picking process (and requirements of the insurance company) the picker houses were almost certainly of brick construction, with corbeled brick cornices and hammered granite sills and lintels similar to those used at the mill itself. The 25' long connecting hyphens that linked the picker houses to the mill were of unknown construction, possibly wood but more likely brick because of the same threat of fire. They had a single, small square window centered in the east and west walls. Both the picker houses and the hyphens rested on granite faced foundation. The picker houses and the hyphens were removed prior to 1865, most likely when a large, freestanding picker house was constructed in 1860-61 north of Mill No. 4.

While it has been previously assumed that the continuous dormers at both planes of the gable roofs for Mills No. 1 through 4 were added with the construction of the connector between the pairs in c.1863-65, a comparison of construction details, visual appearance and overall size of the dormers at each location raises a question as to their being concurrent. They are not identical in design. It is suggested here that the freestanding mills were provided with this additional illumination prior to 1863- 65. The dormers were frame, with ribbon-like rows of 8/8 double hung sash set into wood casings and sills. The roofs had simple moulded cornices at the eaves. (Unfortunately, the removal of all dormers for the construction of the fifth floor c.1881, precludes any investigation of structural techniques to substantiate or refute the possibility of a pre-1863-65 construction date for the dormers at the mills.

Also somewhat in question is the exact date for the construction of the connector between Mills No. 1 and 2 and Mills No. 3 and 4. While numerous sources list 1865 as a precise date (Coolidge, Crowley, HAER) the 1983 Shepley, Bulfinch, Richardson and Abbott survey, in a convincing analysis, suggests otherwise:

Construction dates for the various structures built during the Civil War are given in most sources as 1865; however, the large increases in equipment reported by the company in 1864 suggest that construction was carried out between 1861 and 1863, a period during which the mills were shut down three separate times for rebuilding and improvement. 1865 may merely be the first year in which new buildings were opened for manufacturing.[9]

At any rate, the connector was in place by the mid- 1860's, and its original appearance is documented (Photograph 22) in an unlabeled view of the same period (Figure 11) in Special Collections at the University of Lowell Library.[10] The connector was 75' x 94' - 97' in plan, originally four- full-stories high, with cellar windows partially exposed at the south elevation. It had a dormer lit roof, differing as mentioned above from the design of the dormers at the flanking mills. The south facade was eight bays of full height windows, the combined sills and lintels of one piece of hammered granite at the floor/ceiling line. Sash was 20/16 double hung. The wall was laid in common bond. 7:1 matching the coursing of Mills #1 and 2, but terminated at a finely detailed corbeled and bracketed cornice band. The drop brackets were one stretcher wide, ten courses deep with the bottom three courses corbeled and the top three courses stepped. The corbel table was surmounted with a molded wood cornice at the eaves and roof. The shed roof dormer was inset approximately six feet from the edge of the roof, and provided with a row of full size, adjoining windows with 12/12 sash. The tall dormer returned at both ends to connect with the new stair towers at the southwest corner of Mill #1 and the southeast corner of Mill #2 that replaced the original centered stair towers at this time. The outer walls of the dormer connections had a single 8/8 window, the wall facing inward provided with a 12/12 window.

The 1863-65 towers, except for the cupola and belfry at Mill #2 were identical in design and construction. Square in plan, 16'- 2" to a side, they rose five and one-half stories to a point above the present day fifth floor of the mills and connector, and terminated in a low, hipped roof that was surrounded with a balustrade of paneled square corner posts with urn finials, and turned balusters supporting a molded hand rail. The projecting eaves at both towers had a sawn and paneled wood bracketed cornice with flat frieze that was finished with a wood cyma-recta crown. The tower at Mill #2 had an exceptional, octagonal wood frame cupola with a bell cast copper roof resting on a bracketed cornice of detailing similar to the cornice at the tower eaves. The roof had an excellent copper spire and weather vane, with a stylized shuttle as the wind indicator. The cupola had round headed openings in each of the eight sides, with paneled keys at the top edge, and enclosed a large bell inscribed "Vickers Sons & Co. Limited, Sheffield, 1873, Cast Steel." (The date on the casting indicates that the bell is either an early replacement or simply late in coming, yet it is unlikely that Boott Cotton Mills

would have been without a bell to call the workers to the job for such a period.)* The west tower also had 7' diameter wood clock faces in each of the three walls visible from the yard, set between the fifth floor and a string course just below the bracketed cornice. The clock faces were labeled "E. Howard & Co., Boston" and may be older than the towers, possibly reused at this location from elsewhere at the Boott.

The body of both towers were identical, with full height paneled corner pilasters and beaded 5" horizontal flush siding. The east facade of the east tower and the west facade of the west tower and single, narrow 1/1 windows at each floor, with shallow caps and lug sills. They were set forward towards the front of the wall. The walls opposite these walls were blind. The front facades of the towers had large openings with three stairs at the first floor, presumably for double doors, and were flanked with a single 6/6 window, to the left at the east tower, to the right at the west. A curious tripartite window lit the second floor of each tower (3/3- 6/6- 3/3), trimmed with a flared metal hood. The third through fifth floors had conventional 12/12 sash with molded caps.

A plan accompanying the Barlow Insurance Survey of 1882 shows a rectangular, one story structure in the corner formed by the east wall of the tower and the south wall of Mill No. 1. While it appears on maps of the mill yard as late as 1929, it is unnamed other than "Shed No. 1." The stereoptican (Photograph 22) shows it as having a metal hip- on- concave roof, the west part of the concave roof extending over the entrance in the east tower. It had a 1/1 window in the east wall, a 4/4 window with molded cap in the south, and appears to be of frame construction. The shed was supported on brick piers at the corners.

C. The Courtyard

The Courtyard south of Mills #1 and 2 was open at the south and east ends prior to the construction of Mill #6 in 1871- 72 and the #7 connector in 1876- 78. The area south of the mills was partially enclosed by the Counting House and two accessory structures shown in the 1839 plan of the Massachusetts Cotton Mills (Figure 12). The east end of the Courtyard was more than likely enclosed by an iron fence along the west side of Bridge Street, especially since railroad access to the early coal pocket behind Mill #1 was

* Gary Kulik, writing in Material Culture of the Wooden Age, states the importance of the bell and tower: "Celebrated bell towers, with their bells marking the temporal boundaries of the workday, dramatically reinforced the new sense of time and work entailed by the factory system; for in industrial societies, work would be increasingly defined by the clock rather than the available light, weather and the seasons." Gary Kulik, "Factory System of Wood," in Brooke Hindle, ed., Material Culture of the Wooden Age, (Tarrytown, New York), 1981, p. 327.

provided c. 1850. (The track was in existence until Mill #6, with its enclosed track to the enlarged coal pocket was built.) Access to the Courtyard was limited to the canal bridge at the head of John Street, with a pedestrian walkway constructed along its eastern edge.

The Sidney and Neff "Map of the City of Lowell," (Figure 16) printed in 1850 shows part of the yard in front of Mills #1 and 2 laid out into two ovals, each surrounded by a fence of iron posts and chain. The grass oval plots were bordered by a single row of trees. The areas in front of the mills and the Counting House were not planted, and it appears that they were unpaved, although they may have been in gravel. With the construction of the new tower at Mills #1 and 2, c. 1863- 65, paths were cut across the grass plots, centered on the entrances to the two mills.

Octagonal one-story, frame hose houses appeared in the Courtyard in the 1850's (Figure 10), but their locations are not clear. (Photograph 22) shows a small brick rectangular structure of unusually fine detailing, including a metal bell cast roof, in front of the "Shed No. 1" at the east tower. Presumably it was a variant of the hose house structure. It also has been destroyed. (Records indicate that a tool house in this area was demolished in 1955.) Other accessory pieces that appeared in this period in the Courtyard included cast-iron gate houses controlling the raceways, cast-iron hydrant boxes, and the exposed headgates for raceways 3, 4 and 5. These are still in existence in front of the connector between Mills #1 and 2.

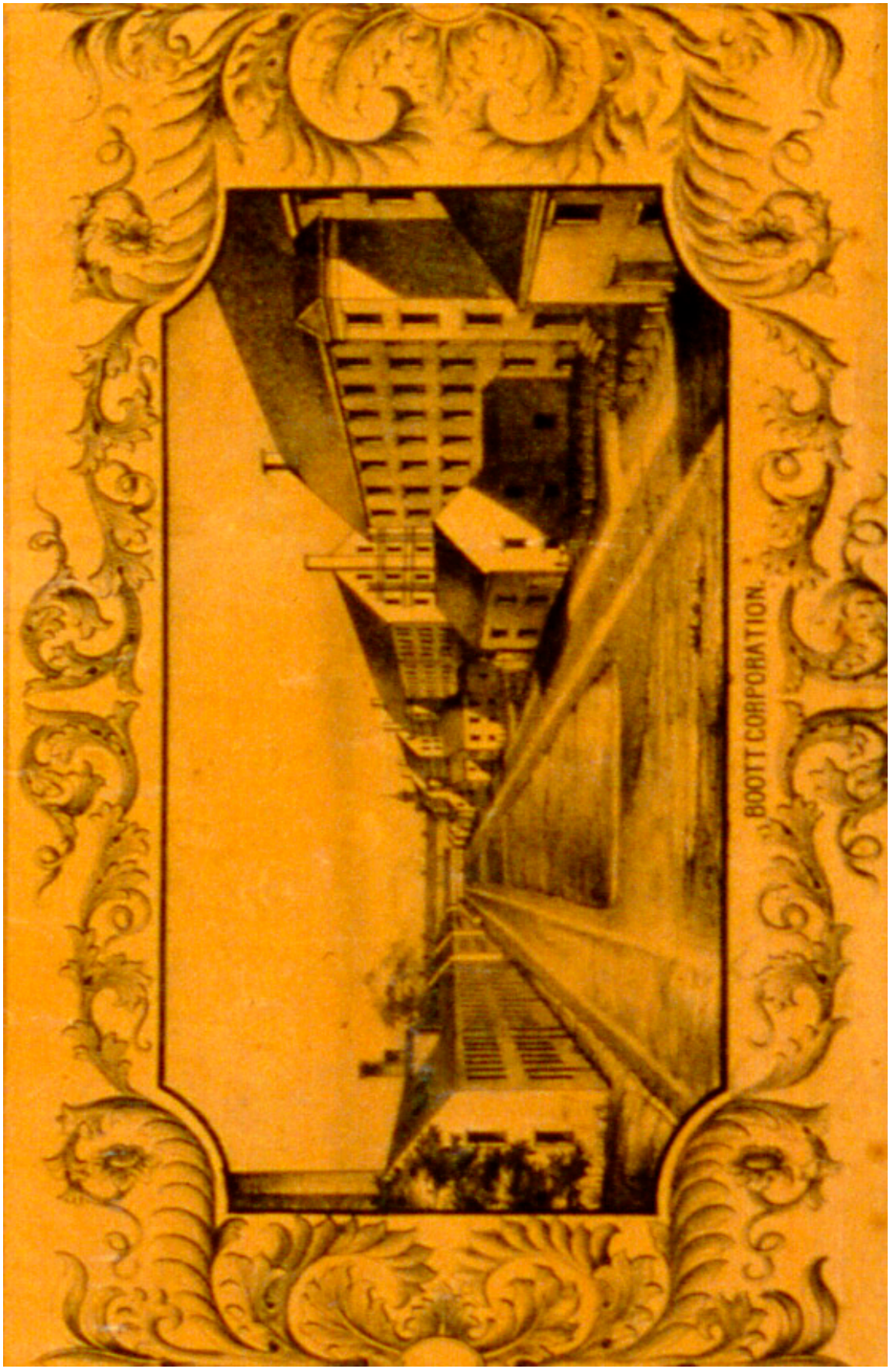


Figure 16. Boott Corporation, from Sidney and Neff's Map of the City of Lowell, Mass. 1850. Mills 1 through 4 are at right, with their picker houses. The Counting House and various repair shops are at left.
Source: LNHP, LOWE 1039

ENDNOTES

1. Shepley, Bulfinch, Richardson and Abbott, SBRA, Cultural Resources Inventory, p. 2.

2. Shelf 112, "Drawings Belonging to the Proprietors of the Locks and Canals on the Merrimack River, " on file at the University of Lowell Library, Special Collections.

3. University of Lowell Library, Special Collections, Photo file, Boott Mills Folder.

4. Locks and Canals Shelf 153, drawing 132 (L & C Office, BCM).

5. Ibid., 153- 114.

6. Ibid., 153- 133.

7. Ibid., Shelf 11 2, Sheet 2246 (U of L, Spec. Col.).

8. View 33, "Views of Lowell Mass. and Vicinity" U of L, Spec. Col., Boott Mill Folder, undated, c. 1865- 80.

9. SBRA, p. 12.

10. Unlabled view of Boott Cotton Mills, undated (c. 1865-1881) U of L, Spec. Col. Oversize Photos, Boott Hill Folder.

11. Plan of Massachusetts Cotton Mill, 1839.

VI. OCCUPATION AND USE, 1871-1904

A. Introduction

Discussion of the "Occupation and Use" of the designated sections of the Boott Cotton Mills will describe the mill's purposes and operations, the machinery it contained, and the relationships between labor, management, and the machines. Because of the unusually fine records on these subjects for this mill, the National Park Service directed the author to prepare a very site-specific report detailing with maximum precision the contents and operations of this particular mill, neither a generic mill nor a generalized treatment of the industry, although the mill will be described within a wider context whenever appropriate.

The result of this approach is an account which follows the development of each factor in the story over the time of the mill' s operation, from early in the 1870s until its closing at the end of 1954. The cumulative effect of this report will be to acquaint the reader not only with the general pattern of cotton mill operations, but also with the ways in which changes in technology, management, and labor interacted to create a pattern vibrant with detail yet broad in scope.

This chronological section, 1871-1904, will describe the equipping of the new mill, including some of the thought which went into making choices between alternate types of equipment. The machinery selected established patterns of operation which would affect the mill for decades. On the other hand, the complement of machinery was not static, and its changes over time will also be noted, along with the effects of those changes on the workforce and on production. At each stage, the capacities of the various pieces of equipment, in terms of quantity and quality of output, will be considered.

A mill is much more than a collection of machinery. It has a population of its own, both workers and managers, whose daily lives are intertwined with one another and the equipment. Their place in this operation, their attitudes toward one another and their activities will play a prominent role. They can be observed in terms of their jobs, their pay, their comments (and those of others), and at times of conflict, such as strikes and economic panics. By noting and analyzing their commentary and conduct one can determine a great deal about their beliefs and how those relate to their performance.

A note about traditional ways of referencing these buildings is in order. Each of the several buildings in the Boott complex was designated by number, most often in the form "Mill #6," for example. Particular floors were indicated along with the building, as in 6-1, 6-2, up to 6-5. Since such indicators are both succinct and exact, this practice will be followed in this report.

B. Purposes, Operations, and Procedures

At the time of the planning and building of Boott Cotton Mill #6, Lowell's monolithic cotton textile industry was in the process of rebounding from one of its most massive failures in judgment: a cessation of manufacture during the Civil War. Anticipating a short conflict, attracted by the prospect of selling large inventories of cotton at suddenly multiplied prices, the interconnected directorates of the several corporations disposed of their stock of raw material at the start of the war and were left without the ability to compete for the large amounts of work available as the war continued. Perhaps their sympathy for their erstwhile and long-defended trading partners in the South, the plantation owners who were their suppliers of cotton, misled them regarding the extent of the national division they had worked so long to deny and/or prevent. Other centers, such as Philadelphia, made great fortunes on government work while Lowell idled. Efforts to improve facilities or run small production in Lowell compared poorly with what might have been.

By 1870, however, the potential for future profit was clear and an expanded capacity seen as a direct route to expanded income. Aside from the obvious error of the war years, the mills saw little reason to break new ground; past methods should continue to produce steady profits. The Lowell model of large production runs of a limited number of styles was tried and true, the market was rebounding, it was time to gear up to new levels of production.

However, this period, 1871-1904, represented a time of critical importance in the history of the Boott Cotton Mills, one in which the company initially exhibited behavior typical of its earlier operation and later shifted toward its future course. The latter aspect included elements of both sides of its coming career, management acting at once intelligent and promising while sowing the seeds of its ultimate destruction.

At first, the plan was to enlarge capacity to do the things which had brought success in the past. In order to produce more cloth, and thereby, presumably, more profit, the owners enlarged their power supply. Steam power had been introduced in the 1860s, and in 1873 they advertised the addition of a 440-horsepower engine.

By 1878 they operated a 1000- horsepower Corliss steam engine. Succeeding engines installed in the 1880s and 1890s made steam and waterpower approximately equal partners in powering the mill complex.[1] The resulting increase in the demand for coal was exponential.

At the same time, they expanded their water power by making more efficient use of the rights they leased from the Proprietors of Locks and Canals. Anticipating the increased power demands that Mill #6 would place on the system, in 1872 the Boott prepared to install a new and more efficient Swain turbine. Records of the Lowell Machine Shop [LMS], with whom they contracted for all necessary materials, show that they ordered in October and received in November new vertical-acting back and head gates for $2323. 55, followed by an order in November by the Swain Turbine Company for the Shop to produce an 80" Swan wheel weighing 9409-1/2 lbs. and costing $9879.66, which was sent to the Boott in December.

Extra bracing, castings, various pattern work, and the delivery and setting up of the wheel cost an additional $1647.22. In January, 1873, the Mill received the two crown gears ($959. 64) which would take power off the wheel, and in February the Shop sent the "Double-Acting Regulator" which would govern the wheel's speed so that it would run at a steady pace no matter what machines were turned on or off at any moment, thus insuring that operating machinery in the mill consistently ran at a predetermined pace. Next, "1 Jack Shaft--2 Spiders and Boxes included. Patterns and Plans $1551.58" arrived to carry the power away from this great wheel. Finally, "3 Plates--9 Stands--12 Boxes--1 Shaft-- 4 Bevel Gears ea. 34 & 35 teeth chipped--to connect #1 & 2 with #6 Mill [Photograph 11]." For a final cost of $2489. 96 the final link had been delivered: power could now flow from the wheel to the new mill![2]

Thus were readied the engines, for water and steam both drove engines providing the motive power for the new factory, and the transmission system to bring the power to the textile machines in Mill #6. In effect, the mill was one great machine with an outside power source. Once the operations for which the new factory was designed are described, the manner of this giant machine's operation will be explained.

Mill #6 enlarged the plant's capacity in carding, spinning and weaving (described in Ch. II). It also contained a blacksmith shop, a large machine shop, a paint shop, and a carpenter shop. The second, third, and fourth stories connected to the dressing mill in #7 where the yarn made by ring frames in #6 was warped in preparation for weaving there.[3] In most respects, its operation was self-sufficient.

The new mill would add to the Boott's production of sheetings, shirtings, and drillings. It would raise the operation's statistics to 112, 752 spindles and 1875 workers processing 6,760,000 lbs. of strict middlings cotton into 23,920,000 yards of cloth per year in 1876.[4]

Later in this period (1893), the plant's overall size increased to 148,412 spindles, 4000 looms, with 1687 female and 523 male workers. In a given year it consumed 6000 tons of coal, 800 bushels of charcoal, 14,500 gallons of oil, and 650,000 lbs. of starch. Print cloth by then offered a new product from the mills.[5] The Treasurer also explored a Korean market for the drillings and sheetings during this period as he attempted to extend the market for their traditional products at the same time he worked to develop new materials.[6] New products, new markets, and new problems, as will be seen.

By the end of this period, warnings were being sounded regarding the mill's products and policies. In 1904 William Parker, a consultant from Lawrence, Massachusetts, provided a survey of operations that charged, "It would appear from a study of the kinds of yarn used and the character of the cloth manufactured, that the mill has attempted to make too great a variety of yarn and cloth." The plant that had begun and for years ran on three types of cloth made with a narrow range of coarse cotton yarns, now spun, in a six- month period, warp yarns of many different weights, or counts (as in hanks per pound), numbered: 7, 8, 10, 13, 16, 18, 20, 22, 28, 40, 50; weft spun on ring frames: #11, 17, 20, 22, 24, 30, SO, 60, 70, 75, 80, 85; and "of Mule Filling, every number from 7 to 85. Here are over 100 different kinds of yarn made of several varieties of cotton, linen, flax and [cotton] waste, to be watched and kept separate through every process of manufacture. During the same time 276 different styles or kinds of cloth were made."[7] This variety represented a new path for a Lowell mill, one fraught with perils for a mill where managers, employees, and machinery were accustomed to a simpler production.

Parker also treated a cause of this changing production: Southern competition. However, despite the South's lower costs, he did not see it taking over textile production, but claimed that Lowell "is still a good place for a good mill, and I believe it is possible in the long run to succeed there about as well as anywhere else." He then initiated a litany which would continue for decades: "I cannot see how it is possible to make a satisfactory rearrangement of the machinery in the old Boott Mills, and would not recommend the expenditure of a single dollar in that direction." He noted a "lack of concentration of machinery belonging to different processes," which found cards in seven rooms, roving frames in eight, ring frames in seven, mules in five, spooling in two, and looms in eight,

"with some of the rooms so small that the expense of caring for them is more than double what it should be. "

When it came to suggesting a solution, the consultant offered bluntly:

> *Your old buildings have perhaps served well their purpose in the past, but they were long ago out of date, and are of no value now even if they can be considered safe to work in.*
>
> *I therefore recommend the entire demolition of the present structures, or at least so much of them as are dangerous to work in, or would in any way interfere with the best arrangement and construction of a first-class new mill.*[8]

An era initiated by new construction thus comes to a close with a recommendation of demolition. Coming just thirty years after the construction of Mill #6, this judgment underlines the belief it was built to out-of-date specifications. The path of this development, as reflected in changing equipment and operations, will provide the subject for this chapter in the mill's history.

C. Building Contents

1. Equipment Installed

In order to consider the occupation and use of Mill #6, it is imperative to understand the machinery installed therein. Since the building was equipped during the period in which nearly all the textile machinery was purchased from the LMS, owned and operated by the same group of investors as the major corporations, and since its records survive, we have a remarkably clear picture of the contents of the building. Because, it appears, of the Boott's difficulties and consultations over time, a similar level of precision remains possible throughout its history, making it perhaps the most precisely described example of this type available for study. Since its importance lies in its typicality, as has been noted, this precision informs not only the history of this operation, but in many ways stands as a significant example of the conduct of business throughout its companion factories in Lowell and elsewhere. Furthermore, the extent of this information permits the creation of a picture of the mill's operations which becomes more and more detailed through the accretion of facts over time.

The value of all this information is further heightened by the lack of attention to the city' s history after the end of the so-called Golden

Age of Yankee "mill girls," foreign visitors, and constant attention here and abroad to the great experiment in the industrial wilderness of the new nation. Historians have given little attention to the playing out of Lowell' s story, despite the fact that the mills ran far longer with immigrant labor and declining conditions than during the pre-Civil War years. Thus the information now presented on the Boott illuminates not only its activities, but in doing so charts new ground on every area of its history: technology, labor, management, and their relationships.

A listing of the machinery proposed for #6 provides the basis for understanding its original production capabilities and determining alterations over time: [9]

Proposed Machinery---Card Room.

76 Breaker Cards with 15 in. Doffers.
22 Top Flats each with Wellman's Top Stripping Apparatus.
1 Lap head with Doubler attached to work with same.
76 Finisher Cards. In every aspect like Breakers.
8 Railway Heads to operate with same.
4 Heads Drawing. 6 Deliveries each, for 1st operation.
4 Heads Drawing. 6 Deliveries each, for 2nd operation.
4 Coarse Compressed Roving Speeders, 24 Spindles each 8- 1/2 in. space. (96 Spindles in all.)
6 Intermediate Compressed Roving Speeders. 48 Spindles each. 7 in. space. (288 Spindles in all.)
14 Fine Compressed Roving Speeders. 72 Spindles each. 5 in. space. (1008 Spindles in all.)

This group of machines occupied the top floor of the building, 6-5, despite the weight of the carding machines. While they represented a greater floor load than the looms, their calm rotary motion contrasted so sharply with the action of the looms that they were better located high in the structure. Further, if the structure-threatening looms were to be located low in the building, putting the cards at the top was necessary to avoid a convoluted flow of materials through the building and the process. In this set-up, cotton moved from the Picker House to the top floor of #6 in the form of laps (batting) via the elevators, then down through the mill until it left as cloth, much like the flow of grain into flour in the prototypical Oliver Evans grist mill; both present early, vertical models for the assembly line.

The breaker cards took the picked cotton and separated the clumps of fibers one from another while beginning the parallelization process which would continue until the cotton was spun into yarn.

In each card, a large main cylinder held in a strong and rigid frame spun rapidly as the cotton was carried around on it and between it and the fixed top- flats; both cylinder and flats were covered with card clothing, and this wire-brush-like material held and straightened the fibers.

All the cotton moved first through one of the breaker cards, after which, again in lap form, it went to a finisher card and was re-carded to increase the untangling and parallelizing effects. The care and precision here affected the quality of all operations to follow, making this equipment very important to the mill's quality of output. The row upon row of evenly spaced cards stood, covered, constantly devouring and emitting streams of white material, 152 islands of iron and wood amidst a sea of cotton.

Mill #6 began operation about ten years after the widespread adoption of George Wellman's top stripping apparatus, the 1854 invention of a Merrimack Manufacturing Company (the Boott's neighbor) employee which significantly affected cardroom work and efficiency. Wellman's invention automatically cleaned the top flats of the card of the dirt and waste which accumulated on them and which previously had to be removed by hand. Costing $60 per card, it is said to have saved $300 of labor annually.[10] In installing these strippers Boott managers made their card room current in the American field.

The railway and drawing heads took the sliver, or rope-like product of the finisher cards, combined a number of them, and then drafted, or drew them out, substantially, enough so that the new product in each case was as small or light as any one of the slivers which had entered the machine. These doublings represented the first of the thousands to be employed in order to minimize the imperfections of the carding. The slivers moved directly from the cards, or from the tall cans into which they had been coiled, into the next machine. In other words, sliver was the form in which cotton entered and left the railway and drawing heads. At the next stage, the cotton began to assume a more recognizable shape and was wound onto bobbins.

In the next production stage, the use of coarse, intermediate, and fine speeders represented the best solution available from the LMS at the time. For United States practice, using the three machines stood as the preferred style, but it did not equal the abilities of the English fly- frames which were coming into the market and which would soon become dominant. The three-stage speeders copied the English system of running the roving through three machines, but they did not match the technical superiority of the fly-frame. The deficiencies would become increasingly apparent as the Boott began to shift to more varied and finer production.

The three types of speeders stood in long rows creating aisles through which workers and cotton moved. At the coarse speeders, slivers were fed from cans into the machine, where they were doubled and drawn before being wound onto large bobbins as roving, the greatly reduced product of this speeder. The 8 1/2-inch spacing referred to indicates the distance between spindles and thus the size (almost) to which a bobbin could be wound with roving before bumping into its neighbor. The bobbins then went to the second and third speeders which continued the process while accumulating the finer products in smaller and smaller packages.

Each of these speeders wound the roving onto the bobbin by means of a throstle, a device much like the flyer of a spinning wheel, which revolved rapidly around the bobbin and made a noise like a thrush, it was thought, thus giving it its name. The room full of speeders would, of course, sound like a greatly magnified thrush accompanied by a cacophony of noises associated with the belts, shafts, pulleys, gears, hand-trucks, and employees moving through its aisles.

These fifth floor operations transformed the cotton from laps, or sheets, to narrow rovings, perhaps between half the size of a pencil and pencil- size. Trucks of these packages of roving on bobbins constantly moved through the room to the elevators where they descended to the spinning department below.

The spinning equipment was of two types: ring- and mule-spinning. Thirty-six ring frames, each with 224 spindles spaced just 1 5/8 inches apart, created aisles much more dense with spinning bobbins than those on the floor above and also turned the bobbins much faster, on the order of 7,000 revolutions per minute (rpm). Since the product here was finally thread, or yarn as it was called, the close spacing still permitted the accumulation of a considerable length of yarn on the bobbin before it had to be removed, or doffed. In the years to come, the general trend would be toward larger spacings, larger packages, and fewer doffs.

In frame spinning #6 arrived at the end of an era: in 1870, for the first time, the LMS made no throstle spinners, thus ending a transitional period, which had begun in 1855, during which they offered both rings and throstles.11 Therefore, the decision to install ring frames in #6 was an easy one.

However, in just those years around 1872 revolutionary developments were taking place in the technology of spindles, the all-important parts that spun the bobbins, and the managers of the Boott faced complex choices between the tried and true and a variety of new inventions. At a meeting of the New England Cotton Manufacturers Association (NECMA) in 1873, A. G. Cumnock, the

Boott Agent, described the process and considerations which led to his determination of which spindle to acquire. His comments, which are reproduced here in part, are significant for several reasons. They indicate the extent to which mill operations were carried out according to the best knowledge of the agents in charge; they underline the degree to which constant efforts in the mills evaluated and extended available knowledge; they describe the source of technological innovation at this time; finally, they reveal the extent to which the corporations shared their discoveries, debating them as they did here in a public forum, confident that their several companies did not compete significantly with one another and therefore did not benefit from the harboring of secrets. The men at the bottom of the financial hierarchy but the top of the operations ladder, the true cotton experts, recognized that they in effect all worked for the same small group of investors who gained from their shared knowledge.

Cumnock's comments:

> *Mr. Cumnock. It became necessary in the mills that I am connected with to decide, early last year, what kind of a ring- spindle we should adopt; as we were about building a new mill, which required 9,000 warp- spindles. I corresponded with quite a number of parties that had some experience running the light spindles of different makes, but could not get any of them to recommend them very strongly, on account of their short experience. On the whole, I was compelled to decide for myself, and I must say that I commenced my experiments with a prejudice against light spindles, for the following reasons: In 1871 we changed our spinning in our No. 4 mill, and put in 60 ring-frames, of 224 spindles each. The spindle weighed 12-1/2 oz., whereas we were running in the other three mills a spindle that weighed 10-1/2 oz. The result of the change was, the heavy spindle ran so much better that the girls could tend 1,120 of the heavy spindle, to 960 of the light. The roving was changed from one mill to the other, and the result was the same. You will of course understand my position from my experience with the light and heavy spindle on the old plan.*
>
> *Before I commenced the experiments on the new styles of spindles I had my doubts of getting a fair and correct result, on account of the bias of overseers and the influence of patentees upon them. So to avoid that, an order was given friend Richardson here, Supt. Lowell Machine Shop, to build a frame and put a spindle in, that was termed, at the time, the Cumnock-Richardson spindle.*
>
> *This was an amalgamated thing. (Laughter.) It was, in fact, a Pearl spindle with the step a little smaller - the size of the Sawyer. This frame was run three months, bands broken and put on again,*

without any knowledge of the overseer what was going to be done with it. At the end of that time, the dynamometer was applied and a test was made that gave us 4 778/1000 ft. lbs. per second on a speed of 6,096 revolutions of spindle, and of front roll, 72 48/100 on No. 30 yarn.

The spindle during the three months ran very satisfactorily, except a slight tremor when half full, and of course increasing as the bobbin got fuller.

The next move was to overcome the difficulty just mentioned. Three sets of spindles were put into the same frame, one after the other, different in size and length, without being able to overcome the tremor. So that we settled in our own minds, that should we adopt a spindle of this kind, we should take the spindle first made. There are now running at the Ocean Mills, Newburyport, 30 of these frames, built like the frame tested, in every respect, and I believe they are running very satisfactorily.

My next move was to have Mr. Draper [inventor and manufacturer of machinery] alter a frame in our No. 3 mill, and have him turn the frame over to me so that it might be run and tested under the same circumstances as the frame I have just spoken of. He consented, and the frame was changed. It was run under the same overseer; nothing was said by me to him as to what was to be done with it, or when the test was to be made. It ran ten weeks; the bands wore out and new were put on as in the previous case, and by the man that put them on the other frames in the room, so that we might get a test of the power of the two spindles mentioned, under ordinary running circumstances, and not a test got up for the occasion, as I fear a great many of them have been that were sent us. The dynamometer was applied at the end of the time mentioned, weighed by the same party under my direction, as in the previous case, and it gave us 4 831/1000 ft. lbs. per second, on a speed of 6,591 revolutions of spindle, and of front roll, 68 43/100 on No. 34 yarn.[12]

Cumnock's statement represents a tour de force of technological sophistication. It reveals a technical knowledge and precision encompassing experimentation, measurement (of both speed and power), and evaluation (of both performance and effect on labor). The original correspondence, the Newburyport example, and this statement demonstrate the openness with which the agents operated. Cumnock went on to describe the continuing assessment of the spindle in #6, justifying its extra cost through the efficiency of its performance. His discussion enables the modern reader to witness the amount of effort, and expertise, applied to the selection of what often seem to be simply a random assortment of equipment.

Yet despite all these words of explanation, a reader might still respond, "But it's only a spindle. Why all the fuss?" Spindles inserted the twist into the yarn as it was being made. Therefore, their speed presented a limit on production; increasing it had the potential to speed the entire mill.

In 1871, Jacob H. Sawyer, Agent of the Appleton Mills in Lowell, addressed the New England Cotton Manufacturers Association and described his new spindle. Through observation and experimentation, he had developed a spindle which was supported at its center of gravity, ran steadily, and could be run at 7500 rpm. "So unwavering was the operation of the faster and lighter spindle that even at its higher speeds it produced less breakage and more uniform yarn than had been possible with the common spindle."[13] Samuel Webber tested the frames in the Boott in August, 1876 and recorded their performance: 5-1/2 oz. spindles ran at 6020 rpm, front rolls turned at 97 rpm producing a draft of 8.80, and requiring 2.144 horsepower per frame.[14] These figures not only record the operation of the frames, but also indicate, again, the precision and sophistication with which machinery could be tested and evaluated.

It is interesting to note that the Sawyer spindle, as well as others of its type, were the products of experimentation of those who worked in the mills rather than of researchers in machine-building shops or elsewhere. Little innovation had been taking place in recent years: "The cotton- textile machinery industry of the 1870s had been softened by three or more decades of heavy demand. In those decades the advance in machine technology had been very slow. On every hand there were complaints from mill men that machinery companies had not changed their models in thirty years."[15] When new ideas did appear, they were likely to arise from the shop floor, an ominous sign for the future of the quiescent machine builders.

In addition to the 8064 ring spindles purchased, twelve mules of 648 spindles apiece (7776 in all) were also installed. The ring frames appear to have filled the ell on 6-4 and part of the main part of the building, with mules in most of the west section of the third and fourth floors. These areas of the building, with their one row of centered columns, were ideally suited to accommodate these giant machines.

Each mule was on the order of 75 feet long with a moving carriage full of spindles rolling back and forth through an approximately 5-foot draw; the mule required floor-space of over 75 feet by seven or eight feet. Viewed from the end of the floor, they ran in facing pairs, the spindles of the mules separated by only a small walkway when the carriages of two machines were in their "out" position, by about ten feet if both carriages ran in (toward the creeled rovings about to be spun). The back or creel of one mule lay to the windows

on the canal, that of the next mule facing it, toward the center posts; behind that, on the other side of the posts, stood the back of another mule facing a fourth with its back to the windows on the yard side. The view of the machines in operation showed all these carriages, rolling to and fro, each spinning 648 spindles, first running out from the creel as the roving was stretched and twisted, then running back as it "wound on" the yarn just made; first an expanse of 648 parallel pieces of yarn five feet long, then diminishing to a scant few inches after the rest was wound onto the bobbin; yarn accordians constantly expanding and contracting.

Up until the Civil War, United States manufacturers relied largely on the Sharp and Roberts pattern mule, of the style of that English inventor of these machines and produced by the Mason Machine Works of Taunton, Massachusetts. While these two independently developed machines served ably, the Civil War's onset took domestic machine-builders out of the textile- machine business to a great extent and manufacturers began to import two English mules, one by Parr, Curtis, and Madely and another, the one adopted by the LMS after the war, by Platt Brothers of Oldham, Lancashire, "both, in all essential features, lineal descendants of the Sharp and Roberts mule."[16] These machines reflected the state of the art and would not quickly become obsolete.

The mules, which made a softer, loftier yarn than the ring frames, produced the weft yarn for the looms. The yarn from the frames made up the warps. They were a high- skill machine, and for that reason avoided in Waltham and early Lowell. Their efficiency, quality, and flexibility had overcome those feelings. Their presence indicated a realization by the Lowell mills that their plans to eliminate skilled labor had limitations. A tendency to move toward increased variety and quality in product at the Boott accentuated the need for mules.

The LMS also provided 285 looms, each capable of weaving 40-inch-wide cloth. These were placed in the ell portion of 1/6, arrayed in rows on the second and third floors. Placed in facing lines, they left little space between them for the weaver to work in, only about 1'9", in fact, while behind them, where access was required for bringing in bulky new warps, wider aisles remained. These rows ran with the ends of the looms on the canal-to-yard axis of the ell, the looms facing toward or away from Bridge Street. Simple plain-cloth looms, their thundering operation resounded through the building, shaking the very floors and walls. Their limited capacity did not suggest a long life for them if the mill were to begin to vary its production. While they were probably adequate, loom-building does not seem to have been an area in which the LMS excelled and was one of the first areas of textile-machine-building which it dropped in later years. In fact, the Lowell corporations had begun in the 1820s by adopting looms like those built in Waltham,

rather than those in the Scotch, or Rhode Island model which were to prevail, and their efforts were somewhat hampered by that mis-choice during the early decades. That event was testimony to both their capacity to err, and their ability to survive their mistakes through their great economic strength.

This carding, drawing, roving, spinning, and weaving equipment completed the basic productive capacity of Mill #6. Supplied by the LMS, it cost $151,982, a large amount of money at that time, but at standard rates from the shop which was integrally connected, economically, to the Boott and other Lowell companies. In general, the choice required primarily consideration of productive capacities, coordination of numbers of cards to spinners to looms, since they were basic units of production for the time if one were to rely on the LMS. However, where there were other considerations, as in the case of spindles, where choice was not automatic at the time, great care was taken.

Of course, running this operation demanded innumerable related tools and supplies which did not appear in inventories of major purchases. Since #6 represented simply another link in a series of comparable operations at the Boott, determining the needed auxiliary equipment would not offer any difficulty.

The Card Room required card clothing, tacks and special hammers for applying it to the cards, hand cards for stripping or cleaning the cards periodically, gauges for adjusting them, and various wrenches, chisels, files and other hand tools for dealing with everyday problems too minor to call for the assistance of the Machine Shop.

The speeders utilized bobbins, with skewers, for both the feed and delivery ends, in addition to a supply of spares. A reel to measure and a scale to weigh the roving maintained quality, and various hand tools permitted minor adjustments.

Spinning demanded thousands of bobbins for each type of machine in order to both make and transport yarn in the mill. Replacement parts, change- gears, testers and hand tools ensured continuous operation.

Warp preparation equipment included several thousand spools, with skewers, as well as slasher combs. Harnesses and drawing-in hooks provided for final preparation of the warps for insertion into the looms.

The Weave Room machinery's rough usage necessitated stock-piling the numerous loom parts expected to wear out routinely.

Leather straps and pickers, shuttles, and other small parts waited in readiness. Weavers' tools, including combs, reed hooks, and scissors had to be provided. Harnesses, heddles, beam trucks, and the usual tools all had to be purchased.[17]

It was these sort of small items which had to be ready at all times if the juggernaut of a factory was not to be halted for want of a nail, as in the horseshoe-horse-battle routine. While the LMS provided the big items, numerous small shops had arisen in Lowell to fill these sundry needs.

Mill #6 also consolidated the mill complex's service facilities: Machine Shop, Paint, Carpenter, Blacksmith, and Belt Shops occupied the first two floors and fulfilled the needs of all the buildings. Most important was the first, which contained a substantial quantity of machines:

1 Upright Drill. Built in 1842, by Putnam Mch. Co.
1 Gear Cutter, Built in 1840.--Builder unknown.
2 Drill Lathes. (Wooden Frames.) Built in 1840.
1 Traverse Drill. 8 ft. Bed. Built by Lowell Machine Shop in 1848.
1 Double Lathe. 25 ft. Bed. Swing 24 ins. Built in 1856 by the Lowell Machine Shop.
1 Double Lathe. 18 ft. Bed. Swing 24 ins. Built in 1852.
1 Lathe. 6 ft. Bed. Swing 10 ins. Built in 1848.
2 Lathes, 8 ft. Bed. Swing 10 ins. Built in 1868 by Warren Aldrich.
1 Lathe, 14 ft. Bed, Swing 16 ins. (Wooden Frame.) Built in 1836. Builder unknown.
1 Chucking Lathe. (Wooden Frame.) Swing 20 ins. Built in 1836. Builder unknown.
1 Daniel's Planer. Built in 1845.
2 Wood Turning Lathes, 6 & 8 ft. Bed. Built in 1845.
2 Saw Benches. Built in 1850.
1 Engine Lathe for turning Pullies. 1873.
1 Boring Lathe.
1 Grooving Machine.[18]

This equipment, of various vintages, was presumably assembled from other locations at the Boott. With it, machinists could make numerous and substantial repairs on the textile equipment. New gears could be cut to replace those that broke or to fill a gap between gears of different sizes when changing a machine's output. Boring of all sorts could produce the innumerable types, sizes, and alignment of holes required in metal or wood. Lathes

could hold pieces of metal nearly as long as their beds and turn out round pieces of regular or irregular shape for shafts, cranks, or other round parts. The Daniel's planer could smooth large timbers, its whirling knife-tipped arms a pronounced danger to operator or passerby alike. Wood-turning lathes and saws permitted repair of wooden machine- and building- parts. The presence of this large group of machine tools made the mill comparatively independent of outside repair facilities. It indicates the amount of wear and breakage that could be anticipated, and, through the size of the investment it required for creation and operation, the importance of ready repair to the mill's success. The variety of equipment could work on the largest and smallest parts of the machines, the shafting system, and even the building. The Blacksmith Shop could bend these parts into needed shapes, could harden the steel which had to bite against softer metal, and weld together those parts which were not bolted or screwed. The role of the Paint and Carpenter Shops is parallel and more obvious, but the connection between the Belt Shop and the rest of the facility may be less clear.

There was another part of this system, this factory-as-machine, which has been alluded to but not discussed: the complex array of shafts, belts, and pulleys which brought the power from the engines, water and steam, noted at the outset, to the building, the floors, and the machines since described. No machine ran off an individual motor. Rather, whole buildings of machines ran off one or two motors. How this system was structured and operated had much to do with the shape, lay-out, and performance of the mill and the machines within.

The "science" of shafting had made significant advances as implemented in Lowell over the years, and its advancement would continue at #6. James Geldard wrote, in 1851:

> *Mechanicians have always disagreed as to the best mode of conveying power from the prime mover to the machinery to be impelled. Some prefer gearing, some belts and pulleys, while others prefer a mixture of both. Doubtless each system has its advantages. All agree, that, to convey the power by the shortest possible train, first to the heaviest and then to the lighter machinery, is correct both in theory and practice.*[19]

BMC inventor Paul Moody had helped do away with the use of gearing in connection with shaft drive during the earlier years of Lowell's development.

The description of the installation of the Swain turbine, along with associated shafting and gears, which initiated this section, represented the beginning, as well, of the system of power conveyance according to Moody's system, which ran Mill No. 6.

The shaft of the turbine rotated in a vertical plane, and two bevel gears turned that power 90 degrees so that it ran horizontally through another shaft. This shaft ran parallel to #6 until it reached a point from which a leather belt could be run from a large pulley on the shaft to a similar pulley in 6-1 (Photograph 12). The belt connecting these two pulleys would have been on the order of 20 inches wide or more, made of several thicknesses of leather, and in its entirety consuming numerous cowhides. Once the power reached #6 it had to be carried to each of the five floors before it could be directed to the many machines. This transmission paralleled that from the wheel to the building, but in a vertical plane, with belts only slightly smaller than the first revolving around a pulley on the first- floor shaft and another on a shaft on at least every other floor above. To recapitulate, vertical rotary motion at the turbine was turned by a pair of gears and ran through a shaft revolving in a horizontal plane, from which it was carried by a belt running around a pulley on the shaft to a pulley that revolved on a parallel shaft in #6, from which it was carried upward from a pulley on that shaft to a pulley on each of several shafts above via more belts. Once the shafts on given floors were turning, power could be taken from them down to machines below, or through the ceiling/floor to machines above, by smaller belts, to a pulley on each machine. In one sense, this was a simple system, all mechanical, no electric motors, computers, or gear boxes. At the same time, it was a highly sophisticated, potentially efficient system with a thorough theoretical background by the time of its installation in #6.

James B. Francis, Moody's successor, had continued the experimentation with shafting in Lowell and in 1867 published the results of his studies in the Journal of the Franklin Institute. His research was available to the men planning and directing the operation of Mill #6. The complexity and specificity of his calculations provided a mathematical basis for determining the necessary diameter of various shafts according to the amount of power to be transmitted and speed of revolution, for example. His precise formulae remind that the engineering of these hundred-year-old mills drew upon sophisticated theoretical foundations:

> *"To transmit the same power the necessary tension of a belt diminishes in proportion to its velocity; consequently, with pulleys of the same diameter, the transverse strain will diminish in the same ratio as the velocity of the shaft increases. In cotton and woolen factories with wooden floors the bearings are usually hung on the beams, which are usually about eight feet apart; and a minimum size of shafting is adopted for the different classes of machinery, which has been determined by experience as the least that will withstand the transverse strain. This minimum is adopted independently of the size required to withstand the torsional strain due to the power transmitted; if this requires a larger diameter than the minimum, the larger diameter is of course adopted. In some of the large cotton*

> *factories in this neighborhood, in which the bearings are about 8 feet apart, a minimum diameter of 1-7/8- inch was formerly adopted for the lines of shafting driving looms. In some mills this is still retained; in others 2-1/8-inches and 2-3/16-inches have been substituted. In the same mills the minimum size of shafts driving spinning machinery is from 2-1/8 to 2-11/16-inches. In very long lines of small shafting fly-wheels are put on at intervals, to diminish the vibratory action due to the irregularities in the torsional strain."*[20]

This theoretical, but experimentally determined, background provides a context for understanding the significance of the few preserved comments of two of the planners of the system under consideration: Channing Whittaker, a consultant for the Lowell Machine Shop and professor at Massachusetts Institute of Technology (MIT), and A. G. Cumnock, the Mill's Agent. The surviving Notebooks of the former provide a wealth of detail regarding the installation of the LMS machinery in the new building. In preparing figures for the installation of the ring frames he specified 18 counter-shafts 6' 8" long and 1-13/16" in diameter, with 4 pieces 15'7" long the same thickness.[21] Elsewhere he noted that all shafting should run at 300 rpm except that of the Weave Room, which should turn at 240 rpm. Card Room shafting would run 1-11/16" diameter and turn the card cylinders at 120 rpm. Railway heads would be driven with "quarter twist belts," and looms would operate at 135 picks per minute (ppm).[22]

Cumnock recommended, in an 1879 comment, a refinement on the question of loom speed; in order to reduce the extreme vibration problem which these machines presented, he called for both balancing the shafting to minimize its vibration, and running alternate rows of looms at plus or minus 3 ppm to help keep them out of synchronization.[23] The looms were the machines most threatening to the structure in which they ran. Each loom threw a shuttle and bobbin weighing a couple pounds back and forth across its width 135 times per minute. This action created serious vibrations at all times. If all the looms on a floor coincidentally began to perform this action simultaneously in a particular direction, in other words, if all the shuttles started flying first north and then south at the same time, the swaying action created would be tremendous, and mills were known to have been brought down by such coincidences. Cumnock's precaution would greatly reduce such a danger.

In considering any part of the mill one must keep in mind the omnipresence of lines of shafting running down the ceilings of most rooms, with belts running from the many pulleys (equal in number to the number of machines) to each machine. On the machine, two pulleys sat side by side, one the idler, loose on the shaft, the other the fixed pulley, fastened to the shaft. When the shafting system

was turning, a belt running to an idler did not operate a machine, but when an operative pushed a lever moving the belt over onto the fixed pulley, the machine started up. In most cases these levers, known as shipper handles, were on the machine, but in the machine shop the two pulleys in question were located on the overhead shafts and drive belts ran to fixed pulleys on the lathes and other machines. The machinists turned the power to their machines on and off by means of long wooden handles extending up to the shaft above their heads. It is indicative of the pervasiveness of this power system and its presence in the mill that these handles created the appearance of such a forest that the machine shop foreman was invariable known as "The Bull of the Woods." Even the general language of the time, outside the factory, shared in such common usage, and a person without full occupation was said "to be on the loose pulley."

The shafts, pulleys, and belts, along with the groups of machines described earlier, made Mill #6 one great machine, interconnected by purpose as well as literally, by metal and leather. Its collection of carding machines, drawing frames, speeders, mules and ring spinners made yarn for the looms, which made cloth. When it began operation, it became one mill among many of a similar configuration in Lowell.

At the same time, it was an integral part of one complex, the Boott. Other sectors of the mill served #6, providing picked cotton, power, heat, and other services. Mill No. 6 served the rest of the complex in turn, through its several shops for machining, painting, carpentry, belting, and blacksmithing.

The planning of the production line and the selection of its components revealed careful and informed thought. Given the mill's goals, determined by the investors and Treasurer, the machinery selected indicated full awareness of the equipment's capabilities. The openness of the exchange of information which led to the choices described reflected operating conditions and revealed the limited nature of competition among the manufacturers there. Only one note, the fact that while the LMS assumed, correctly, that it would equip these mills, technological innovations were coming from people outside its employ, on the floors of the mills, introduced a discordant sound to an otherwise harmonious situation. Complacency, on the part of either the mill or the Machine Shop, carried the threat of relative decline if others worked more assiduously to advance. Whether or not such a threat could be met by the combined strength of these textile giants remained to be seen.

2. Technological Change

While, as noted, the mill's production revolved around the particular machinery purchased for #6, the situation did not stand still from 1871 to 1904, and the changes in equipment provide a good indication of the intentions and performance of the mill' s managers. While it is axiomatic in certain schools of architecture that form follows function, in a textile mill function follows equipment, and they must change together. As time passed the Boott could choose to continue with existing equipment, replace it with newer versions of the same general type, or purchase machinery with new capabilities, signaling new intentions. All these things happened in Mill #6, and in various ways they both suggested management's plans and redefined general operations and workers' practices within it. In fact, the changes demonstrate a furthering of long-time practice, the search for automaticity, and a new goal, the capacity for complex production.

During the first dozen years of the building's use few changes appear to have been made. An 1882 Barlow Insurance Survey described the activity of #6 as nearly unchanged since its erection. Some looms now ran on 6-1, in the south part of the main section and in the ell, but functions had not changed elsewhere:

> *Communicates with wing of dressing mill in second, third and fourth stories by tinned door. A 16 inch brick division wall, about 30 feet from north end, rises to third story; tinned doors. First story: division at north end, blacksmith shop; main portion, machine shop; south part and wing, weaving. Second story, north end, paint room; main portion, carpenter shop; balance of this floor, weaving. Third story, weaving and mule spinning. Fourth story, frame and mule spinning. Fifth story, card room.*[24]

Thus for a dozen years or more, operations in #6 apparently changed little. In 1879 Boott Cotton Mills had spent over $50,000 at the LMS for new equipment,[25] including 192 looms (at least 156 of which ran in 6-3 east in 1914, although that was apparently not their original location).[26] In any case, this purchase indicated only an effort to maintain production, not to initiate anything new.

However, more significant changes were made in machinery and production, as will be seen from an analysis of Parker's 1904 accounting of the equipment of #6:

No. 6 Mill.

One row of race looms on each weaving floor.

1st Story Weaving, 287 Draper Looms

2nd Story	350 Crompton and Knowles Fancy Looms
3rd Story	156 Crompton Fancy Looms 6 Pair Lowell Mules = 7968 spindles
4th Story	4 Pair Lowell Mules = 5184 spindles Ring Spinning = 12096 spindles
5th Story	152 Lowell Cards - 1 Lap Head 8 Railway Heads 54 Deliveries Drawing 4 Lowell Slubbers = 160 spindles 25 Roving frames 27 = 3018 spindles.[27]

Reviewing these machines in process order, starting with the fifth floor, it appears that management had not replaced the 152 top flat cards despite the fact that they have been made very outmoded by the introduction of revolving flat cards. The eight railway heads, equally dated, probably also represented original equipment. Drawing heads had increased from 48 deliveries to 54. These may indicate that some of those purchased by Boott in 1896 went into #6 as replacements.[28] They could suggest increased drawing to produce some of the finer yarns the mill produced by this time. The Lowell slubbers (identical or similar to speeders) do not match the 96 spindles of the original coarse speeders, nor do they correlate with any of the modern fly-frames (see below) the mill had purchased. Apparently they were some of the replacement speeders introduced between 1872 and 1875.[29] While they would not have brought significant technological change, and in fact by their untimely purchase probably delayed such change, they would have increased production. What all this meant is that cotton laps brought to #6 were still processed through the original carding machines despite the advent of the greatly superior revolving-flat cards well before this time. The result was at least a loss of efficiency relative to competing mills, and likely of quality as well, particularly regarding the higher quality production now being attempted (described below). Railway heads and drawing frames, as well as the slubbers, or coarse speeders, were also original or little different and similarly limited the quality of these early preparatory stages of production.

The roving 25 frames, which combine numbers of intermediate and fine frames, represent a doubling in capacity over the original 1296 spindles. While there exists no way to determine which of the many frames of different sizes purchased between 1873 and 1904 operated in Mill #6, most of these spindles had to be on fly-frames, since only 800 spindles of the old speeders remained by this time. This new machinery represented both modernization of equipment and improvement in quality and flexibility regarding the mill's product.

The new English fly-frames served particularly well in producing the finer yarns toward which Boott moved in this period. Unlike the speeders used previously, which could only be changed from one count to another through "intricate adjustment of bobbin and spindle,"[30] the new machines offered truly flexible operation. An awareness of the greater ability of these frames to produce finer yarn was indicated by the original 1872 purchase of three-stage speeders, but that stop- gap attempt by American machine- builders to parallel the English advance did not equal the performance of the fly- frame. George Sweet Gibb described the situation:

> *Not only did the speeder require intricate adjustments, but it failed to impart enough twist to the roving. On coarse work this latter deficiency was not important, because the roving was strong enough to be processed, even with little twist. On finer numbers twist had to be imparted to give the roving sufficient strength to hold together under subsequent processing. At the time the various speeders were being used in America, a new system was being evolved in England which grew out of the improvements effected by Houldsworth in 1826. This system usually involved the use of three roving frames, designated the slubber, the intermediate, and the fine roving or jack frame, all of which incorporated Houldsworth's basic improvement... The essence of the improved English roving process, which eventually displaced the American speeder, was the subdivision of that process -- the use of three (sometimes four) machines, instead of one or two... Realizing that the system of working roving down to the requisite fineness on three or four highly specialized machines was superior to the existing practice of achieving that same fineness by repeated doublings through one machine, or even by processing through two machines., these manufacturers (among them the Lowell Machine Shop) began to build three varieties of speeders. This remedy postponed, but did not prevent, the triumph of the English fly frames. The basic mechanical superiority of the latter over the speeder could not be overcome by this rather transparent modification of the American system.*[31]

Thus the Boott seems to have belatedly adopted the English system available since long before the equipping of Mill #6. One cannot tell, now, whether the original decision and later change were related primarily to shifting from coarser to finer production, or from a loosening reliance on the offerings of the Lowell Machine Shop.

Parker's report underlines Cumnock's astuteness in choosing the Sawyer-spindle ring frames originally, for it appears that up to 29 of the original frames still ran in #6. More spindles of ring spinning (with similar Rabbeth spindles) had been added, however. In 1875 six new frames for spinning warp yarns had been installed in 6-4, along with three in 1885 and 53 frames in 6-5 in 1886. None of these

additions and rearrangement s required changes in the building's structure.

The capacity for mule-spinning in Mill #6 had also increased, again reflecting the move toward increased quality and flexibility, the mule's forte. Eight of the twelve originally installed remained, and twelve newer 664-spindle mules had been added. Capable of producing finer yards as well as being more easily changed from one weight and twist to another than spinning frames, these machines were eminently suited to a mill interested in producing varied, fine products. In fact, altering the amount of twist inserted by the mule into the yarn, and the amount of draft, required only the relocation of two indicator pins, a change so easily made that the pins were protected by locked covers in order to prevent the attendants, mulespinners, from changing the settings to suit their own fancies (which had more to do with achieving high production and thus high piecework wages than matching predetermined standards).

The looms present the technology most of ten and thoroughly altered during this period, and the reasons stem from both technological change and revised production goals. None of the original Lowell Machine Shop looms remained. They had been replaced twice by this time, first with LMS looms which incorporated some of the technical advances of the 1870s and 1880s such as the Bartlett let off (on the warp beam), the Estes, Amoskeag, or Boott take-ups (on the cloth roll), and the Stearns parallel motion (on the picking motion).[32] In each of these cases, the new machines displayed the results of continuing effort to make power weaving more consistent, by improving the regularity of the let-off and take-up motions, and smoother and more efficient, by devising a picking stroke which sent the shuttle straight across the loom (avoiding the tendency of the pivoting picker-stick to direct the shuttle along an arc). These types of changes have been constant in loom engineering from their invention until the present day, and indicate the imperfection of all methods in the difficult task of combining the varied motions which go into weaving.

The other alteration in the complement of looms in #6 represented a much more drastic change. The Crompton and the Crompton and Knowles fancy looms (the Crompton and the Knowles loom-building companies merged), manipulated up to 20 harnesses to produce the complex new styles of cloth toward which the mill was moving. These looms represented a change, not of degree, but of kind in a weaving operation. Technology, labor, and product were all significantly changed by their introduction.

The manner in which they accomplished ends already described represents a focus for the change they represent. Instead of using

cams turning over treadles beneath the warp to create a shed, these looms employed dobby heads on the side of the arch above the warp to control the harnesses. These mechanisms consisted of a series of levers to lift or depress each harness before each pick of weft. They were programmed by an endless chain (a loop) to produce a predetermined pattern. Each bar in the chain corresponded to one pick; each bar carried, for each harness in use, a riser or a sinker. The former lifted levers and caused the corresponding harness to be raised. The latter, by not lifting, caused the remaining levers to be caught by a knife moving in the other direction which lowered the harnesses. Not only could these mechanisms control many more harnesses than could cams (on the order of 20:6), but they could also be easily changed to produce a variety of fabrics. New chains, with a different arrangement of risers and sinkers, needed simply to be prepared, away from the loom, and exchanged at the time of a style change.

These looms generally also incorporated drop-boxes which permitted the weaving of various weft colors. Several shuttles, carrying bobbins of different colors, were held in boxes on either side of the loom, with one box always empty to receive the shuttle thrown last. Thus a 4 x 4 loom included four shuttle boxes on each end of the lay and could weave with up to seven weft colors. If one color predominated in the pattern, then several shuttles would carry that color and serve a filling- mixing purpose. While all yarn may look pretty much the same to the untrained eye, even identical counts of yarn spun on different machines or from different batches of cotton varied slightly; by intermixing several bobbins of yarn in the filling these differences were minimized (compared to the effect which would be produced if one bobbin traveled back and forth until it was empty in one section of the cloth).

The drop-boxes were controlled by the same type of chain as the harnesses. Before each pick the chain indicated to the boxes, through a series of cams, gears, levers and chains, which shuttle was to be thrown. On many of these looms, known as “Pick and Pick” looms, the picking motion operated simultaneously on each side of the loom at every pick, presenting the opportunity to throw a shuttle from either side at any time. The operation of these box motions, of course, had to be very sure and precise. Any misalignment of the box and the race plate would result in the shuttle being thrown out of the loom at great speed and considerable danger.

These looms, by their combination of complex and easily changeable warp and weft control, permitted the introduction of new styles and shorter production runs. These changes increased both the variety of materials and of production problems of all sorts which the mill had to face.

As the density of the above description of these looms' operation suggests, they presented new situations to everyone associated with their operation. Managers had to provide quality yarns; weavers had to bring greater skills; loom-fixers had to learn new and more precise techniques; even the marketing of the mill's output had to shift. The struggle to make all these changes while maintaining production will represent a connecting thread between descriptions of those various aspects of the mill's operation, not only in this period, but later in its history as well. These looms, more than any other single change in the machinery of Mill #6, suggest the extent of the changes going on at this time. They were not installed because they could run faster and produce more cloth, but rather because they could make a more complex cloth, as well as a wider variety, and thus a more valuable product. In other words, they offered the hope of increasing profits not by speeding up production of the traditional coarse and unchanging materials, but by generating smaller amounts of changing and more highly valued cloth.

The nearly 300 new Draper looms were cam looms (Photograph 13), like LMS models they replaced. That similarity serves far better, however, to mislead than it does to elucidate the significance they represent. For one thing, these looms were weaving corduroy, the familiar fabric with certain weft threads manipulated to form the loops of a pile, while other wefts create the ground filling to hold the fabric together. The loops were later cut to create the brushy, soft surface associated with this cloth. So, to begin with, the new Drapers introduced a new and complex material, much as did the fancy looms.

Yet the change to corduroy pales in comparison to the real impact of these machines. Because of one major change in how they operated, these machines were known as "Automatic" looms from the moment of their introduction. In weaving on all earlier looms, replacing the nearly spent bobbin in the shuttle represented a major part of the weaver's work and set the limit on the number of looms one could tend. Since weaving entailed roughly half the cost of making cloth, continual efforts had been made to overcome this limitation through new technologies capable of replenishing the weft without the weaver's assistance. Most of these involved shuttle-changing mechanisms; none was successfully marketed. James H. Northrop greatly affected the development of textile history when he invented a series of mechanisms which would automatically change the bobbin, rather than the shuttle, while the loom ran.

The three key features of these looms, introduced in 1895, included a circular hopper, or "battery" (like a Gatling gun) mounted on one end of the loom and holding a supply of full bobbins; a filling detection system; and a warp stop-motion. Each time the shuttle reached the right side of the loom, a filling fork reached in through

a hole in the side of the shuttle and felt the amount on filling left at the base of the bobbin. If the supply of weft had run out, or nearly so, the empty bobbin was knocked out through a hole in the bottom of the shuttle and a new bobbin inserted from the battery, all without any stopping of the loom or any intervention by the weaver. If for some reason the shuttle returned on the next throw without filling, the same mechanism stopped the loom. Because this mechanism took over such an important part of the weaver's work, a worker could tend many more looms. Since the person's oversight of the larger number of machines could not be so close as it had been before, warp stop- motions were required. When a warp thread broke, it not only began to produce a defect in the cloth, but would soon become entangled with neighboring threads and lead to an irreparable fault. Therefore, these looms also carried a mechanism which included "drop-wires," small pieces of metal through which each warp thread was drawn; if the thread broke, the drop-wire fell, activating a mechanism which stopped the loom.

In addition to these features which made the loom more "automatic," certain other advances played a part in the novelty of the machines. In order that the bobbins when inserted would begin to trail their yarn across the loom, the yarn on each was attached to a part of the battery. Rather than leave these ends trailing along the cloth, the temple on the right side was equipped with a pair of blades which cut off these ends. The take-up roll was also altered. Instead of the cloth passing over the breast beam and then down onto the take-up, a high take-up roll behind the breast beam guided the material to a cloth roller directly beneath. This set-up left more room for a fixer to work and also kept the cloth at a more consistent width by locating the take- up closer to the fell of the cloth. The Draper automatics were also unusual in that they were always made one-handed, with the shipper handle on the left and the battery on the right.

These looms represented a quantum jump in weaving technology, and the Boott was very quick to seize upon this opportunity to significantly improve a part of its equipment. In fact, it was one of the first mills in New England to use these looms.

Hindsight permits a judgment that Boott management adopted the ideal weaving technology more quickly than most other operations of its time in buying Draper automatics in the first years of the century. Their move toward greater complexity of production, along with the increased variety it entailed, also set them apart from other mills in the area which operated on their scale. In these ways they were leaders and innovators.

One can, on the other hand, question the wisdom of the incompleteness of their changes, the continuance of outmoded

carding and drawing practices, in conjunction with the demands of the new materials being made. However, little can be said with certainty; conceivably, they no longer used these machines and brought roving from another of the mills in the complex to feed their new fly-frames in #6. But if that were the case, they occupied a good deal of space with idle obsolete equipment.

It can be said with certainty that the new operations presented new challenges to all people involved in production, from the office to the mill floor. The difficulty of planning and operating under these conditions made new demands on everyone, demands for which their previous work at the Boott had not prepared them. These new demands and the responses to them will be treated in the next section, and, indeed, throughout the report.

D. Activities, the Interaction of People and Machines

1. Introduction

People played diverse roles in Boott Mill #6. The machines with which they worked have been described, but just as the system of shafting brought power to the machines, the workers brought the machines to life through their attendance at them. They changed the scene from one of hardware to one of activity, and the intensity of this activity was fierce.

Each floor had its own varieties of work, with a predominant mode as well as a plethora of associated tasks. Understanding of what went on will develop during the course of this report as details about the work and the changes in it accumulate, and as the data from which to base such interpretation of activities improves. Still, knowledge of the machinery installed permits general accounts of the human side of the operation.

In the Card Room workers carried or trucked the large laps of cotton, about four feet long and some two feet in diameter, wrapped around protruding shafts, from their entry point to the feed of the breaker cards, then from that card's delivery to the feed of a finisher. The sliver from the finisher was carried by the mechanism to the railway head without assistance. There it was accumulated in a tall (3'-4') tin can which had to be removed when full and taken to the drawing frame. This task was repeated to get the fiber to the coarse speeder, after which the roving was wound onto bobbins as it progressed. At the intermediate and fine speeders, a worker would doff, or remove, bobbins as they became full and replace them with empty ones. The full bobbins would be placed in trucks

which other workers would roll to the elevators and take to the Spinning Department.

The work described moved the cotton through the first department of Mill #6, but it only begins to account for the activity there. Different workers cleaned the carding machines, oiled them, repaired and re-clothed (with the wiry card clothing) them. They ground, or sharpened, the teeth of the card clothing as it became dull, mounting emery wheels on the card frame to do so. At the opposite ends of the scale, there were Sweepers and Scrubbers who worked beneath (very far beneath), the Second Hand and Overseer who directed the others and planned production. The contributions of all these people were immediately necessary to make the room work.

Work in this room was the dirtiest in the building. The air was constantly full of "fly," loose cotton and dust which is now recognized as the cause of the debilitating byssinosis, or "brown lung" disease which permanently diminishes the breathing capacity of many cotton mill workers. Because of the dirt and the heavy lifting involving laps most of the carding employees were male.

The hierarchy in ring-spinning paralleled that in carding. Workers doffed and replaced full bobbins, reattached broken ends, and picked off threads errantly winding around the drafting rolls. Others maintained and repaired these frames, trucked the product, cleaned and supervised. Work was less dirty than in carding, less heavy, but fatiguing from the constant nature and the stress of piecework employment. Women generally tended the frames, their jobs defined by the number of "sides" tended: they moved up and down the alley made between several frames rather than moving around fewer (half as many) machines, thus sides, rather than frames, tended.

The situation in the Mule Room was different. There the chief attendant for each pair of machines, the mulespinner, enjoyed considerable status. He controlled his helpers, piecers, who helped reconnect broken ends (yarns) as the machine ran and doff it, stopped, when the bobbins filled up. Despite the fact that these machines were said to be automatic, or "self-acting," mules, his skill remained considerable. He was hard to replace, the prime measure of worth in the mill's account books, and therefore well- paid. Work here was male, somewhat controlled by the power of these men who found their own assistants and regulated admittance to their trade. It was also hot and humid, as was ring- spinning, so that the yarns could be formed most efficiently. The mulespinners generally wore their pants rolled up, wore light shirts or none, and worked barefoot. Boys not only brought fresh roving to the

machine's creel, but also moved underneath the yarn to pick up broken ends and clean up the fly accumulating there. The machine was stopped for this operation; a failure of communication (the boy threw up his hand as he emerged) or inattention would result in the long carriage running in before the boy was out, catching and crushing him against the back beam. Danger from byssinosis and other occupational hazards also persisted here, as they did, in fact, throughout the building.

The inexorable process of the cotton directed the bobbins from the mules to the weaverooms, where they would be placed in shuttles and provide the weft for the various cloths. Work there followed the same pattern as on the floors above: all the supervisors and more skilled jobs, such as loom-fixer, the province of males, women in machine-tending and cleaning roles. The hierarchies of work within areas will become more clear as the tale unfolds. Since the work of the Weave Room was greatly affected by the changes during this chronological period, detailed discussion of it will appear in conjunction with the technological causes.

2. Effects of Technological Change

In most aspects of the work experience for those in Mill #6, technological change had little impact during the period 1871-1904. Card room employees operated the same machines at the end of the period they had at the start. Some roving machinery had changed, but its differences applied more to the quality of its production than the difficulty of its operation. The work of the overseers and fixers in changing from one weight of roving to another would have been simplified by the new fly-frames where change-gears easily accomplished this task. Inserting a gear with a given number of teeth into the drive train of these machines gave a particular ratio between the weight of input and output. Racks of these gears offered a wide choice and easy adjustment.

In spinning, little had changed regarding ring-spinning work. For the mulespinners, there were simply more spindles to tend, thus more help to oversee and greater distances to walk while running the longer machines. The work itself had altered little.

The weavers' work bore the brunt of technological change. In addition to the innovations already mentioned regarding the Draper loom, it also required a new self-threading shuttle. In these a clamp grasped the base of the bobbin; when the bobbin emptied, it was forced out through a hole in the bottom of the shuttle and a full bobbin was pushed down into the clamp; the yarn on the full bobbin, attached to the battery, slid down into a self-threading slot near the nose of the shuttle. The significance of this aspect of the new loom lay in the realm of worker health. The fastest way to

draw the thread through the ceramic eye in the side of the old-style shuttle was with a quick, sucking "kiss" on the eye. If the person who performed this operation previously had a communicable disease, such as tuberculosis, the second weaver was in line to contract it. In any case, lint, dyestuffs, and other foreign matter were inhaled, hence the name "kiss- of- death" shuttle. It is no wonder then that 70 percent of textile operatives died of respiratory disease at a time when only 4 percent of Massachusetts farmers died from this cause.[33]

The new Draper looms altered a weaver's work in many other ways, as well. While accounts of a weaver's job assignment at the Boott do not survive for this time, a contemporary description is available which provides a detailed, blow-by-blow description of the sequence of tasks involved in just one part of the job, maintaining the filling-, or weft-supply. The Draper Company's advertising described a weaver's work on both the old and new looms:

> *To appreciate the great saving introduced by the filling-changer, it may be well to note the operations gone through by a weaver on a plain loom, when the filling is exhausted. They follow in the sequence now recorded, the weaver performing the following functions:*
>
> 1. *Releases the shipper brake.*
> 2. *Pushes the lay back.*
> 3. *Withdraws the shuttle.*
> 4. *Puts the reserve shuttle in the shuttle box on the l ay.*
> 5. *Pulls the shipper handle to start the loom.*
> 6. *Rubs the cloth below the breast beam to prevent a thin place, i f light goods are being woven.*
> 7. *Picks up the discarded shuttle again.*
> 8. *Pulls the shuttle spindle out on an angle.*
> 9. *Removes the empty bobbin or cop tube.*
> 10. *Puts in a new bobbin or cop.*
> 11. *Pulls off a sufficient length of filling.*
> 12. *Snaps the shuttle spindle back into place.*
> 13. *Holds the filling over the shuttle eye entrance.*
> 14. *Sucks the filling through the eye.*
> 15. *Places the shuttle in its holder, where it remains until needed.*
>
> *Now, this series of performances must be gone through with every time the filling is exhausted. On one loom, the filling may run from one minute to twenty minutes, according to the size of the yarn and the amount of yarn in the shuttle. The average time is perhaps six minutes, especially if we count the number of times that the weaver must come to the loom to start it up when the filling breaks. With a loom having an average of six minutes between such*

> *stops, the weaver must come to the loom once every six minutes. If running eight looms, he would have such a duty oftener than once a minute. With the Northrop loom, on the contrary, the weaver can fill a hopper containing 25 bobbins, which, with the same average of running time, would last two hours and a half, without requiring attendance. A co-operating feature of great advantage with the Northrop loom is the fact that the weaver can fill the hoppers at convenient intervals, rather than be forced to come to the looms with irritating regularity.*[34]

This description suggests the magnitude of the change this new equipment represented.

One can also infer, something of the tedium and strain associated with this aspect of the work. The stress involved in trying to keep a full assignment of looms operating, whether eight or twenty-five, can be pictured as the weaver moves from loom to loom either because they have shut off or because they are about to, with the knowledge that every idle moment of loom time represents a diminution of the weaver's pay.

Data on other day- to- day operations in this period is thin. However, William Burke, a former Boott Agent, did comment in a general way on the comparison between work and workers between 1838 and 1876. At the latter date, 32 weavers tended 194 looms, or just over six apiece. Overall, each operative in the mill produced 3.33 lbs. per hour. He also noted that whereas in 1838 11 percent signed the payroll with marks, in 1876 25 percent did. Health had improved since the change from 76 hours a week to the 60 hours of this time; the incidence of "bowel complaints, dysentery, typhoid, and fevers" particularly during August and September had declined, perhaps because the operatives were able to eat breakfast before going to work.[35] Technological change had enabled the mills to reduce hours, increase production, and anticipate healthier, if less educated, workers.

While job descriptions do not survive for the Boott in this period, areas in which management was investing its time can sometimes be determined. In 1875 F. A. Leigh gave a presentation on "Repairs in Cotton Mills" to the New England Cotton Manufacturers Association. He noted:

> *Seeing that most of the movements in cotton machinery are made by friction, and the loss of speed for want of proper cleaning or oiling causes breakage and irregularity of work, we can understand how necessary it is to keep all the parts clean and perfectly oiled.*
>
> *Most of the breakage will be caused by neglect, and nearly all could*

> *be avoided by cleanliness, proper oiling, and keeping machinery level, so that the shafts, rollers, and bearings are not bent down by untrue floor, caused generally by the settling or overweighting of buildings.*[36]

Burke describes the necessary conjunction of labor and management efforts required to maintain machines and buildings alike.

The performance of the Boott with regard to these last issues will emerge over time. As to the oiling, however, there is a carefully prepared account for the early part of this period. A. G. Cumnock in 1868 described the system devised at a mill in Nashua, New Hampshire and adopted by the Boott under Burke, his predecessor as agent. Instead of placing a ten-gallon can in each room for the workers to draw from, they used one 1500- and one 600- gallon tank in a separate room:

> *We have a man in charge of this room, who has under his care two sets of Oilers,--one set in the Mill and one set in this room. Except for the Weaving and Dressing Rooms, which are serviced once each week, it is his daily practice to fill the set of Oilers in the "Oil Room," weigh the amount of oil put in the Oilers that belong to each department, try the Oilers to see that they are in good running order and are not leaky, and then carry them into the department that they are charged to. Here he passes to each hand his or her Oiler and receives the Oiler that has been in use the previous day.*[37]

This system kept leaking oil cans out of the mill, monitored use, and insured that the workers were prepared for necessary oiling every day. The importance of this seemingly minor aspect of the mill's operation was indicated by Cumnock's 1879 comment that after tests at the Massachusetts Institute of Technology showed that his oil had excess "gum" in it, he switched to another with equal resistance to evaporation and as high a flash point and gained 8 percent in power.[38] This attention to detail offers partial explanation of his high reputation:

> *"When we personally first knew Mr. Cumnock he was agent of the Boott Mills in Lowell, and the Boott for a great many years, under Mr. Cumnock, seemed a great success. Mr. Cumnock went out, and almost immediately the Boott became close to being a disastrous failure, recovering its high position in later years under Treasurer Flather. When Mr. Cumnock left the Boott he went into the Appleton, which wasn't then a great success, but Cumnock made it a tremendous profit maker."*[39]

Given the innumerable opportunities for variation in the performance of people and machinery in a cotton mill, the importance of intelligent over sight seems clear.

Cumnock's attention to the oil's "flash point" raises the issue of fire protection at the mill. The danger of fire in cotton mills had been recognized soon after they began operating and American operators had been devising precautions against the threat since shortly after they began to build mills. Since they had initiated mutual fire protection insurance in those days, all their knowledge had been pooled for decades and the shared knowledge led to strict rules for construction and fire prevention, rules which an individual owner broke at risk of his insurance.

The basic reason for the concern stemmed from the fact that cotton dispersed in the air has almost the same tendency to combust as grain in the air at the grain elevator, the only difference being that cotton requires a spark. The potential for sparks was plentiful, however. Picking represented the most obvious process-associated fire danger, with volumes of cotton dispersed in the enclosed space and rapidly moving metal parts available to strike a spark on any foreign matter. Picking houses separated this process from the rest of the mill structurally early in the industry's development. However, the cotton throughout the mill offered a ready source of fuel should a fire begin. Danger from oil-soaked floors, overheated bearings, accumulations of waste, and oil or gas lamps meant that the threat of a fire capable of consuming a mill with great rapidity was constant.

In connection with fire protection, outside attention was regularly applied to the Boott. Both the Proprietors of Locks and Canals and the Associated Factory Mutual Fire Insurance Companies conducted quarterly inspections of the buildings and yard to check the condition of sprinklers, hydrants, extinguishing apparatus, and the rooms themselves, as well as certain employee conduct. James Francis, as acting Agent of the Proprietors, wrote in 1882 to complain that during one such inspection, Overseer "J. Henry Traver was not present as required."[40] It should be noted that most of Francis' reports on the Boott contained no major complaints.

The 1878 regulations to which Francis referred spelled out the duties of the people involved throughout the mill and yard:

WATCH RULES.

Duties of Overseer of the Watch.

1. *To sleep in the yard, or in the immediate vicinity thereof.*

2. *If absent from the yard, to go there on every alarm of fire given in the yard or in the neighborhood.*
3. *To remain in the yard during dinner time of the Mill Hands.*
4. *To see that hose and other fire apparatus are always in good order.*
5. *To see that the Sprinkler Gates be kept lighted up at night; or that a lighted lantern be kept near them.*
6. *To accompany the men employed by the Locks and Canals Company to make the quarterly inspections of the fire apparatus; and to have with him at the time, all of the Watchmen then on duty.*
7. *To take the management of fires occurring in the yard, in the absence of the Agent or Superintendent; unless someone else be appointed for this duty.*
8. *To keep every watchman thoroughly instructed in the use of the fire apparatus.*
9. *To send promptly for the Agent, Superintendent, and Fire Brigade, in case of fire in the yard or upon the corporation.*
10. *To see that the ladders, platforms, and doors of hydrant and sprinkler houses, be kept clear of ice, snow and other obstructions.*
11. *To see that the Yard Gates be kept closed in case of fire in the yard; and to appoint a man to tend the gates in case of fire and admit only such persons as may be useful.*
12. *To see that one axe and one bar are near each entrance upon the main or first floor; and two blankets and two pails of water at each entrance of each room.*

This description is noteworthy not only for its account of procedures, but also for the specificity regarding conduct in this regard which it reveals. The responsibilities and duties of watchmen and overseers were similarly defined. Watchmen not only had to be present, but also had to "drive watch-clock pins" hourly from "ringing out" at night until work resumed, and at any other time the mill was idle, whether lunchtime or holidays. This practice involved carrying a clock to a series of stations around the mill and using the pins, or keys, at those locations to mark a recording paper in the clock, thus proving that the circuit was being made, and at the times set. If they found a fire, they were to fight it, but as soon as it appeared impossible to overcome, the watchman had to sound the alarm and immediately turn on the sprinklers on the floor involved. All iron and tinned doors were to be kept closed and there were to be no gaslights in the idle mill except where repairs were being made.

Overseers were supposed to be always in their rooms when they were "lighted up" and to turn out the lights and shut off the gas when leaving. They were responsible for seeing that wet dirty waste not be left in the room (it might spontaneously combust), keep steam pipes free from waste or lint, prevent belts from coming into contact with wood, where friction might start a fire, and see that fire-pails and barrels were kept full of water. Each room was required to have between one and three full pails per 1,000 square feet of space, according to the fire hazard there: Card Room, 3 pails/1,000 square feet; Ring Spinning, two; Mule Room, three; Weaving, one. Friction matches were barred from the complex, with the exception of the Counting Room, and lighted cigars and pipes were forbidden not only in the mills, as cigarettes were, but also in the yard.[41] The threat of fire hung over the mill like a pall. Everyone connected with the mill was aware of the possibility of plant, and jobs, disappearing, if not in a puff of smoke then in a billow. The full force, intellectual and coercive, of the mighty Lowell corporations was continually brought to bear against this danger.

These "Regulations" are significant for what they say about what was expected of workers and by way of fire-fighting equipment in the various parts of the mill, and also for the amount of effort they demonstrate being directed by this mutual company of manufacturers to minimize losses despite the persistent fire danger associated with loose cotton, potential for sparks, over-heating of machines through friction, and numerous other sources mentioned or implied. They reflect the careful study applied to mutual problems and the extent to which the Lowell corporations operated as one huge unit on such concerns.

3. Courtyard

The regulations noted above suggest some of the activities associated with the Courtyard at this time. Hose and hydrant houses figure prominently there, as the attention given to them would suggest. The yard appears a nearly closed world featuring ordered plantings and walkways, a place for mingling on the way to or from work or during breaks (Photograph 22). Later in the period, it became a sparer scene, with plantings and most houses removed (Photographs 23 and 24).

Railroad tracks entered the yard from the south on the west end to bring cotton into the complex. Another set came around the end of #3 Mill and served the #8 Mill at the 2nd story level. These rail lines represented the only freight traffic in and out of the yard. All other movement came across the bridge adjacent to the Counting House. Workers moved in and out of the mills, and horses brought smaller items to the loading docks at various buildings.

These activities which can be grouped around the concept of technological change display the inter-connectedness of the efforts of management and labor, the rippling affects of any changes, and at times unforeseen consequences associated with technological change. Working to prolong the life of the machinery involved structural issues such as the levelness of floors, not addressable by workers, as well as oiling and cleanliness, which could not be accomplished without the workers' active cooperation. When decisions were made to produce different and less coarse materials, machines changed, as did the work associated with them. Sometimes, as in the elimination of the "kiss- of- death shuttle," changes initiated for one reason had unforeseen consequences (beneficial to the employees in this case). At the same time, although hours had been reduced over decades, all evidence suggests that the work became more stressful as the machinery ran faster and an employee tended more machines, an issue which will recur throughout the report.

4. Working Conditions

While the "powers that were" continually patrolled the mills inspecting conditions relative to fire danger, they took no collective note of other general conditions there. Simply put, plants were expensive to replace and mutually insured, while effects of other conditions were of concern only to those involved in a given mill, they believed. The disparity between their attitudes towards buildings and toward workers was made clear by the fact that the Commonwealth of Massachusetts felt compelled to inspect the mills' premises to protect the employees against too harsh an implementation of the system which equated minimum expenses with maximum profit. The state's experience with the cotton industry had shown that management was not to be trusted in matters regarding safety, sanitation, age laws, or even in meeting their agreement to pay fairly the low wages they offered. Rufus C. Wade, Chief of the Massachusetts District Police, Chief Inspector of Factories, Workshops, and Public Buildings, and Fire Marshall, noted 26 inspections exclusively for textile factories:

> *"To see that machinery is properly fenced, to look after the safety of the elevators, to inspect the sanitary arrangements of the mill, to see that the means of egress in case of fire are adequate, and that all young persons under twenty-one years of age employed in the mill have had or are receiving a proper elementary education, to prevent time-cribbing, and to see that the particulars clause (modelled on our [England's] own) is complied with, so that every weaver may be able to check the amount of his or her wages. "*[42]

T. M. Young, the Englishman who cited Wade, points out the difference between the two countries' regulation: "The 'particulars

clause' which I have mentioned differs from ours in allowing the employer a margin of 5 percent in the length of the cuts; that is, the employer may agree to pay 20 cents per cut of 50 yards, and require the weaver to weave 5-1/2 yards for 20 cents." The prospect for a 5 percent extra profit is not overlooked.[43] The trend toward rising regulation in Massachusetts will reappear, as will the struggle over who does what for how much, and how the production gets measured. Even when things are running smoothly there is continual evidence of mistrust on the parts of both management and labor of the other side's intention and practice. The role the Commonwealth took lends credence to labor's complaints of unfair treatment.

The inspections by the Commonwealth indicated mistrust of the operators of textile mills in general, but Parker raised questions about the attitudes of the Boott owners in particular as revealed by conditions in their mill. He noted the unpleasant conditions in the Boott, then commented on the type of employees who would come to work in these dark and gloomy buildings:

> *Operatives are not attracted to such rooms, seek employment there only because they cannot get it elsewhere, and are constantly discouraged in an honest effort to do good work. The best of machinery cannot be arranged or operated to the fullest advantage in such mills. The alleys in No. 6 and other mills are very poor, especially in the weaving... Excessive vibration of floors, and rocking of whole buildings is a common complaint throughout the yard, and it is unnecessary to say that machinery, however well made, set up and cared for, is soon injured more or less by such conditions.*[44]

These handicaps on employee performance represent an on-going aspect of the Boott story.

While there exist few accounts of the precise operations within the mill at this time, Young's description of an operation of the "tackler," or loom fixer, and a "room girl," in the Merrimack Mill, literally next door and in all ways a very similar mill, suggests the nature of their work:

> *I could never understand how one tackler could attend to so many looms until I saw one of the Merrimack tacklers change the beams of a loom and 'gait' it up. Before the old warp had run out the new warp was brought in from the sizing-room on a trolley which carried four beams held vertically. As soon as the last cut was finished the tackler and a woman specially employed for such work took the loom over from the weaver. The woman helped the tackler to 'gait' each beam, and in fifteen minutes the whole job was done and the loom running again. The weaver had nothing to do with the new warp*

until the loom had been started and was working smoothly.

Nor had the weaver to take the woven cloth out of the loom. The whole roll was lifted out (not pulled off) and examined by a 'room-girl' in the room in which it was woven. If any serious faults were discovered in the piece, the room-girl would report them to the overseer, and the weaver would be' called up' before the whole room. This 'calling-up' is felt by the weavers to be something of a disgrace, and the superintendent assured me that its disciplinary effect was even greater than that of the fines.[45]

The descriptions, and Young's surprise at the procedures, underline the extreme subdivision of work and the careful manipulation of labor in the Lowell system to produce the desired effect: cost efficiency. The weaver had no part in this work, it not being a part of the job in which weavers received training. The loom-fixer, a more skilled worker (and one of the first to organize successfully, in the powerful Lowell Loom-Fixers Club) played his limited role assisted wherever possible by cheaper help; to this was added a system to embarrass a weaver with "serious faults" in a piece. Each part minimized the role of any individual in order that no one person could exert much influence over production. The mill's need for the knowledge of the fixers combined with the fixers' organization to make them among the most able to resist the pressures of the system. The lesser skill of the weavers subjugated them to a style of operation which not only paid by the piece in an effort to maximize control, but also worked to ridicule people in front of their peers in an effort to squeeze a last bit of production out of them.

These aspects of conditions at the mill, as revealed by the attitudes of the Commonwealth and the owners, mark elements of the ways in which these mills worked. The issues they raise represent constant elements in the story of the Boott Mills.

5. Wages

The record of wages paid to Boott workers offers a view of daily earnings, indirectly of annual income, of management's idea of the relative importance or difficulty of replacing certain skills, and provides accounts of numbers of workers of different types in the mill's departments. Payroll records for this period are far from complete. However, wages for most of the jobs associated with #6 have been uncovered, permitting assessment of the employees' income and their changes during the years 1873- 1904.

In 1874 one can connect pay-rates and overall income for one month. A payroll entitled "Five Weeks Ending Saturday Evening, November 7th 1874" gave Names, Time, Rate and Amount for the

workers in one of the Card Rooms. It did not indicate the location of the room, but such work would not vary significantly from room to room, as spinning or weaving might, so this payroll can represent 6-5 (and in fact could well be for 6-5). The payroll also gave hours worked each day during the period for each worker. The standard week consisted of five days of 10 hr. days and 8 3/4 hr. on Saturday.

First, second, and third hands, the room supervisors on corresponding shifts, worked in the vicinity of 300 hours at rates ranging from 17.5c to 28.2c per hour, accumulating $52-$72 for the five week period. Card Grinders, men who sharpened the teeth of the card clothing with emery rollers, earned 15.5c an hour, worked about 290 hours, for income of $43-$46. Oilers and Elevators, men who oiled the cards and ran the elevators, earned 12.7c, worked nearly 300 hours and got $38. Most of the 26 Card Room employees fell under the heading "Roving and Strippers," those who tended the roving frames and those who stripped, or cleaned, the cards periodically as dirt and waste clogged their teeth. While the hourly rate varied only from 12.5c-12.2c, hours worked ranged from 300, in the cases of four men, to as few as 1 1/2, with 17 people working 24 hours or less, essentially an hour a day when they workd at all. Pay for these people, all of them women, was listed as roughly $20, 2/3 that of the men while the women worked more than ten times as long. Whether they were drawing on past or future earnings, or if there was another explanation, cannot be determined. Last were 4 women listed as Sweepers earning 7.5c- 6.0c, again generally for 24 hours, for a total of $14-$18. These amounts are similarly inexplicable. The fact that many workers put in less than a full week reflected the widely recognized custom of running the mills only as market conditions demanded; many workers therefore were employed just 9 months per year, a factor to be borne in mind when considering the already low hourly or piece rates.

This payroll presents other interesting information, as well. A perusal of the names in each category not only injects real working people into the history, unusual in itself at this date, but also enables a reader to witness the shifting ethnic composition of the group, with the English males concentrated in the top jobs, and increasing numbers of the presumably more recent immigrants with Irish and occasionally French surnames, and increasing numbers of women, in the lower-paid positions:

1st, 2nd and 3rd Hands	Roving and Strippers
Ruel J. Walker	Maggie Lynch
Alonzo M. Bartlett	Elizabeth Kennedy
Solon R. Henderson	Mary McVey
Frank Caverly	Sarah Boyle
Patrick Callahan	Sarah Leach
	Alzina Lord
Grinders	Mary Sullivan
James Casey	Mary Ells
Martin Sexton	Harriet Jay
John Kenyon	Elizabeth Adams
Patrick Riley	Julia Roach
J. Irving Forbes	Rose Boyle
	Kate Dorothys
Oilers and Elevators	Bridget Hart
Hugh Golden	Emma Sheldon
James F. Kenyon	Ann Ward
Hiram Gilman	Bridget Costello
Anson S. Miller	
	Sweepers
Roving and Strippers	Mary Fitzsimonds
Michael Riley	Margaret Murphy
John Magee	Mary Keefe
Thomas McCarty	Mary Sullivan[46]
Lewis LaCross	
Michal Lalley	
Charles Ragan	
Richard Gray	
William Cahill	
George McEwan	

Later pay records from the period do not include names, but one can assume the ethnic breakdown would be more similar than different from that of the Card Room.

Although the other payrolls do less in terms of individualizing workers, they describe not only the pay scales, but often provide indications of the ways the jobs were divided by task and the number of employees working in a given room. A September, 1875 pay scale for the Card Room in #6 gives numbers of workers and tasks while detailing a pay-cut relative to the 1874 rate, for most:

1875 Sept 29.		Card Room #6.
The present price paid to the Overseer, 2nd hand, 3rd hand and grinders will remain as now - viz		
Overseer 28. 2	Second hand 21.2	Third hand 16.5

Grinders 15.5	Elevator 12.	Oiler 12.
One stripper will strip	76 breakers	@ 12. per hour
One stripper will strip	76 finishers	@ 11. 8 per hour
Two lap boys	76 cards each	@ 6.0 per hour
Ally hands	4 in all	@ 4. 5
Lap head man		10 per hour
Railway and Draw-ing		6.5 per hour
Last head front side		7.5 per hour
Int		
Fine		
All day sweeper		6. 5 per hour
Scrub		9 per hour
Coarse Speeder	per hank	3 7/8c
Int Speeder	per hank	3 3/4c
Fine Speeder	per hank	4 3/8c [47]

While the positions described here do not correspond exactly to those used in 1874, they do reflect a lowering of wages in most jobs, as suggested by the initial reference to the "present price," as well as a shift from hourly to piece rates for speeder tenders, previously lumped under Roving and Strippers. This payroll also more carefully indicates the number of positions with very low pay, as in the case of lap boys and ally (alley) hands.

In January, 1876, just 4 months later, pay scales were either the same or lower for each job, and those on the speeders had been switched from piece rates, paid for hanks in 1875, back to hourly. Fifty-seven workers were noted, with numbers in several positions not indicated. Later that year, wages were further cut in the same room. This pay list also gives daily rates and seems to indicate a slightly shorter day than had been the case in 1874, perhaps reflecting the impact of the new Massachusetts' 10-hour law for women and children.

Salaries in the Spinning Departments followed a similar course. Work in the new mill coincided with a wage cut in mule spinning as indicated by the figures to the right in the chart below for those associated with this work throughout the mill:

1873			Mule Room
Dec. 5.			
	Three 2nd hands	2. 25	
	Two 2nd hands	present price 2.12 1/2	
	Three 3rd hands	$2.00	1.90
	Two 3rd hands	1.95	1.85
	1.12 = 1.05 = 90 = 84 = 65		
Doffers	1.04 = 96 = 84 = 78 = 60 =		
	58 =		
Back Boys	54 =		
	Roving hands	1.56 at present 1.42	
	Sweepers,	.65	
		#	now
Plattes	1800 spindles	33 yarn	10 1/4 to 9 1/2 mills
Plattes	1560 spindles	33 yarn	10 1/4 to 10 1/3 mills
Plattes	1248 spindles	33 yarn	12 1/2 to 11 1/2 mills
Plattes	1200 spindles	38 yarn	14 1/2 to 13 1/4 mills
Sharpes	1296 spindles	29 yarn	12 to 11 mills
Sharpes	1296 spindles	33 yarn	14 1/4 to 13 mills
Sharpes	1104 spindles	33 yarn	14 1/2 to 13 1/4 mills
Smiths	1180 spindles	29 yarn	12 to 11 mills
Smiths	1180 spindles	33 yarn	14 1/4 to 13 mills
Smiths	512 spindles	29 yarn	17 to 16 mills

These lists lay out wages for all mule-related work, throughout the Boott complex. In some cases, different people doing the same work were paid different rates, as in the two groups of second hands making $2.25 and $2.12-1/2 per day. Aside from these five men, everyone was taking a cut. Most of the rates indicated are per day, and the contrasts between them are striking: back boys get half what doffers earn, and doffers make half or less what third hands earn. The mulespinners are paid in mills per pound according to the number, or weight, of the yarn they are making on the two mules (thus 1800 spindles, for example) they tend. Finer yarn required the same amount of time to spin and might break more often, so it commanded a higher price per pound.

A continuation of the list describes the staff of the Mule Room in No. 6: one second and one third hand, 2 doffers, 7 back boys, in addition to one mulespinner for each pair of mules, 6 men. Wages in No. 6 Spinning declined in 1873, 1875, and twice in 1876. These figures indicate that No. 6 started up in time to experience the first pay- cut along with the rest of the Boott. The mules' importance to the mill had not diminished, however. In 1895, Mill #6 supplied filling, primarily if not entirely spun on mules, to looms in Mills #l, #2, #3, #6, and #7, 882 looms in all, according to the memorandum of V[ictor] I. Cumnock, Superintendent.48

Pay for the No. 6 Weaving first appears for July 17th, 1876; parallel schedules for other rooms on that date represented a pay-cut, so these may also be presumed to mark a reduction (strike- overs represent pay before the markdown):

Overseer 27.5 per hour & .75 1.00 per day additional at the end of every three months

Second Hand	20¢	18.5¢ per hour	
Third Hand	16¢	15¢ per hour	
Bobbin Boy	11¢	9¢ per hour	
Room Girl	10¢	9¢ per hour	
Scrub	8¢	7¢ per hour	
Weaving	"M"	24¢ per cut	18*
	"D"	25¢ per cut	19*
May 2, 1878	C		19 1/4*
	K		17 3/4*
	Argyle		16 3/4*

The asterisked figures indicate the 1878 reduction of the 1876 reduction, a third cut.[49] These pay-cuts were not restricted to the Boott, or even to Lowell. They were reflections of the declining economy nationally during the decade. Their significance lies in the degree to which the owners were able to pass along the effects of such economic difficulties to be borne by the workers.

After these cuts, weaving prices climbed steadily, although it would be some time before they equalled the level before the 1876 cuts. While the change in rates is clear, total earnings cannot be since the weavers' piece work wages were susceptible to influence by changes in loom speeds, the machines' downtime, and the amount of repairs the weaver had to make because of faulty yarn.

Furthermore, the disparity between prices for 1st and 2nd quality goods was often about a 50% penalty. In addition to calling people up in front of their fellow weavers when their cloth had faults, there was also this economic penalty. Since the faults could be avoided when the cloth was cut for use, these "fines" were in effect more incentives than real reflections of damage.[50]

As fancy weaving appeared in the mills, piece rates skyrocketed. In fancy goods, faults did lower the value of the material more, providing part of an explanation for the extreme difference between rates for 1st and 2nd quality. Since they required much more supervision from the weaver, fewer looms could be tended, so prices per unit woven had to be much higher. When instituting production of a new material, setting prices was speculative, thus a sudden early revision often occurred. As the mill's entire production process became geared to the new product, problems diminished and weavers produced more cloth and rates gradually fell, theoretically without a loss of total pay.

Average daily earnings in the New England cotton industry in general declined through 1879, recovered somewhat to mid-1883, declined again through 1884 and 1885, before rising through the end of 1890. After 1893 the slide resumed as employers continued to use wages, and hours worked, as a buffer against any factor from market softness to increases in the price of cotton. Earnings declined steadily from 1895-1899. The national boom and bust economy was continually revealed in textile wages.

In addition to these cuts, the cotton workers' position relative to those employed in other industries also worsened. Both before and for 45 years after the Civil War, cotton mill operatives' real earnings declined relative to those in other industries.[51] According to Fidelia O. Brown, writing in Cotton Was King: "The depression of 1893 cut back work to half-time at all the mills for several years; many operatives who formerly would have protested now felt fortunate to have even starvation level pay."[52] When the entire economy was in trouble, the workers had little hope for improvement.

Average pay per worker per year at the Boott had risen slightly by 1902, to $7.8064/week, or $398.13 per a year of 51 weeks. Average 1900 Massachusetts cotton mill employee income was $351.06, placing the Boott slightly above average (in cotton, not relative

to industry in general), as would be expected for a mill making increasingly fine products. According to Robert G. Layer, however, Lowell workers averaged just under 38 weeks of work in 1902, which would have meant less than $300 earned.

In terms of efficiency, Parker calculated that Boott operations were wasteful and over-expensive, utilizing 11.42 hands per thousand spindles, despite its complement of Draper looms, whereas the work should require but 8 3/4 to 9 hands per thousand spindles.[53] Poor pay, perhaps similar to other Lowell companies, and inefficient utilization of people, a bad combination from anyone's perspective.

6. Labor-Management Relations

The paucity of direct evidence in this period requires that most information for assessing labor-management relations comes from reading between the lines in the data. When Agent Cumnock observed in 1875 that in the time from January to April he had more complaints regarding tender yarn than in the three years previous, one hears the faint echoes of innumerable complaints from spinners, weavers, and everyone else working with the yarn because it made their work harder, less remunerative, and of lower quality and came at a time of falling pay, as well. However, there exists no other record of the complaints, in part because there was no grievance mechanism. Cumnock blamed the bad cotton crop.

At the same time and place, the meeting of the New England Cotton Manufacturers Association, Cumnock and others noted and objected to the description by George E. McNeill, a Deputy State Constable, of conditions relating to education and factory children. McNeill quoted a mulespinner:

> *"Am English born, and have been a spinner since ten years of age; have a wife and two children; herself and child, 12 years old, work in the mill, both weaving; the wife, with girl's help, tends ten looms, running 156 picks per minute; some tend eight, some seven, if without child help. Wife and child leave the house four days of the week at 6.20 in the morning, and do not return till about 7.30 at night. Wednesdays and Saturdays they leave home at 5.30 A.M., and on Saturdays go home at about 4.15 P.M., so that they are absent from home on four days of each week thirteen hours, ten minutes; Wednesday of each week fourteen hours; Saturday of each week, ten hours, forty- five minutes, making for absence from home each week, seventy-seven hours and twenty-five minutes. Of this time they occupy about three hours going and returning, and four and one-half in eating dinner at the mill, as they never go home to do that.*

*"For breakfast we manage thus: I get up at 5 o' clock, and wife and children lie till I get the meal ready, then they get up, we eat and start for the mill. Question. Do you mean to say that you get the breakfast? Answer. Yes, sir. Q. Who gets the dinner? A. We make it and put it in the pails over night, because we have no time in the morning. * * * * * "Q. Is this the common way in which operatives in your city live? A. Yes, sir. Q. All of them A. Yes, sir; those that have wives that go to the mill. Q. They all live pretty much as you now describe A. Yes, sir; all the difference will be, that some of them put up their dinners in the morning, and we put up ours at night. "*

I do not know of any city in the State of Massachusetts where all the operatives live in this way. [Cumnock]

Speaking of the manner in which they get their breakfasts, and how they manage their children who go to school, he says:

"I have my youngest child at home; she is ten years old; she gets her own breakfast from what we leave for her on the table. Then she washes herself, or comes to the mill, and we wash her."

Mr. Cumnock: Gentlemen, that is a public document of the State of Massachusetts.

Mr. Sawyer: This shows the bias of the man who is employed by the State of Massachusetts to attend to these matters. Referring to the times, some thirty years ago, when "the agent and the spinner sat in the same church, belonged, perhaps, to the same Masonic lodge, when the deacons of the church were overseers," he says –

"The hands (workmen) were expected to vote as the head (agent) directed, but as both were generally more truly united in interest, it was in most cases less hardship than now.

"Then, the spinner might leave, and become carpenter, teamster, blacksmith or grocer. Now, we have that dreadful thing, a fixed factory population,--not fixed as to locality, but as to handicraft. A hand!! A hind!! An operative!! Brought up in the mill from childhood; lulled to sleep by buzz of the spindles, or the incessant thud of the loom; short of stature, mostly without beard, narrow chested; somewhat stooped; a walk not like the sailor's, but equally characteristic; not muscular, but tough; flesh with a tinge as though often greased; cheeks thin, eyes sharp, --a man pretty quick to observe, and quick to act, impulsive and generous, with a good deal of inward rebellion and outward submission. A lover of freedom,

but not to be humbugged with non-interference theories unless it touches his beer; an advocate of short hours by instinct. Except to obey, the agent and overseer are nothing to him."[54]

McNeill's accounts cannot be overlooked, nor can these men's reaction. They describe the confrontation between the regulatory government and a defensive management.

Work in the cotton mills in this period was not attractive, particularly for the operatives in non-supervisory positions. The work was monotonous, dirty, often hard. Pay was low and pay- cuts routine. Workers in the Boott were handicapped by old and insubstantial buildings badly laid out for their current use. The machinery varied from state-of- the- art to archaic. Yet management also suffered from some of these problems, and their remedies lay beyond the reach of those who worked in Lowell. Only the Treasurer and the Directors, from their Boston offices, could remedy these ills. Cumnock obviously thought "his" mulespinners did not share the difficulties of the one quoted. His feelings tell a good deal about his belief, and deserve consideration. The case cited could be an extreme one. But on the other hand, the quote is likely to be a t least suggestive of a way of life of which we have few glimpses.

The second part of McNeill's account noted a clear- cut change from the early days of Lowell, when workers were seen as an impermanent part of the production process. He saw little opportunity for them to move from one occupation to another. It is significant that the mill managers who saw little truth, apparently, in the mulespinner's tale, did not deny the second story by calling the existence of a fixed factory population untrue. It seems they objected to the description of the person but did not call into question his existence. In any case, their personal indignation appeared clearly: they did not want to believe that they were party to a system which degraded those who worked under their direction.

Despite these men's concern for the employees, important interactions with them take place out of their control. Letters from the insurance company to the Treasurer provide an example:

We acknowledge your letter of this day notifying us of an injury to your employee William Winters on Mch. 24, 1888.

We approve your course in removing him to the Lowell Hospital, and shall be ready to reimburse you for all reasonable expenses incurred in his behalf. Please obtain the affidavits of the witnesses of the injury as to the cause and manner of its occurrence.[55]

The Boott provided medical care, and with the other major Lowell corporations supported the hospital, but the relationship was plainly a legalistic one and a search for useful testimony began immediately. Another letter provided a further view:

> *We are in receipt of your notification of today of injury occurring to employee John Cox on Aug. 17th 1888.*
>
> *From your account we should think no liability could attach to the Boott Cotton Mills, the only question being whether the hatch ought to have been closed. We shall be ready to reimburse you for reasonable expenses for doctor's services.*
>
> *If Cox threatens to make trouble we should prefer to have your agent do something moderate for him, if a suit can be avoided in that way. Please keep us advised of any developments.*[56]

The question of liability was paramount, and though liability was denied, the denial seems weak, both in its concern about the hatch and in the company's willingness to pay small amounts through the agent to avoid the risk and expense of a suit. This willingness appeared commonly in these letters. In effect, it routinely used small pay-offs to prevent suits for damages or continuing claims. It indicated a careful and distant relationship between employer and worker, one in which the power was concentrated on the side of management, for its protection, and in which the worker had few rights beyond immediate care for injuries stemming from a workplace accident.

The power and organization of the owners also appeared in a letter to the Boott Treasurer in 1888 from the Associated Textile Industries. This letter announced an assessment on members "to pay for aid on account of strikes during the year ending April 13, 1888." The Boott owed $133.47 of the $5994.23 total, based on its payroll.[57] In an era which was virtually pre-union for textile employees, employers already confronted them from a position of organized mutual support. Unorganized workers faced not only giant corporations, but also found the companies in league against them.

Strikes during this period were occasional and generally restricted to the members of one of the few craft organizations in the mill. Mulespinners, a predominantly English group known for their skill and the independence that it enabled them to demonstrate, figured in occasional organized disagreements with management. Parker's report cast an interesting light on the resulting conflict and its relationship to technology: "Have estimated for 45,600 new Mule spindles, and specify mules for three reasons: Fine filling yarn

can be made cheaper and better on mules; they take less power; and are cheaper per spindle. You may object to mules on account of the possible trouble with Spinners Unions, and this factor will probably have a bearing on your decision."[58] Despite what appear to be four factors favoring the mule on the basis of both quality of product and price, reservations about their use were anticipated. There had been a strike by Lowell mulespinners during the wage-cuts of the 1870s. The owners had responded with a lock- out of the mulespinners and won the strike. Many of the spinners left the city and those who returned to work could only do so on the condition that they sign " yellow-dog" contracts, a promise not to strike in the future.[59] The overwhelming power of the owners, particularly in a community such as Lowell where they wielded enormous power over the local economy and politics, was not enough to make them comfortable with any group, or individual, which could interfere in any way with their control. So thorough was their opposition to any sharing of power, no matter how slight, that they could be expected to abandon a technology which was full of advantages, except for the skill of those who operated it. That the owners could, and did, organize indicates the degree to which they saw themselves as the rightful arbitors of all interests.

The contrast between the power of the owners and that of the workers was made clear in the attempted strike of 1903. Despite the long hours and low pay, operatives had not drawn together to resist except in the cases of a few craft unions: "These unions were represented by the Lowell Textile Council which as a federation helped coordinate the activities of the craft locals. Its president was Robert Conroy of the Beamers' union, and its fifty- six members represented the unions of the carders, weavers, beamers, mule spinners, loom-fixers, knappers, and knitters."[60] The predominantly Irish- American unions included a few French-Canadians but virtually none of the Poles, Portuguese, and Greeks who had come to play a major role in the Lowell mills.

Claiming a 25 percent cost-of-living increase since 1899, the Council sought a 10 percent wage increase, comparable to that won by Fall River workers the previous year. The agents responded collectively, using William S. Southworth, Agent of the Massachusetts Mills, as their spokesman and rejected the request. When the unions threatened to strike on March 28, 1903, the mills locked everybody out. Management later admitted that the high price of cotton and large inventories of goods would have caused them to close the mills anyway. The workers could not have chosen a worse time. By May, people were hungry, at best, despite efforts at mutual support among the strikers. The mills announced that they would reopen June 1 and re-hire anyone who returned within a week. Boott Cotton Mills claimed a 45 percent return on the first day. Soon most of those who did not belong to a craft union returned and the mills were operating. Many unionists, who held out beyond

the one week period, were never rehired and the craft unions were permanently damaged. The workers who replaced them, in many cases the newer immigrants, received promotions to better jobs as a result, further damaging the union cause in Lowell in the years to come.

The relationship between Lowell workers and the real power in the corporations, the treasurer and investors, was one of extreme distance, geographically and ideologically. Management felt justified in assigning all discretionary judgment to itself, indicating its views of the workers' rights and, presumably, abilities. While it had been able to inflict national economic fluctuations on pay rates, to act from a position of strength and organization while denying that right to labor, in addition to controlling the course of the mill's production, its power would gradually find itself confronted by others who also felt they had a right to a role, as had already been the case with the Commonwealth. The ability to deal with new relationships would be a major factor in the mill's future.

7. Conclusion

Mill #6 went up at a time of new hope after the lost opportunity of the Civil War era. One suspects that the forces behind Lowell operations were anxious to put that hiatus in production, and the mistake it represented, behind them. Their continued faith in their overall pattern of operation and their ability to continue their success was embodied in the new building, its equipment, and labor.

At the time of its erection, they readied new steam and water power to provide the motive force for their increased production. In the purchase and installation of a Swain turbine they demonstrated their ability to call upon local knowledge and production to acquire an efficient new technology.

In equipping the new mill they similarly relied on the offerings of the Lowell Machine Shop and filled the floors with the standard parts of a standard Lowell factory. Where choices were to be made, the agent carefully weighed alternatives, applying the best science of the time to his evaluations. He picked a modern spindle, and new technology, and thus demonstrated the correctness of the faith placed in him. During the course of his tenure he would continue to apply his expertise, studying oil and oiling, determining ideal loom-speeds, and in other innumerable ways examining production in the interest of maximum efficiency.

Given the interlocking nature of the Lowell corporations' directorates, the agent could call upon the expertise of his age in

making his determinations. He did not need to act secretly or to protect his knowledge, the results of his expertise, from the eyes of his compatriots.

The vertical assembly line he created was well prepared to perform the task assigned, the manufacture of a limited number of materials in great runs. High quality and rapid changes were factors to be considered in the production of other mills. Within these limitations the cards, speeders, ring- and mulespinners would churn out adequate yarn to be woven into plain cloth by the simple looms on the floors below.

At the same time that the new mill became one more of a group of similar cogs within, first, the Boott Cotton Mills, and then Lowell (and even many other New England cities), it also serviced the buildings and equipment of the mill complex. Its machine, blacksmith, paint, carpentry, and belt shops worked as steadily as the textile operation in their effort to keep everything running.

As the decades passed, however, the idea of the mill's goal began to change. Fly-frames were introduced and improved the ability to manufacture higher quality roving. Fancy looms better able to take advantage of this new capability appeared and wove more complex and varied cloth. New demands were made on the mill's workers and managers in the effort to maximize the efficiency of the new equipment.

Automatic looms were also purchased and were significant for their demonstration of speed in adopting a radical new technology. From another point of view, they were significant for their impact on the work of those who tended their operation.

The new looms represented the latest in a long line of developments aimed at minimizing the role of an individual worker while maximizing the number of machines a person could run, and thereby the amount of cloth he or she could produce. The new Drapers' potential along these lines was quickly recognized, but their arrival at the time of a shift toward more varied and complex production offered a source of potential conflict between different goals of management.

Work in general did not change drastically. The usual movement toward faster machine speed, the speed-up, and increasing machines per operator, the stretch-out, continued as usual, and only changed more suddenly than usual with the advent of the Drapers. Hot and humid working conditions, dangerous exposed gear teeth and belts, errant shuttles and other dangers were the constant of the textile worker's lot in these times. The air full of fly

endangered everyone's health and led to the characteristic term for cotton worker: "lint head."

The endemic nature of such conditions, and the mill's apparent unwillingness to alter them, led to increasing inspection by the Commonwealth to protect the workers from the effects of the operation of the Lowell system. Efforts were made to police the wages, safety, and ages of the employees.

Wages, while always low, fluctuated as a function of the national economy as the workers buffered the owners from those effects. In addition, production and employment rose and fell with the market; low pay and intermittent work ensured the poverty of the work force.

The economy in which they operated was less subject to analysis than were issues susceptible to engineers' management; if dividends were to be maintained, leeway had to be discovered elsewhere. As has been shown, pay-rates offered a prime opportunity, as did reinvestment in plant and equipment. Both fluctuated wildly. As a result, machinery did not remain current, and working conditions and wages were susceptible to decline.

At the same time, the lack of alternative employment maintained the dependency of the employees on these jobs. Management had long resisted the entry into Lowell of other major employers, and their power as a group was overwhelming. Through their own organization, they were able to prevent their workers from organizing successfully. From the point of view associated with their paternalistic outlook, only they had the capability and right to make the decisions by which the mills, and the lives of the workers, would be run.

This period, 1871 to 1904, thus displays the currents and the tensions according to which the mill's history will continue to be played out. Automaticity versus flexibility, maximum efficiency versus minimum cost, management's interest versus labor's desires will continue to not only contest one another but also intertwine with one another throughout the course of this history.

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4. Samuel Webber, Manual of Power for Machine, Shafts, and Belts, with the History of Cotton Manufacture in the United States (New York: D. Appleton and Co., rev. ed., 1879)

5. " Lowell and Vicinity of Today," Lowell Daily Citizen, 1893 (the source also gives other, conflicting evidence) Flather Collection (F.C.).

6. BCM Correspondence with American Trading Company, 1888, FC.

7. Walter E. Parker, "Report on the Condition of the BCM, Lowell, Mass., 1902" (n. p., 10/1902), FC, pp. 25- 26.

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12. Thomas R. Navin, The Whitin Machine Works Since 1831: A Textile Machinery Company in as an Industrial Village (Cambridge: Harvard University Press, 1950), pp. 182-184.

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22. A.G. Cumnock, "Proceedings," New England Cotton Manufacturers Association, XXVII (10/29/79), p. 60.

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24. Gibb, Shops, p. 652.

25. LMS, OH-1.

26. Parker, Report, p. 6.

27. LMS, OG-2, p. 47.

28. Parker, Report, p. 18.

29. Gibb, Shops, p. 193.

30. Ibid., p. 758.

31. LMS, OH-1.

32. David Cole, Immigrant City, p. 235.

33. George Otis Draper, Labor Saving Looms, pp. 42- 43.

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35. F.A. Leigh, "Repairs in Cotton Mills," NECMA, XIX, 10/27/1875, p. 31.

36. Cumnock, "Proceedings," NECMA, V, 10/20/1868, pp. 23-24.

37. Cumnock, "Proceedings," NECMA, XXVI, 4/30/1879, pp. 15-16.

38. From The American Wool and Cotton Reporter, quoted in Cotton and Rayon Textile Companys: An Analysis of Comparative Investment Values and Opportunities, FC.

39. James B. Francis letter, Proprietors of Locks and Canals Collection (PLCC), DC-2.

40. ''Fire Regulations," PLCC, inside front cover, DC-2.

41. T.M. Young, The American Cotton Industry, p. 4.

42. Ibid., p. 5.

43. Parker, Report, p. 10.

44. Young, Cotton, p. 32.

45. Five Weeks Ending Saturday Evening, November 7, 1874, FC.

46. Boott Cotton Mill Wages and Prices, FC (as are all ensuing figures until noted).

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49. E.G. Young, Cotton, p. 32.

50. Robert G. Tayer, Earnings of Cotton Mill Operatives, 1825-1914, p. 45.

51. Fidelia 0. Brown, "Decline and Fall: The End of the Dream," in Cotton Was King, p. 148.

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54. Letter from American Mutual Liability Insurance Co. of Boston, Mass., to BCM, 3/27/1888, FC.

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56. Letters from Associated Textile Industries to BCM, 4/12/1888, and 3/24/1887, FC.

57. Parker, Report, p. 40.

58. Carol Polizotti Webb, "The Lowell Mulespinners Strike of 1875," in Surviving Hard Times (SHT), pp. 11-20.

59. Shirley Zebroski, "The 1903 Strike in the Lowell Cotton Mills," SHT, p. 45; my description draws heavily on the above account.

VII. PHYSICAL HISTORY 1871- 1904

A. The Counting House

There are no documented changes to the Counting House for the period 1871- 1904, nor are there any obvious alternations that may be attributed to this time frame based on architectural inspection.*

B. Mill #6

Construction of Mill #6 was initiated by Locks and Canals in 1872 (Photograph 14). As only a small number of relatively unimportant drawings and little other documentary evidence has been found detailing the original construction, the following discussion describes existing conditions unaltered from the initial building phase (or in specified instances, documented changes that took place between 1871 and 1904).

C. Exterior

1. General Description

Situated along the northern edge of the Eastern Canal, Mill #6 was built as an "L"-shaped plan, five-story structure measuring 311'-2" x 113'-8" at its longest dimensions. The west section was oriented on a north-south axis, parallel to the canal and measured 237'-9" (29 bays) by 48'-2" (an equivalent of 6 bays). The east section (Photograph 15), perpendicular to the canal and bordering on Bridge Street was put up 113'-8" (14 bays) by 73'-5" (8 bays).[1] The exterior bearing walls were laid without buttresses or pilasters, and rested on granite foundations. The virtually flat roof was surrounded by a low parapet wall. Access to the mill was limited to two octagonal stair towers, one at the northwest corner of each section. The newest section of Mill #6 enclosed 56,491 square feet of floor space, the east section 42,044.

2. Foundations

The foundations at the east, north and west walls were constructed of solid granite blocks. The south foundation sat on the north wall of the canal, bearing on a series of granite capped brick barrel vaults resting on solid granite walls that enclosed the penstocks running

* The drawing file that contained the records concerning the Counting House, stored at the Boott Mills by Locks and Canals, has been misplaced and therefore was unavailable for research and documentation.

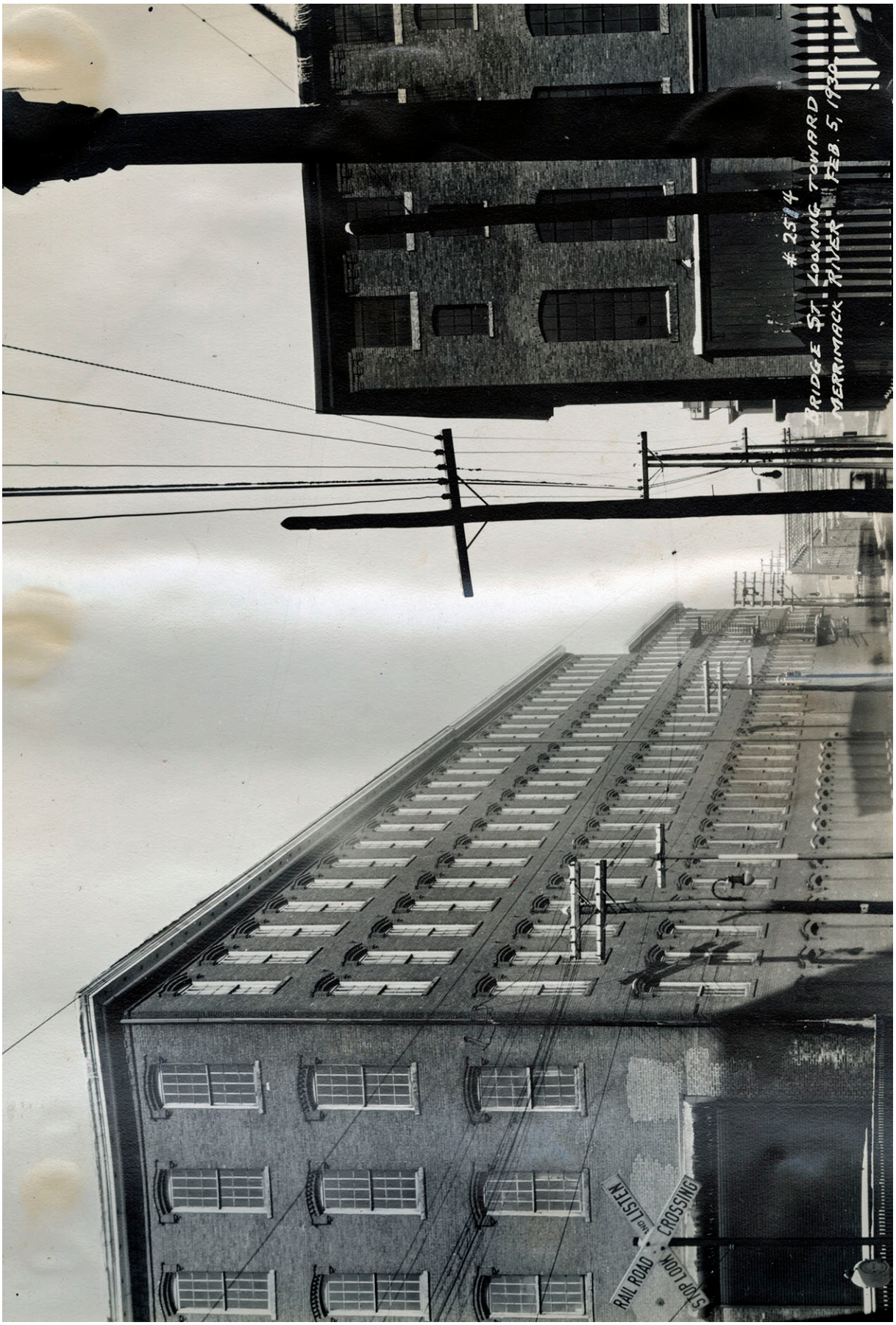


Photo 15. "Bridge Street Looking Toward Merrimack River, February 5, 1930" Note blind arcade of Bridge Street elevation of Mill Number 6
Source: LNHP, Museum Collections, LOWE 8786

under Mill #6, from the third bay from the west end through the 19th bay. Individual three foot square granite piers were constructed (the top course consisting of a single massive stone) to support the first floor framing. The foundations enclosed a crawl space, with access provided to service the penstocks through the floor above (see Appendix A for a description of existing conditions of the crawl space).

3. Walls

The exterior load-bearing masonry walls were laid in "American" (or common) bond, 7:1 (stretchers to header course) using medium density machine made 2-1/4" x 4" x 8" (nominal size) salmon to dark red brick. Mortar joints were struck flush.[2] Wall thicknesses are recorded on a section prepared in the 1870s[3] as 24" for the first two floors, 20" at the third and 16" for the fourth and fifth floors in the east part, 20" at the first two floors and 16" for the third through fifth floors in the west.[†]

The walls were solid masonry, unplastered but painted at the interior. As mentioned, there were no strengthening wall pilasters or buttresses inside or out, and no belt courses in the main blocks. However, the mill was enriched by a simple corbeled three- course, projecting, brick continuous cornice that surrounded the eaves, supported by six-course, deep corbeled pendant-like brackets that terminated at a two-course brick string course.

4. Fenestration

All windows in the east and west sections were set into 4'-0" x 8'-7" segmental arched openings, the openings trimmed at the head by projecting brick hoods and closed by rock-faced granite lug sills. The hoods were constructed with a row of standing stretchers alternating with stacked headers below a projecting cap of headers laid flat. The ends were trimmed with pendants that dropped three courses below the lower chord of the segmental hood. A full stretcher in width, the pendants terminated with a centered header over a queen closer. The hoods at the second and fourth floor windows were visually accented by setting the lower course of the arch face flush with the wall surface and toothing the upper course at 45 degrees. The granite sills were described and sketched by Whitaker (Figure 17) in 1872 while the mill was under construction: "sills for windows 52" long... granite sills 4-1/2" deep, 8" wide, 52" in length."[4] The 12/12 wood double hung sash measured 3'-8" in width, with the upper section 4'-1/2" high, the lower sash 4'-1-3/4". The lites were 10" x 15", and of clear glass. The timber casing

[†] Field measurements made in 1984 show that the only discrepancy from this section was that the walls at the first and second floor in the east section were only 23" thick.

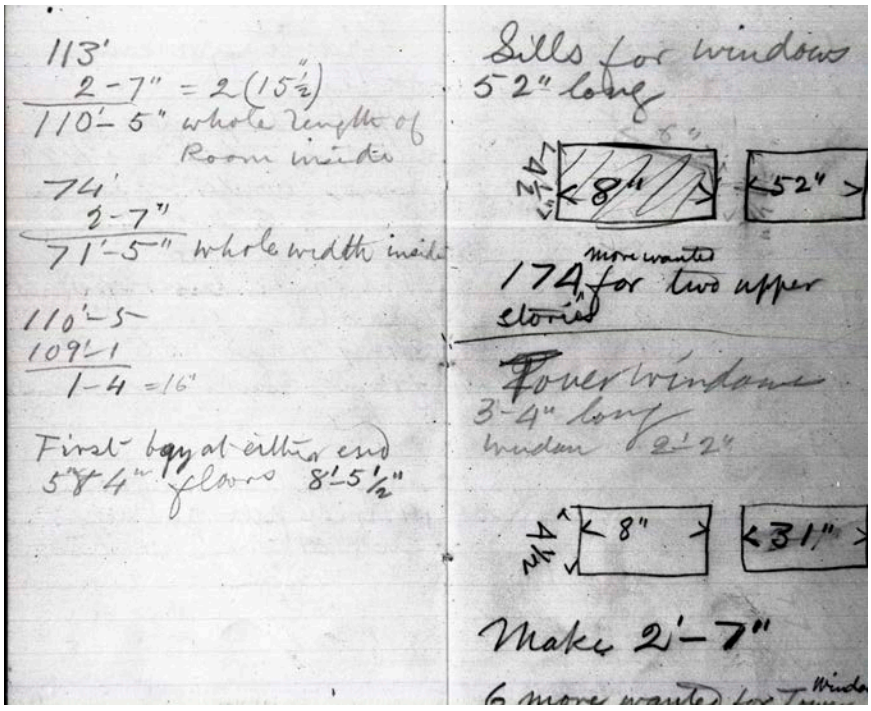


Figure 17. Detail of window sills for Mill Number 6, from Channing Whitaker's sketchbook, undated, but pre-construction
Source: UML, CLH, Lambert Collection (Channing Whitaker's Sketchbook), undated.

had a heavy ovolo mold at the jambs and head, with the segmental head returned to the horizontal to accept the rectangular sash.

Whitaker describes the location of the windows in the south elevation as: "7'-6" from Bridge Street wall to middle of 1st window, 8'2-1/2" to centre of each succeeding window…"[4] and for the east wall, "Beginning at Bridge St. Side at the Canal End the 1st middle of window is 4'-4" and the succeeding ones each 8 feet from center to center, the last being 4'-4" from centre to outside edge of wall."[5]

The blind arcade at the first floor of this east facade is an unexplained anomaly (Photograph 16). Consisting of full height openings with the typical corbeled brick hoods and rock- faced sills, they are bricked in, recessed 4", with no indication of the infill being later. As they occur in the wall that runs along the coal pocket, they may be the original condition.

The north facade fenestration or "windows in the yard" were spaced, "4', 11'-11", 19'-10", 27'-9", 35'- 8", 43'-7"."



Photo 16. Bridge Street facade of Number 6 with blind arcade, June 1985
Source: LNHP, Museum Collections, LOWE 8786, HAER, MA 16, 1985

5. Roof

While the original roof covering is not documented, a five-ply tar and gravel roof was uncovered during the 1980 reroofing. This roof conforms to specifications for similar construction at the turn of the 20th century (Appendix B) and in all probability is either the original roofing or a replacement made before 1904 (Photograph 26).

The six-course, corbeled, brick roof cornice described above was surmounted by a pressed metal cornice (cyma-recta crown on a square fillet and a cavetto bed mold) which projected 6" ± above the finished roof.

6. Coal Pocket

The extreme easterly two bays of the first floor in the south elevation was occupied by an entrance to the coal pocket, a facility that permitted the off-loading of coal from railroad cars at the rear of Mill #6 to fire the boilers located to the north. Entry was provided through a rectangular opening, 11'- 0" wide by 8'-11" high[6] with a segmental arch hood (header, standing stretcher, and header laid flat as a cap), with the tympanum bricked in to the horizontal (Photograph 17). The second bay of the first floor was partially taken over by this opening, therefore the window was omitted. The large rectangular door was clad in metal (to retard the spread of fire) and slid to the west (left) on an iron channel that was secured to the edge of the window in the third bay (Photograph 18). The coal pocket was served by a spur from the Boston and Maine Railroad line along the south edge of the canal, over an iron framed bridge that had a timber plank floor and wood picket fences, approximately three feet tall.[7]

7. Stairwells

The exterior of the stair towers located at the northwest corner of both sections of the mill were identical in design. Octagonal in plan, 17'-3" along the north and south walls, 19'-2" along the entrance or west facade, the towers were built of the same salmon to dark red brick as used in the mill proper, with flush joints, but the coursing varied from 7:1 to 9:1. The foundations were rock faced granite.

The entrance to the mill were at the first floor of each tower, centered in the west wall and protected by bracketed hoods (Photograph 19). They were served by three granite steps which reached the height of the stone foundation course. The entrance hood spanned the entire west wall area, from inside edge of the full height pilasters that formed the corners of the octagonal plan to inside edge. A

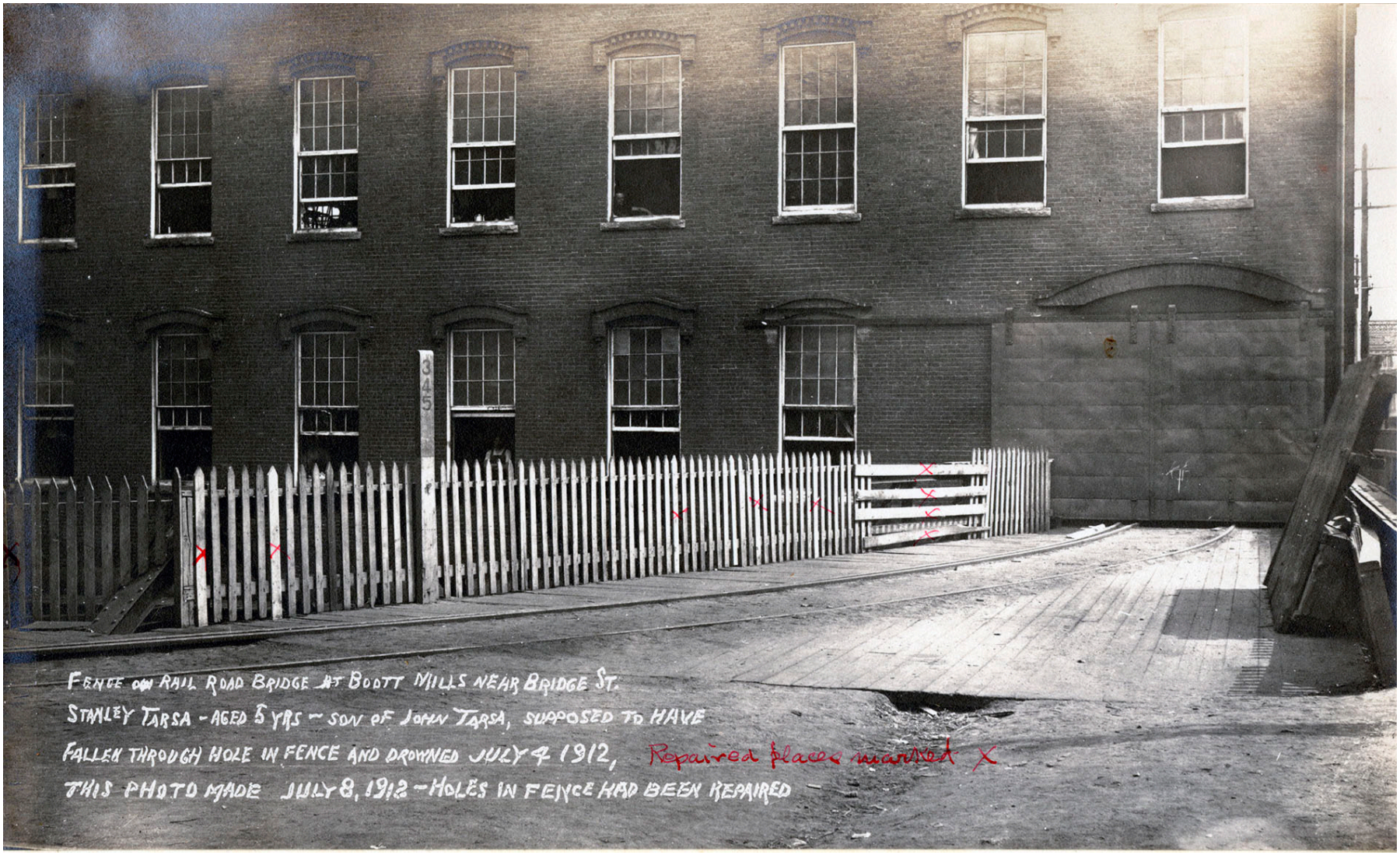


Photo 17. "Bridge and Coal Pocket at Mill No. 6 (1912)." Note wood picket fence and sliding door
Source: LNHP, L&C, LOWE 7638



Photo 18. Side Track and Bridge to Coal Pocket of Boott Mill, Sept. 3, 1926" showing original design of Coal Pocket and sliding door
Source: LNHP, L&C, LOWE 8514



Photo 19. Boott Mill Number 6, June 1985
Source: LNHP

sheet metal cornice at each hood had a cyma-recta crown mold on a rectangular fillet and flat fascia. A segmental architrave panel had an ovolo on cavetto crown under the soffit of the projecting cornice. The entire construction was supported by large sawn and paneled scrolled consoles.

Windows occurred only in the north, south and west wall of the towers, from the second through the fifth floor--the first floor was blind. All windows were set in recessed panels at each floor level, the panel at the second floor rectangular with a single corbel at the top edge, the panels at the third and fourth, segmental. The third floor had a granite belt course above the panel that swelled over the segmental opening and returned across the entire tower, while the fourth floor had toothed corbeling at the top of the ached opening. The fifth floor panel was enriched with four-course deep drops set flush with the outer wall surface. The wall surfaces in the angled pat of the tower were recessed but blind, all with horizontal tops. The fifth floor repeated the pendant drops and granite string courses that lugged into the walls at the bottoms of the panels. The window openings at the second through the fifth of the floors were detailed the same as the windows in the corresponding floors o he mill proper, and had rock-faced granite sills, described by Whitaker as: "tower windows make 2'-7", 6 more wanted for tower windows [sketch] 4-1/2" x 8" x 31"."[8] Sash at the second and third floors of the towers were double hung, 1'-11-1/4" x 8'-7", while those in the fourth and fifth were shortened to 6'-7". All sash was 6/6 wood.

In addition to the rock- faced belt course at the fourth floor level, there were granite bands at the bottom edge of the other recessed panels, at the floor lines. The sixth (top) floor of each tower projected slightly from the wall surface below, resting on an 8" bank of rock-faced granite that returned around the corner pilaster strips. The band projected 5" from the wall surface, with two courses of brick above, and was supported on seven course deep pendant brackets below course a single course of brick. The drops consisted of two stretchers at the top, followed by four courses of stretcher/header, a single stretcher, and a centered header.

Unlike the first five floors, the top level of each tower had a window in each of the eight walls, with a round opening and a projecting corbeled cap resting on drop pendants. The 1/1 sash is round-headed. The recessed panels at each wall surface of his level had a horizontal top edge with corbeled drops, the panel enclosed by the corner pilasters. The corbel band at the sixth floor line was repeated at the roof line, with a projecting pressed metal cornice consisting of a cyma-recta crown, rectangular fillet, and flat fascia terminating the tower structure. Both tower roofs were enclosed with a cast and wrought-iron balustrade, which are documented by numerous photographs and prints made pre-1950 (Figure 14 and Photographs 14, 23, 24 and 26).

8. Fire Escapes

Records of the Lowell Machine Shop (LMS) on file at Baker Library, Harvard University, document the installation of fire escapes, $1719.49... sent Sept. 1"

D. Interior

1. Floor System

Paired 6" x 12 " Southern yellow pine timbers were used as the transverse beams to support the first floor of Mill #6. They rested on 9" deep, 16" wide by 30" tall brick piers along the north and south walls, the piers sitting on a corbeled shelf of the granite foundation. The beams ran from the exterior wall to a row of granite blocks at the middle of the west section, and at the third points in the east part. Cast-iron columns passed through the beams to rest on the supporting piers, with the composite floor beam notched to accept them. The first floor beams were bolted together in three places, but unlike the beams in the floors above, were not attached to the exterior load-bearing masonry walls with anchor bolts. The span of the beams at the first floor was 22'-4", 24'-0", 8'-4" from the west wall of the east part to the columns that define the three bays. The narrow spacing at the east reflected the introduction of a masonry wall to close off the coal pocket from the mill itself. Column and beam spacing was 8'-0" in the west, 7'-10" in the east.

The floor beams at the second through the fifth floors were also of a composite design, of a slightly larger section (6" x 13" each) and of Southern yellow pine. Unlike the first floor beams, these were constructed with a 1" to 1-1/2" space between the individual members, a common practice recommended by many millwrights of the period (Appendix C).

The spacing of the beams at the upper floors was constant, 8'-0" in the west section, 7'-10" in the east, the dimensions agreeing with statements in an 1882 Boston Manufacturers Mutual Fire Insurance Company (BMMFIC) report:

> *The beams may be either 8 feet apart, 9'-6" or 9'-8" apart, or 10'-6" to 10'-8" apart. In the latter case, nothing less than plank of 4 inches thickness should be used for the under floor, unless girders and intermediate beams are supplied. With respect to the details, the preference may perhaps be given to bays 8 feet only in width, for the reason that a floor constructed of 3-inch plank and 1-inch top floor, over 8-foot bays, is amply strong as compared to one of 4-inch plank and 1-inch top floor, over a bay of 10 feet 8 inches, and planks of 16*

feet in length form a part of the common stock.[9]

The paired timber beams were let into pickets at the exterior walls, with additional support at the east section provided by five course corbeling at the top of the east and west longitudinal walls. The pockets had narrow open spaces along the vertical sides: Where beams pass through the walls, ventilation should be assured by placing a board each side of the beam while the walls are being built up, and afterward withdrawing it" and rested on iron plates.[10] The ends of each of the beams at the second through the fifth floors were secured by tie bolts through the walls, contrary to recommendations published in 1885:

> *In mills, where the amount of vibration is great, Woodbury advises to securely bind the beam to the wall by embedding in the masonry a flat cast iron plate with a transverse fin upon each side near the end.... Under no consideration should the old-fashioned anchorage of fastening the girder on the outside of the wall with a large anchor plate be used, as when the beams burn through, the leverage brought to bear on the wall will overturn it.*[11]

The anchor bolts used at Mill #6 were wrought iron, 3/4" in diameter, 40" long with a 2-1/2" threaded end that was bolted at the exterior face of the load-bearing exterior wall using a diamond shaped cast iron plate. The end of the anchor bolt toward the interior had a 1-3/4" long hook that wrapped around the first of the three bolts that fastened each part of the composite beam together. The beams were treated with whitewash, as explained in recommendations of 1885: "Ordinary whitewash is a cheap and excellent coating against fire. It adheres tightly to the wood, impregnating it to a certain depth, and, when frequently replenished will form an excellent protective coating."[12] This probably reflected an early awareness of potential problems addressed in an English article published in 1884, quoting the Boston Manufacturers Mutual Fire Insurance Company: "Wherever and whenever solid beams or heavy timbers are made use of in the construction of a factory or warehouse, they should not be painted, varnished, oiled, filled, or incased in impervious concrete air-proof plastering or metal, for at least three years, lest fermentation should destroy them by what is called dry rot."[13]

The length of the beams varied slightly, becoming longer from the first floor to the fifth, reflecting the decreased thickness of the exterior walls as the structure rose. Lengths in the west section increased from 27'-4" in the north bay of the second floor to 27'-9" at the fifth, and from 27'-5" in the south bay to 22'-10". At the east part, they varied from 23'-0-1/2" in the west bay, and 23'-9" in the center bay of the second floor to 23'-8" and 23'-11" respectively at the fifth floor. The span from the east row of columns and the

Bridge Street wall at the third floor (over the coal pocket) is 23'-6", increased to 23'-9" at the fourth and fifth floors.

2. Floors

The floor system was of slow-burn construction, with 2-3/4" to 3" x 8 to 12" spruce planking, splined and nailed directly to the beams. Typical slow-burn construction is described as: "three inch plank, planed on one side and grooved on both edges, laid planed side down,... the hardwood splines are inserted into the grooves before the planks are pressed up and spiked to the beams."[14]

Similarly, the use of splines, and the suggested length of the planking was detailed in a report printed in 1902 and followed here:

> *Splined planks have a groove cut in each edge into which a spline is driven. Thus they serve the same purpose as though tongued and grooved, and are cheaper because there is not so much timber wasted in cutting them. They should be planed on one side and should be long enough to span two bays; that is, 16, 20 or 21 feet, as the case may be. By this means the joints can be broken on the timbers and the strength greatly increased when laying them. About 6-inch spikes should be used in fastening them to the timbers; one keg of 100 pounds will lay about 1,400 square feet of floor.*[15]

Two layers of additional flooring were applied to the planking, each 7/8" thick, with enough remaining in situ at the second and fourth floors to indicate that the sub-flooring throughout the mill was 4" wide, laid diagonally. The finish floor was laid in the same direction as the planking, as suggested by the BMNFIC:

> *Usually a top floor of birch or maple is laid at right angles to the planking, but the best mills have a doubletop floor, the lower one of soft wood laid diagonally upon the plank, the upper one laid lengthwise. This later method allows boards in alleys to be easily replaced when worn, and the diagonal boards brace the floors, reduce vibration and distribute the floor load even better than the former method.*[16]

As also recommended in another BMMFIC report of 1902, the layers of flooring were separated by the application of tar paper: "To protect the content of the floors below, three thicknesses of tarred paper should be placed between the floor plank and top floor, each layer to be mopped with tar, asphalt or similar material..."[17] This same report recommends that "The edges of the floor plank should be kept clear of the faces of the brick walls by about half an inch, in

order to obviate the danger of cracking the walls, which sometimes occurs from the swelling of the plank when laid close against them."

The floors at No. 6 included this 1/2" space, and as further recommended, the granite thresholds at the stair tower entrances to the mill at all floors were raised 1-1/2" above the finish floor level to contain water in the event of fire, the flooding to prevent the floor from igniting (Appendix D).

The space between the floor beams was sheathed with 9/16" tongue and groove boarding, creating a ceiling-like finish to the space below.

3. Columns

The floor beams were supported in the west section by a centered row of cast- iron columns, 8'-0" on center, and in the east part by two parallel rows, located at the third points of the flood plan (Photograph 20). The columns were "grey cast iron" and had a wall thickness of 13/16". The diameter of the pipe-like columns varied from 6-3/8" at the lower three floors to 5-1/2" at the fourth and 5" at the fifth. Room heights, from finished floor to the underside of the beams were 12'-0" at the first in both sections, 12'-2" at both parts of the second floor,[18] 12'-0" at the west part of the third, 11'-9" at the east and 14'-4" at the fifth (where the beam was actually a girder that ran parallel to the long axis of each part, exposing the low gable profile of the roof).

An "Extract from Daybook No. 17, 18 71-1876" prepared by James B. Francis, Engineer of the Proprietors of Locks and Canals, describes his calculations for "pillars for the No. 6 Boott Mills:

June 3, 1926

Extract from Daybook No. 17, 1871 - 1876

Pillars for No. 6 Boott Mill

March 25, 1872	Area of Floor supported by one pillar 23-1/2 x 8 = 188 sq. ft.	
Size Reduced to Col. 2 page 22, my book on pillars	5th Story. Pillars supporting roof - 14 ft. long	
	Weight of roof called same as floor or	21
	Snow on roof, say 24" = 4" water =	21 lbs. per sq. ft.
Reduced weight	Total weight per sq. foot	42 lbs.
	Weight supported by pillar 42 x 188 7896 lbs. = 3.95 tons	
2.62 tons		
4" x 1/2"	14 ft. long say 4-1/2 inches diam. 5/8 inch thick	

	4th Story. Weight of 5th floor	21 lbs. per sq. ft.
	Weight of cards, taken same as Atlantic	24 lbs. per sq. ft.
		45 lbs. per sq. ft.
	Weight to be supported by one pillar 45 x 188 = 8460 =	4.23 tons
	Total weight to be supported by pillar in 4th story =	8.18 tons
4-1/2 x 5/8"	13 ft. long, say 5 inches diam. 5/8" thick	
	3rd Story. Weight of 4th floor	21 lbs. per sq. ft.
	Weight of cards as above	24 lbs. per sq. ft.
		45 lbs. per sq. ft.
	Weight 45 x 188 = 8460 lbs. =	4.23 tons
	Total weight to be supported by pillar in 3rd story =	12.41 tons
5" x 5/8"	13 ft. long, say 5-3/4 inches diam. ¾" thick	
	2nd Story. Weight of 3rd floor	21 lbs. per sq. ft.
	Weight of ring spinning frames as Atlantic	25 lbs. per sq. ft.
		46 lbs. per sq. ft.
	Weight 188 x 46 = 8648 lbs. =	4.32 tons
	Total weight	16.73 tons
5-1/2 x 3/4	13 ft. long 6-1/2 inches diam. ¾" thick	
5-3/4 x 5/ 8		
	1st Story. Weight of second floor	21 lbs. per sq. ft.
	Weight of looms	22 lbs. per sq. ft.
		43 lbs. per sq. ft.
	Weight 43 x 188 = 8084 lbs. =	4.04 tons
		20.77 tons
6- 1/2 x 5/8	13 ft. long 6-3/4 diam. 7/8" thick	

Copy of above sent to Mr. Cumnock March 25, 1872

The columns were cylindrical (not tapered) and were provided with a cast, foliated cushioned cap that incorporated a flat, rectangular cast iron plate that supported the ends of the floor beams (or in the case of the top floor, the roof girders). A round, cast pintle was centered in the top face of the cap plate, used to align the column from the floor above, which bears directly on the plate. The composite beams, as mentioned, were adzed out to accept the columns and were fastened together with horizontal flitch plates, secured with four iron bolts. The use of the pintle and cap plate is condoned by millwrights of the late 19th century: "At the points of support in a line of columns, the beams should be free from all compressive stress, transmitted through the lines of columns from floors above, by means of iron pintles between the cap of one column and the floors of the next one carrying this load."[19]

The use of cast-iron columns at Mill #6 continued a tradition that lasted until 1880 when with the construction of Mill #9 (and subsequent mills), Locks and Canals finally heeded the advice of a number of engineers and turned to the use of timber columns (Appendix E).

4. Roof Structure

The roof in the east section of the mill was supported by 3" x 11" spruce rafters that rested on a four- course brick corbel at the top of the east and west fifth floor walls, and two roof beams, (more properly termed girders) that ran parallel to the north-south axis of this section, seated on the parallel rows of cast iron columns. This divided the open roof area, as was the case with the floor beams below, into three 112' ± long bays, with the underside of the entire roof structure exposed. The parallel beams were 10" x 12", of a single piece rather than paired like the floor beams, and were put up in five sections, all with bolted iron plates at the joints. The roof framing in the west part was identical except there was only a single 10" x 12" beam along the center line of the east-west axis. The roof was planked using 1-5/8" x 12" boarding. The ceiling area between the joists was finished with 3/4" beaded edge boarding similar to the ceiling in the floors below.

5. Interior Walls and Partitions

The interior face of the load-bearing peripheral walls were painted (probably whitewash originally, no paint analysis having been completed to date). The double row-lock (standing header on standing header) window openings had splayed jambs (2" at each side), and brick stools without wood trim that vary in depth from 10-1/2" at the first floor in the west part to 6" at the fifth, with the deepest being 14-1/2" at the second floor of the east part. Sill heights varied from 2'-8" at the lower floors to 2'-4" at the fourth floors of both sections. The windows were set high in the wall surface, the top row of the row-lock arch only three courses below the finished ceiling, reflecting current thinking: "The top of the window should be as near the ceiling as practical, because light entering the upper portion of a room illuminates it more evenly, and with less sharply marked shadows, than where the windows are lower down."[20]

a. Interior Doors

Entrance to the individual mill floors was provided at each level of the stair towers through paired doors. Based on the literature of the period and the use of similar construction elsewhere at the Boott Mills, the doors were likely to have been metal clad wood doors rat her than rolled iron:

> *Experience with iron doors of various forms of construction show that they have been utterly unreliable in resisting the heat of even a small fire. They will warp and buckle so as to open the passageway and allow the fire to pass through the doorway into the next room. A door made of wood, completely enveloped by sheets of tinned iron, and strongly fastened to the wall, has proved to resist fire better than any door which can be applied to general use. The door should be made of two thicknesses of matched pine boards of well dried stock, and thoroughly fastened with clinched nails. It should be covered with heavy tin, secured by hanging strips, and the sheets lock-jointed to each other...*[21]

The doors were 8'-0" tall, with each leaf 2'-6" wide, and were hung on butt-hinges attached to the 4" beaded casings that framed the double row-lock openings. The use of double-leafed, hinged doors would later be discarded.

> *Sliding doors are preferable to swinging doors for many reasons, especially because they cannot be interfered with by objects on the floor. But, if swinging doors are used, care should be taken that the hinges and latches are very strong, and securely fastened directly to the walls and not to furring or anything in turn attached to the walls.*[22]

A further description of the construction of such doors and their value was published in England in 1894:

> *The American door is made of two thicknesses of matchboards, not more than 4 in. wide, laid at right angles and nailed together. They are covered by tinned plates, lock-jointed and nailed under the joint, the sheets being bent round the door, so as to have no seams on the edges. The doors are hung on sloping rails, and are kept open by fusible solder attachments which melt at a temperature of 162 degrees F. Doors so formed and protected have been shown to be practically indestructible with ordinary fires.*[23]

The use of so called fire proof doors at Mill #6 is substantiated in a letter written in 1883 by James Francis to A. G. Cumnock, the Agent at Boott Mills, mentioning "the fire proof doors in the partition wall of the 3rd and 4th floors of No. 6…"[24] Iron lintels above the double, row-lock, arches of the entrance doors, at the mill room side of the tower-mill connection, may or may not be of original construction.

Material handling was accomplished by the use of hoists (see discussion on the interior of the stair towers below) served by dumb-waiter like openings set into the wall area just to the north of the door openings in each tower. The service openings were 42"

wide and ran from the floor to a double, row-lock, arch set one course below the entrance door openings. The hoists had iron-clad doors set on a cable and slide arrangements, opening vertically into the recessed opening. The opening was framed with an iron lintel at the mill side, with the area above this to the arch infilled with brick. An original door remains in situ at the fifth floor east tower.

Also of apparently original construction but of an unknown use is a 2′ x 3′-6″ rectangular opening centered above the entrance doors at the fifth floor of the east tower. A 1′-0″ x 4′-6″ brick stack was centered in the west end wall of the west section, from the first floor through the roof where it terminated at the chimney.

b. Masonry Partition Wall

A load-bearing masonry partition (Photograph 21) was constructed at the intersection of the east and west sections of Mill #6. Running on a north-south axis, the wall was 1′-11″ thick at the first two floors, 1′-8″ at the third through fifth floors, with communication between the two sections provided by two large triple row-lock arched openings (headers on edge). The south opening measures 14′- 2″ wide, the north 18′-0-1/2″. The arches were strengthened by 2″ diameter iron tension rods set at the spring of the arch. The easterly pair of floor beams in the west section, at all floors, are through- bolted to the west side of this wall with additional support given by corbeled brackets. The opposite side of the partition has a continuous corbel table to support the ends of the floor beams that span the east part on an east-west axis.

6. The Paint Shop and the Blacksmith Shop

When built, the first two floors of Mill #6 housed four workshops; the paint, carpenter, blacksmith and machine repair shops. The 1882 Barlow Insurance Survey locates these shops: “First story, division at north [actually the west] end, blacksmith shop… second story, north [west] end paint room; main portion, carpenter shop.”[25] The blacksmith shop at the first floor and the paint shop at the second floor of the west end of the west section of the mill were enclosed in a fireproof construction consisting of a concrete floor at grade and barrel vaulted brick ceilings at both levels, set off from the remainder of the mill by a solid masonry wall, two wythes of brick thick (16″) that extended from the first to the underside of the third floor. The resulting space was three bays wide, 24′-0″ with each bay incorporating a single vault. The beams to support the brick vaults were ordered in 1872: “Wrought iron beams for the fire proof floor over the smithy & paint shop at the Boott Cotton Mills, length of beams between bearing, 23′.”[26]



Photo 20. Cast iron columns at first floor of Boott Mill Number 6, June 1985
Source: HAER, NPS MA-16, 1985



Photo 21. Connecting wall between east and west sections of Boott Mill Number 6, third floor. June 1985
Source: HAER, NPS, MA-16, 1985

The range of vaults at both levels terminated at the west end wall and at a masonry fire wall thirty feet to the east. The vaults rested on three course brick corbels. (The 3/4" iron tie rods used during construction remain, but they were superfluous after the barrel vault had been keyed.) The iron beams in the second and third bays were supported by cast-iron columns, part of the centered row that supported the timber floor beams in the adjoining areas of the west section of the mill.

The purpose of this type of construction is obvious:

> *Fire-walls are brick interior walls arranged to separate portions of the mill in which processes involving a greater risk of fire are carried on, from other portions of the mill. They should be carried down to secure foundations like the other walls of the mill and carried up through the roof, so as absolutely to intercept the progress of a fire and prevent its spreading and destroying the entire plant. They should contain as few openings as possible, and these should be thoroughly protected with automatic fire-doors, the construction of which will be explained later.*[27]

7. The Coal Pocket

A solid masonry wall was constructed at the east end of the east section to separate the mill itself from the enclosed entrance to the coal pocket at the rear of Mill #6. This passageway between the Bridge Street end wall and the first floor of the mill was 11' wide[28] and enclosed a track that consisted of "two 9 inch street-car rails supported on 18", #55 I-beams spaced about 11-1/2' apart."[29] Access was provided by "bridge No. 345 across the canal":

> *This bridge consists of two Pratt trusses, between which are cross-ties (8" by 14" average) which rest on the lower chords of the trusses. There are wooden stringers on top of these cross ties, with 4" planking above the stringers. The rails rest directly on the 4" planking. One truss is at right angles to the canal, while the other crosses diagonally in order to take care of the curve in the track. This means the ties on the Amory Street end 3 of the bridge are something over 27' in length between the trusses.*[30]

The paired timber beams spanned the full width of the coal pocket at the second floor, tying into the east wall where they were secured with the typical wrought iron tie rods. (Presumably the underside of the second floor would have been whitewashed to retard fire, but nothing remains of the original construction except the infilled pockets for the beams.)

8. Interiors of the Stair Towers

The interior of the octagonal stair towers located at the northwest corners of both the east and west sections of Mill #6 were finished in much the same manner as the mill itself. Walls were exposed, painted brick, the floors were framed with timber beams let into pockets at the north and south walls and sheathed with 3-1/2" plank and a finished floor, and the windows were set in splayed openings with row-lock arches and brick stools. The paired iron-clad wood doors leading to each floor of the mill were secured to 4" timber casings in the segmental row- lock arched doorways. The hoists previously mentioned were located contiguous to the doorways, separated by a 16" segment of the wall to the north. Set into the northeast corner, the hoists were accessible from both the tower and the mill side for loading and unloading.

Records of the LMS dated 1/29/73 provide the only known description of the hoists: "2-3 1/2 f. x 5 1/2 xf. Elevators, ready for service without line weights or Ropes for 5 floors ea. for #6 Mill… $2,079. 85."[31]

Stairs were located in the southern one-third of each tower, running in an elongated oval plan from the east wall to the west where they exited at the next floor. Each floor was reached by 20 treads and 21 risers at 7 3/4" in height. The construction spiraled around an open 6' 6" wide well, the ends semicircular in plan. The length of the treads was uniform at 4'0". The location of the stairs was consistent with the thinking of millwrights in this country since the start of the 19th century, but the choice of an oval plan without landings had been discouraged:

> *…the stairways should be placed outside the building. Such stairways should not be spiral stairways, but should be made in short, straight runs with square landings, because in the spiral stairway the portion of the stair near the center is of so much steeper pitch that it renders them dangerous when the help are crowding out of the mill.*[32]

And:

> *The best method of making stairways is to divide the flight by making a landing half way up. This construction makes short, straight flights and there is much less danger of crowding in the case of fire, while at the same time they will be found convenient on all occasions. In cases where spiral stair cases must be used, although they are not to be recommended, care should be taken to have the central pier large enough to insure a proper width of tread on the inside of the stairs.*[33]

The stair treads were protected with cast iron plates, with Boott Cotton Mills cast into the face. Manufactured by American Safety Tread (Lowell) and used in many of the other mills on the site, the plates were installed because: "The wear of stairs from the tread of many feet presents a difficult problem. A very common practice consists in covering each tread with a thin piece of cast iron marked with diagonal scores, and generally showing the name of the mill."[34]

The stair construction ran from the ground floor to the sixth, with access to the balustraded roof of the tower of unknown design--probably a simple ladder stair to minimize the roof opening. The stairwell was sheathed inside and out with beaded tongue and groove matched boarding and had a molded rail cap and an excellent, heavy, turned starting newel. The enclosure rose as a continuous well for its entire height.

9. Mechanical Systems

a. Heating

Mill #6 was warmed by a central steam heating system fed by boilers located in a boiler house north of Mills 1 and 2. A pair of 30" x 60" twin[35] Corliss steam engines were installed in 1874-75, replacing earlier models. (There were 30 steam engines generating 3690 steam horsepower at the mills in Lowell in 1870.)[36]

Steam heat had been in use in British Mills since the first decade of the 19th century and had been adapted by almost all textile mills in America by the decade preceding the construction of Mill #6.[37] An article "Statistics of Cotton Manufactures in New England 1866" stated that of 47 New England mills surveyed in that year, 43 were heated by steam, two by wood stove and one by coal stove.[38]

While steam was the accepted source of heat, the location of the required piping was to be debated for the next 40 years. At Mill #6, however, the original steam heat pipes were fixed to the lower section of the exterior walls, below the window stools on wood blocks. Rows of 2" x 7-1/2" vertical wood nailers were inserted in the brick walls between each bay at all floors, set three courses below the window stool line. Many mills initially selected the location of pipes as suspended from the ceiling, yet the use of the peripheral walls found considerable favor during this period for a number of reasons:

> *I wish to say one word in reference to the wording of the notice in your circular. It seems to imply that something new is to be said upon this subject, or that the plan of overhead heating is new. Now, that plan was in vogue twenty years ago almost universally; but it*

> *gave a great deal of trouble, on account of the kind of pipes used. These were large cast iron-pipes, and expansion and contraction caused the joints to leak, and water continually falling from the overhead was a great nuisance in almost any manufacturing establishment. Perhaps that, as much as any other one reason, led to bringing the pipes down to a lower level.*[39]

Despite the remarks of "Mr. Grinnell of Providence" that he would place the pipes "within six or eight inches of the ceiling," J. W. Cumnock, agent for Boott Cotton Mills at this time, adamantly disputed the ceiling location, primarily because of problems associated with a potential conflict between the belting and shafting and the pipes:

> *If those pipes are put in the center of the mill (at the ceiling), running lengthwise, I must go over them, through them, or under them with the belting. Everyone knows that when belting goes under a pipe, if it strikes it, it is apt to make a leak. If you run six or eight lines of pipe through a mill, and then belt over it, as you would have to do by this system, I think you will find it impractical.... In the mills I mentioned, where I am agent, the machinery has been altered over five or six times. If the gentleman put up his pipes the first time, they might not be right five or six years hence, and consequently they would all be taken out.... My men put up pipe more quickly on the wall than they can on the ceiling. So far as the piping goes, it is entirely out of place for me [at the ceiling].*[40]

This article, published in 1880, documents the location of the steam heating pipes at the walls at the Boott complex, which is confirmed in the 1882 Barlow Insurance Survey of Boott "Heating: Steam pipes around the sides of rooms."[41]

b. Ventilation

Despite dire warnings promulgated by the likes of Lewis Leeds in a series of lectures presented in 1866-67 and published in trade journals in 1871, the problem of "vitiated air" was not addressed at Mill #6, except through the traditional procedure of opening the double hung sash. A report submitted to the Boott Mills in 1916, in addition to commenting on "the antiquated steam heating system" states that there was "no artificial ventilating system."[42]

c. Sanitary Facilities

While no records were discovered dealing with the provision of sanitary facilities at Mill #6, prior to 1906, it is obvious that such did exist from the time of the opening of the mills. It is speculated that the toilet and washroom facilities were clustered at the masonry

party-wall that links the east and west parts of the mill, along the south wall, providing convenient access to the Eastern Canal directly below. It is not known if separate facilities for men and women were provided at each floor--if this was the case, as it was in later years, the spaces were probably set off from each other by the brick wall, using it is a convenient partition and anchor for the disposal drains.

d. Lighting

While lighting at the Boott Mills prior to the construction of Mill #6 was provided initially by oil (animal, vegetable, or whale) or kerosine (made popular after 1853 when the ready availability of petroleum made the refining of kerosine practical) Mill #6 was provided with gas lighting‡ consisting of simple vertical pipes dropping from overhead lines along the exterior walls and provided with stop-cocks at a height convenient to light the work areas.

The Merrimack Manufacturing Company had experimented with electric lighting as early as December, 1878.[43] The Lowell Electric Light Company was organized in January, 1881 and had sixteen street lights in service a year later. However, Mill #6 continued to use gas lighting (supplemented by electric) as late as 1908. A report prepared for the mills indicates "1072 gas jets on property [all of the Boott] ... burned about 2 hours in the morning and 2 hours at night."[44]

Gas lighting lines remain in situ on the third floor (between the 9-0th, 16-17th and 19-20th bays on the north wall, between the 9-10th and 20-21st bays at the south) of the west section of Mill #6, and at the fifth floor (15th bay, both walls) of the west section, and at the east wall of the fourth and fifth floors in the east part.

10. Lockers and Coatrooms

No documentary evidence has been found to substantiate the presence of either lockers or coatrooms during the initial phase of Mill #6. To the contrary, a report made in 1911 leads to speculation that such facilities did not exist at the mill until well into the 20th century:

> *The other matter of perhaps slight comment is the question of lockers for the operatives clothes. In almost all the rooms of the Boott Mills, the common practice was to hang the outer garments*

‡ Hill states that gas was first introduced to Lowell on January 1, 1850, (Frank B. Hill, Lowell Illustrated, Lowell, 1884, p. 9) and gas lighting had been used in England by 1792, while the first American patent was issued in 1810 for use in Newport, followed in 1816 when Baltimore became the first city to extensively use gas lighting (see Peterson, p. 196).

on a nail or hook, nearby the machine on which they were engaged. The odors arising from these clothes' especially on a damp morning is considerable…"[45]

11. Interior Drainage

As was the case with Mill #6: "In many instances mills are built with brick cornices without any of the wood projection from the side; and in other buildings the walls are carried above the roof, which slopes toward the center, and all water falling on it or melted from the snow is conducted from it by pipes leading down through the middle of the mill."

The roof of Mill #6 was drained with interior downspouts, 5" cast iron pipes located between the 4th and 5th and the 15th and 16th bays in the south wall of the west part, at the east corner of the brick party wall that connects the two parts of the mill, and at the southeast corner of the east part, all of which run from the roof through the first floor to the canal below. Additional drains were located at the northeast corner of the east part, from the fifth floor to the fourth where it exited through the north wall, and between the 15th and 16th bays of the east wall of the east part, exiting through the coal pocket.

12. Fire Protection

The 1888 Barlow Insurance Survey states "Sprinklers§ in No. 6 mill each floor, and in paint and black-smith rooms."[46]

Existing sprinkler pipes in Mill #6 are probably replacements of the original, in the same locations. Most likely they extended from a supply line that was suspended from the ceiling along the north wall of the west part and along the west wall in the east part of the first four floors of the mill. The actual spinkler lines ran perpendicular to the supply at each bay, between the floor beams, stopping just short of the opposite wall (or at the first two floors

§ Cowley states, "The corporations also have an elaborate system of 'sprinklers,' which enables them in an instant to wet down the whole or any part of a room, or all their rooms, so that fires are arrested at once. This admirable machinery of sprinklers, however, was not introduced until after the establishment of the reservoir at Lynde's Hill in 1850." (Charles Cowley, Illustrated History of Lowell, revised edition, Boston and Lowell, 1868, p. 60). The use of sprinklers at the Boott in the 1850's is corroborated by a letter from James B. Francis, CE, acting agent of the Proprietors of the Locks and Canals to the editor of the Insurance Monitor dated July, 1877: "Inspected in 1874 [sprinklers]... even pipes that had been up twenty years or more." (Records of the Proprietors of the Locks and Canals, Vol H-1866-79 of Boott Mills Office, p. 145.)

in the east part, short of the wall that set off the entrance to the coal pocket). The sprinkler heads in the west part of the fifth floor were supplied by mains located between the 3-4th and the 26-27th bays of the north wall, with the feeds perpendicular and extending almost to the south wall. The sprinklers were parallel to the north and south walls, two lines at either side of the central east-west girder that supported the roof rafters. The east section of the fifth floor had a single supply at the underside of the roof, running east-west from a vertical pipe at the north edge of an opening made for the 1917 elevator (see next section). Two north-south lines ran in each of the three roof bays.

Supplementing the sprinkler system for the prevention of the spread of fire in the mills were: "Vertical Pipes-Two or more in each set of mills, with short lengths of hose attached at each story..."[47]

Vertical stand pipes with valves and hose connections were installed next to the south edge of the stair tower entrances at all floors in both sections of the mill. The blacksmith shop at the first floor and the paint shop above it at the west end of the west section were serviced by these standpipes. The area to the east of the masonry fire wall that separated these uses from the mill proper was provided with a pipe that fed down from a lead along the ceiling of the first floor, and fed up to the second floor where it terminated in a hydrant and hose connection at waist level. All of the original standpipe system remains, and is in service today.

E. Changes to the Original Fabric Prior to 1904

1. Mill No. 6

The above discussion summarizes Boott Mill #6 as built in 1872-73 by the engineers of Locks and Canals. One major and a number of minor changes were made to the original fabric prior to 1904.

The major alteration concerns the changing of what were windows in the east bays of the north wall of the east section, to provide access to the connector constructed between 1876-78 linking Mill #6 with the dressing mill and boiler room to the north. Initially the connector was only two stories high and access was limited to a door (or doors) at the second level, since the passage to the coal pocket ran through the lower level. No record of this door or doors remains, and all architectural evidence was lost in the expansion of the coal pocket in 1927-28. However, the existence of a door at this

level, as well as other floors by 1882 is documented in the Barlow Survey of that date: "Dressing Mill and Boiler House communicated with… No. 6 mill by connecting wing and tinned doors in second, third and fourth stories."[48]

The mention of doors at the third and fourth stories reflects the addition to the connector of the third through fifth floors in 1882.[49] The unfinished condition of the fifth floor may account for the fact that there is no mention in the records of this period of a connecting door at the top floor, although the architectural evidence suggests that the existing door is contemporary with those at the lower floors. The connector was served by the rebuilding of two window openings in the eastern-most bays of the north wall as doors at the third and fourth floors in 1882. James Francis, in a letter to A. G. Cumnock dated June 17, 1883 mentions the doors: "The fire proof doors in the partition wall of the 3rd and 4th stories, between Mill No. 6 and the Building over the Coal Pockets should have holes in them, through which hose can be passed."[50] No mention is made of the doors at the second or fifth floors.

Windows in the third bay west of Bridge Street at the second, third and fourth floors were altered to doors when enclosed bridges were added along the west side of the five story connector, sometime between 1889[51] (based on architectural details and the bridge at the second floor) and 1911[52] (the third and fourth floor bridges were not built until 1930).

The floors of Mill #6 have been patched and repaired a great number of times, with the result, that coupled with a total lack of documentation from this time frame, (the repairs would have been recorded under maintenance) it is impossible to precisely locate pre-1904 changes. However, given the frequency of shifting machinery in the first 25 years of operation at this mill (156 looms were moved in 1879, a number of drawing heads installed in 1896... etc.) a good deal of the original flooring may have been repaired or replaced if for no other reason than to level and balance the new machinery. Certainly, the shafting and belting, as mentioned by Cumnock when he defended the wall mounted steam pipes (see above), was changed many times, which would require holes to be cut into the floors and ceilings. Records documenting changes to the mechanical systems made during this period are also sparse and appear to be limited to repairing sprinkler gates in 1886, 1887 and 1888.[53]

2. Facades of Mills #1 and #2

The facades of Mill Nos. 1 and 2 and the connector between them were materially altered with the addition of a fifth floor. While not precisely dated, Hill's Lowell lllustrated[54] published in 1884

reproduces a view of the Boott Cotton Mills (Figure 14) that has the top floor in place, and the 1882 Barlow Survey lists the mills and connector as five stories and basement. Based on the above and similar material, the date of construction for the fifth floor has been placed by various historians as c. 1880.

The new fifth floor caused the removal of the gable roofs and monitor units from Mills Nos. 1 and 2, and the penthouse from the connector, between them, along with the original cornices and rake boards. The c.1880 addition continues the fenestration pattern that evolved with the construction of the existing stair towers and connector in 1865, retained the towers at their original height and kept the corbeled cornice at the fourth level of the connector. Fifth floor windows are all 12/12, wood, double-hung, sash set in segmental openings. The window caps are similar to those at the second and fourth floors of Mill #6, with a toothed lower chord of the row-lock and corbeled pendant drops. A new cornice spanned the entire composition, with a shallow cyma-recta on a fillet pressed metal crown that rests on a series of four course corbeled brackets, again, similar in design to Mill #6. The fifth floor walls were laid with machine made brick, common bond, 7:1 with flush joints. With this important exception, it appears that the facades of Mill Nos. 1 and 2 and the connector were otherwise unaltered during this period other than a probable replacement of sash to the 9/9 and 6/6 that is present today. None of these window changes are documented.

3. Connector at Mills #7 to #6

The connector at Mill #7 to Mill #6 was initially built two stories high when built in 1876-78, 21 feet wide, with walls laid with machine-made brick in common bond, 7:1 like virtually all of the construction carried out during this period. In 1882 an addition of the three upper levels was made. Entrance to the first floor of the connector was provided through a segmental arched, double-door width opening in the south bay of the west wall. (The opening has been infilled, but an early vertical board door, hung on iron straps and drive pintles, may have been reused from the 1876- 78 construction.)

The frame bridge at the second floor level has been altered with the application of corrugated siding and three, six-lite steel casements. The fourth level bridge is frame, board and batten, with six, six-lite inoperable wood sash. It has been strengthened by the addition of a steel beam at the underside. This bridge projects out over the third floor bridge (built in 1930, see Part III, this chapter) and second floor bridge and runs decidedly downhill to Mill No. 6. There is no bridge at the upper level of the connector. The wall surface here has

four segmental window openings. The detailing of the windows, and the brick cornice, repeats the detailing found in Mill #6.

4. The Courtyard

Documents indicate that changes to the courtyard (Photograph 22) made during this period included repairs to the existing sprinkler gate house (letter to A. G. Cumnock from James Francis, May 10, 1886) and hydrant houses (similar letter dated December 1883). Photographs show that the courtyard ceased to be the planted, treelined space that appeared on various views of the 1870's (Photographs 23 and 24).



Photo 22. View of Boott Mills, c.1865-1880. Mills Number 1 and 2 and their connector is at the right. Note House and structure at stair tower
Source: UML, CLH B6456 CN 01

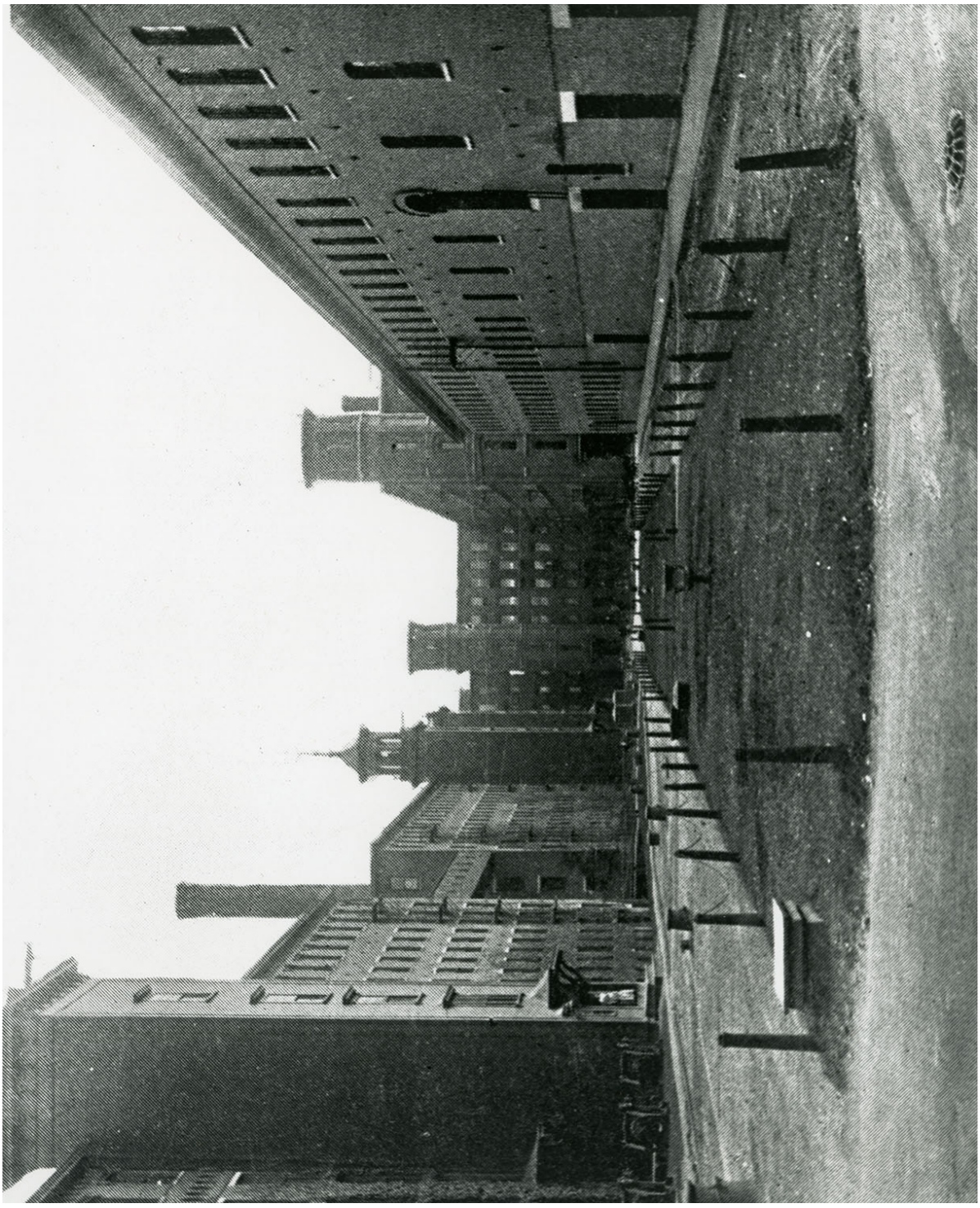


Photo 23. Boott Mill Yard, c.1895
Source: LNHP, Library Collections, Illustrated History of Lowell, 1897, P. 261

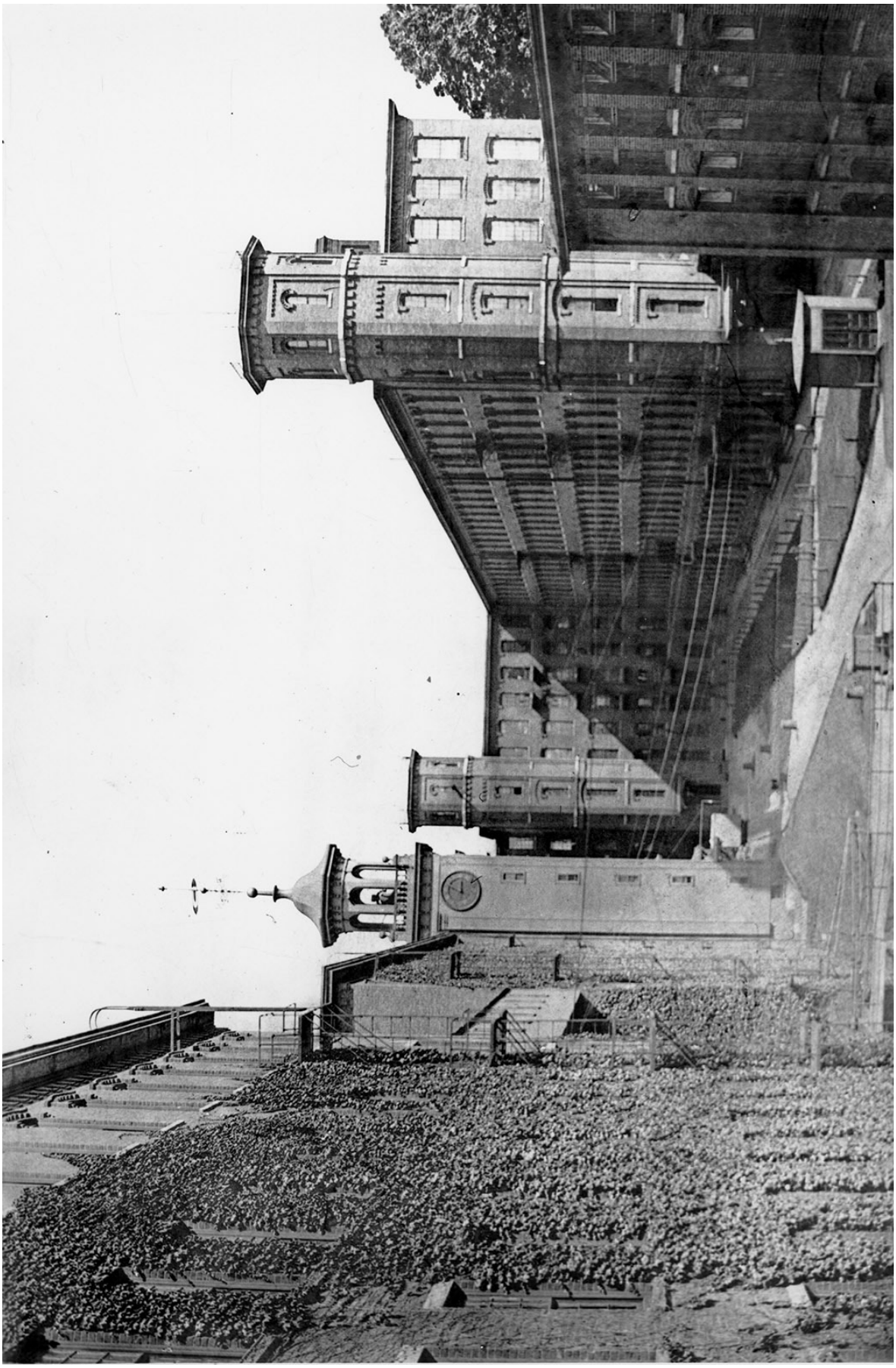


Photo 24. "Yard of Boott Mills" Note removal of house houses and fenced lawn area
Source: UML, CLH, LHS, LM, Pin 4111

ENDNOTES

1. All field measurements are taken from preliminary HAER drawings prepared in 1983 and substantiated by drawings prepared by Earl Flansburgh and Associates in 1984.

2. Mortar analysis indicates that the original formula was 1 part cement, 2.54 parts lime, 9.31 parts sand. See Appendix of Structural Report of Mill 6 Boott Mill in Lowell, Brown, Rona, Inc., Boston, 1984 (hereafter referred to as Brown, Rona).

3. Chandler Whittaker, Record Notebooks, Merrimack, Tremont, Suffolk, Boot (Mills), undated booklet at U of L Spec. Col. np. (References to years 1872- 1873 at contiguous pages).

4. Ibid.

5. Ibid.

6. Locks and Canals File 1009 (L&C Office, Boott Mills), Summary memo dated September 13, 1926.

7. Locks and Canals Photos #1460 (7/18/1912) and #2720 (9/13/1924).

8. Whittaker Notebooks, unpaged.

9. Boston Manufacturers Mutual Fire Insurance Company (BMMFIC) Special Report #10, p. 5 and 8.

10. Scientific American, (Supplement 648), May 26, 1888, p. 10330.

11. C. John Hexamer, Mill Architecture, article appearing in the Journal of the Franklin Institute, Vol CXX, July 1885, No. 1.

12. Ibid., p. 5.

13. Joseph Nasmith, Recent Cotton Mill Construction and Engineering, D. Van Nostrand Co., New York, 1894, Flather Collection, U of L Spec. Col.

14. Scientific American, June 2, 1888, p. 10347.

15. BMMFIC Report 115, 1902, p. 60.

16. BMMFIC, Modern Mill Building, May 1908.

17. BMMFIC, Standard Mill Construction, November 1902.

18. Extract from Day Book No. 17, 1871 - 1876, Locks and Canals file, L&C Office, Boott Mills.

19. Scientific American, (Supplement No. 648), May 26, 1888, p. 10345.

20. Ibid.

21. Ibid.

22. Ibid.

23. Nasmith

24. Boott Mill File 1883, Baker Library, Harvard University.

25. Barlow Insurance Survey (1882) No. 7379, Flather Collection, U of L Spec. Col.

26. Daybook 13, Locks and Canals, pp. 105- 107.

27. Hexamer, p. 9.

28. Locks and Canals File 1009.

29. Ibid.

30. Ibid.

31. Treasurer's Report to the Director s of the Boot t Mills (Hexamer D. R.), 1920.

32. Scientific American (Supplement 648), p. 10330.

33. Mill Engineering, NMAH, published by the International Library of Technology, 1902~ p. 68.

34. Scientific American, (Supplement 648) p. 10330.

35. Walter E. Parker, Report on the condition of the Boott Cotton Mills, Lowell, Mass., 1902, p. 23.

36. Patrick M. Malone, Canals and Industry, Lowell Museum, Lowell, 1983, p. 21.

37. Charles E. Peterson, ed., Building Early America, The Carpenters' Company of the City and County of Philadelphia, Chilton Book Company, Radnor, Pennsylvania, 1976, p. 67.

38. "Statistics of Cotton Manufactures in New England, 1866" Proceedings of the New England Cotton Manufacturer's Association 1 (Boston, Wright & Potter, 1872, pp. 22- 23.

39. Frederick Grinnell, "Heating by Overhead Steam Pipes", Proceedings of the Fifteenth Annual Meeting Held at Boston, April 28, 1880, 28, Boston, Franklin Press and Rand Avery & Co., 1880, p. 38.

40. Ibid., p. 48.

41. Barlow Insurance Survey, 1882 (Locks and Canals Files, B. M.).

42. "The Industrial Audit of the Boott Mills, Lowell, Massachusetts", Valentine, Tead & Gregg, Industrial Counselors, 1916, FC, p. 41.

43. Frank B. Hill, Lowell lllustrated, Lowell, 1884, p. 9.

44. Report, John A. Stevens, Consulting Engineer, to Frederick A. Flather, June 4, 1908, p. 45.

45. L. A. Hackett, "Report on the Boot t Mills", 1/9/1911 (Flather Collection).

46. Barlow Insurance Survey, 1888, p. 2.

47. Barlow Insurance Survey, 1888, p. 2.

48. Ibid.

49. 1883 Lowell Yearbook, p. 124.

50. Files of L&C, op cit, Vol I, 1883 np.

51. Insurance Survey of 1878 updated to 1880.

52. Insurance Survey of 1911.

53. Letters, James B. Francis to A. G. Cumnock, May 9, 10, 18, 1808, File 1009, Locks and Canals (Boott Mills Office).

54. Hill, p. 9.

VIII. 1905-1930 OCCUPATION AND USE

A. Introduction

In the period following the turn of the century, the Boott operated in a new era, the confluence of old traditions and new circumstances, old practices and novel situations. Looking back, one finds a mingling of the modern and the archaic which taxes the historian and makes demands on the reader's attention in order to assess the ways in which the times were like and unlike those of recent years.

William Wood was in the process of putting together a great woolen-mill conglomerate at the same time that Draper automatic looms, the standard in the field until after 1960, were being delivered by horse-drawn wagon. A person could travel from Lowell to any other eastern city without leaving the trolley lines, but if something were to be moved around the millyard, horsepower moved it.

Waves of immigration were inundating the country, the city, and the Boott, but potential cosmopolitanism was stifled by nativist sentiment. Even as the immigrants swelled the population, their labor served the demands associated with the coming Great War. For textile mills, the war effort of this and friendly nations spelled prosperity so great that it could carry the industry, and even the American Woolen Company of Wood, a dinosaur that needed no anti-trust legislation to bring it down but would collapse of its own weight in the 1920s.

The Boott rolled on amidst this turmoil, experiencing its ups and downs, faltering once, but responding to outward circumstances more in the degree of its activity than in its kind. New management appeared with the arrival of the Flather family which would oversee its course from 1905 until 1954.

This period also represented the time of a new thoroughness of information about the mill, its operations, and its tasks. Identifiable individuals more of ten entered the story, and the activities of all the people associated with the mill took on a new clarity, a heightened definition.

It was a time when it was believed that the study of management and the scientific analysis of production would lead to increased worker productivity without increased worker exertion. Partly because of this view, Boott management repeatedly hired consultants, both textile engineers and management advisers, men who reported on the quality of the building, the machinery, the

employees, and the administration of all of them. Their evaluations and recommendations for change offer a rare opportunity to study mill operations in detail for a period, after the Civil War, to which little attention has been given despite the importance of this period in American history. Not only was industrial production an important aspect of the great events of the time, but during the period 1905- 1930 events and decisions took place which ultimately led to the textile industry's wholesale relocation to the South.

In addition to revealing the inner workings of the mill, the consultants' reports also enable one to identify and consider the daily roles of the workers in the Boott. Such specificity of data permits detailed descriptions of workers' activities, providing a more direct view of events than is ordinarily possible. Rather than the generality of "textile work," one finds descriptions which bring the jobs and work spaces involved in the report to life.

Based on the records mentioned and numerous other sources, this chapter will recount the story of the failure of the Boott Cotton Mills and the birth of the Boott Mills in its stead. It includes the coming of a new management and a battle for control between it and the mill's selling agents. A series of agents provides a look at administrative thinking, training, and background, and the activities of the Counting House become more detailed. Day-to-day operations there and the relationships between employees in the offices and in the mill clarify these important aspects of the operation.

The complement of machinery to perform the textile operations continues as a presence in the account, along with its changes and, most interestingly, its condition, another example of the precision with which activities can be described. Unusual as it is to be able to know just what ran in a mill at a given time, adding the all-important factor of its condition over time presents a rare degree of insight.

The work environment also takes shape. The condition of the work place in #6, the activities in the Courtyard, the definitions of jobs, the relation of wages to the cost of living, and the oversight of the work combine to bring the mill to life. Finally, labor-management relations offer insight into ways of thinking about the work, the mill, and life in general in this period.

B. Purposes, Operations, and Procedures

The purpose of the Boott Cotton Mills had always been simple: to make money. After the difficult economic times of the final quarter of the nineteenth century, it came as less than a surprise when things came to a head in 1905:

> *The affairs of the old company have been complicated for some time, and the final crash came on Feb. 4, [1905], when it was announced that the company must cease operating its plant. On that date the mills were closed and it was stated that unless a complete new corporation could be organized and new capital introduced the mills would have to be sold and further operations suspended.*

At this point Frank E. Dunbar put together a group of investors to buy the plant and equipment. Although he had hoped to raise the necessary money in Lowell, and had reported assurances of support, when the time came only about 1/4 of the total capital came from local residents, the rest primarily from Boston interests.[1] Those investors authorized Dunbar to pay no more than $300,000 for the plant and assets and to organize a new company with a capital stock not to exceed $600,000, of which they had already pledged $500,000, including the purchase price. Previous stockholders would be given the first opportunity to buy remaining shares.

The failed hope expressed for local participation indicated the extent to which Lowell industry remained the captive of outside interests, separated not only from the city itself, but remaining part of a financial/investment market without allegiance to that which local residents might perceive as the city's best interest. This situation had been in place when the city was founded. Its operation over time had continued to draw the profits of the mills away from their locale in the self-perpetuating manner which led to difficulties in finding Lowell money for investment in a project judged potentially profitable.

Also from the time of the mills' origins, they had utilized selling houses in Boston or New York to market their cloth in return for a small percentage of its value. The flow of marketing advice from the selling house, cloth from the mill, and intertwined financial dealings of several sorts (such as investments in the mill), had long made these relations complex and at times difficult.

Wellington, Sears, & Company, the selling house, took half of the 1905 subscription. Though most of the money came from outside Lowell, Frederick Ayer, heavily involved in the patent medicine business in Lowell in earlier years and now significant in the American Woolen Company run by his son, Wood, invested $75,000 and was the second largest stockholder.[2]

The Lowell Daily Mail announced that the mill would re-open at once: "It is understood that only a small proportion of the old operatives of the Boott have left town, so that when the gates are re-opened and the help summoned to take their old places, the mill will be able to resume operations with practically a full complement of operatives."[3] Ariel C. Thomas, the previous Agent, would resume

his post. Thus rebirth followed catastrophe, and there was new hope for future accomplishment and profit for the newly named Boott Mills (without the "Cotton" in the title).

First as part of the decision to reorganize, and in a series of analytic efforts thereafter, a steady stream of consultants arrived over the following years to attempt to prescribe to the ailing operation. Their commentary must have injected a note of caution, to say the least, into the discussions of the new owners.

These advisers were drawn from a substantial pool of experts on textile and mill engineering, administration, personnel management and related fields. From Boston, Providence, Lawrence, Fall River, and New York they brought decades of tradition and significant experience and knowledge of factory operations. Hired by the Directors, usually at the recommendation of the Treasurer, they offered both expertise, objectivity, and neutrality in case of an internal conflict. They represented, in part, another manifestation of the nature of a situation in which mills were run by financiers rather than production experts.

Lockwood- Greene and Company, a well-known and respected firm of consulting engineers (founded by Stephen Greene, the famous "mill doctor"), inspected the plant and operations during 1906-1907. Its assessment presented a litany which would continue throughout the mill's active life to 1954:

> *We consider that when your Company took this property over it secured a manufacturing plant which was both as regards the style and construction of the buildings and the arrangement of the machinery and the relation of the processes to each other, a very poorly constructed and arranged plant, judged by modern standards. Mills 45' and 50' in width and six stories high cannot be considered good buildings for any department of a modern mill.*

They felt that the operation would be best served by rebuilding elsewhere, and if it was to continue on the present site, "all of the buildings with the exception of the storehouses and the No. 7 Mill should be destroyed and new buildings erected in their places."[4] These characterizations were encountered repeatedly, and one must assume that they persisted in the minds of those making decisions as to the operations and investment policies of the mill.

Another well-known textile engineering consultant, F. P. Sheldon of Providence, Rhode Island, also reported on the mill in 1907. He made comments similar to those quoted above and, moving to an aspect just slightly less pervasive than the buildings, he characterized operations and prospects:

The power equipment of the mills is outrageous--the worst I have ever seen, as you doubtless know well. I think you must be losing fully 40% of all your power by friction losses on account of the arrangement of the driving. It would cost a very large amount of money, indeed, to reorganize this equipment, and I should hate to spend such a large amount on this equipment as well as on the machinery to adapt it to these old buildings. It could be made a little better, but it can never be made as good as it ought to be. There can be no doubt at all that the cost of producing goods in these mills must be very much higher than it is in good mills, and while it may not cause loss in years like the present one, still, when margins come down close as they have been in past years, it might be very hard to earn a profit which would warrant a large expenditure to be made on machinery and power.

Like the buildings of which it was an integral part, the shafting system had worn out. Sheldon despaired of making the mill into a going proposition in any but the best, most favorable years, such as the industry was experiencing as he wrote. The types of problems he noted applied not only to the driving of the equipment, but to nearly all aspects of the mill's operation:

As the machinery is now arranged, there is in the total mass, quite a large amount of unnecessary machinery, the result of which is that it is not driven to fullest capacity, because it is not needed; and still the help are in the mill and being paid, and I can see that this condition is almost unavoidable. In other words, the arrangement of the mill is not such that the labor can be trimmed down exactly as it is in the mill that is properly built and kept with all the departments in balance, or somewhere near it.

And again, these buildings contain an immense amount of surplus floor space--more than is necessary for the production, and all this space has to be heated and lighted and kept in repair and looked after. Besides, which, it is impossible for machinery in so many scattered departments, covering so much floor space, to receive from overlookers that close attention which is necessary for the best results, so that the first obstacle which comes up in attempting to layout any reorganization, is the buildings. Of course, the machinery is the most important item and ought to be changed and improved, and a large saving can be effected by doing that even, but after spending this large amount of money the mill will still not be in condition to compete with a modern mill. The general expenses must run high, necessarily. The division of labor cannot be made to the best advantage. If the property were mine, I would rather run a smaller number of spindles compactly situated and properly balanced, and then eliminate from operation temporarily a large amount of surplus floor space which has to be maintained and taken care of now, involving loss of labor without a proportionate return.[5]

Sheldon's diatribe became increasingly specific and focused, moving from power to machinery, to its lay-out, and culminating in oversight and labor, all of which will be themes of this chapter. In general ways he spoke to the issues of the mill's operation, and found them wanting on all counts. He painted a picture of the new owners and managers starting with severe handicaps; their efforts to overcome them represent an underlying theme at all points in this account.

Moving to the program and purposes of the buildings under consideration, the Counting House and Building No. 6, along with the Mill Yard, did not differ in 1905 from its status at the end of the previous period. By 1910, and through 1930, however, it adopted a new pattern of occupation: the 5th floor of No. 6 became Ring Spinning, the 4th both Ring and Mule Spinning, the 3rd combined Mule Spinning and Weaving, and Weaving filled nearly the lower 2 floors. On the 2nd floor a Recreation Room abutted the Counting House; beneath it lay a Repair Shop, and at the other end of 6-1 the railroad passed through to the Coal Pocket. In the Counting House one finds Vacant Attic on the top floor, Office Rooms on the second, and in the basement, Supplies and a Belt Shop.[6]

The production during this period was the wide and varied assortment of materials which worried the advisers. The range encompassed heavy ducks, fine lawns, and "even veiling with silk filling of equivalent cotton count of 350's."[7] The ducks themselves included a number of materials of varying weight, while woven bags, toweling, corduroys, and numerous other materials, eventually even including sewn products such as curtains, contributed to the output at one time or another. Production of 40 different warp yarns and 50 filling yarns, combed and uncombed, appears to have been typical.

During the period 1905- 1930, #6 was in the process in becoming the ''Fine Hill" of the Boott complex, specializing in the production of the finer, or lighter-weight, yarns and cloths. Weavers in #6 made 45 different styles of cloth in 1923. Moleskin, repp, velvet, scrim, and duck came off the looms, each in endless varieties. The first three represented fabrics with raised surfaces of different types; the thin strong scrim served as linings for upholstery; duck was much like canvas, but lighter.

Despite the deficiencies noted in plant, power, lay- out, machinery, and oversight, the new mill moved rapidly into finer materials which taxed everyone and everything involved. They were seen as the response to market forces making them increasingly valuable at the time when Southern mills' competition for coarse goods business mounted steadily. Market forces were seen as exerting more pressure in one direction than mill conditions presented in

the other. Obviously, tension resulted, and the accounting of it will proceed throughout this chapter.

C. Activities: The Counting House

1. The Treasurer

The takeover Dunbar engineered early in 1905 marked the advent of a new direction for the Boott, despite the fact that most of the staff, including the Agent, continued in their slots. Frederick A. Flather was named Treasurer, a move of great significance. Unlike most current corporations, the major textile mills had always made the Treasurer the officer of greatest power, particularly on a day-to-day (even month-to- month) basis. This tradition had its origin in the merchant backgrounds of its New England initiators, the Lowells, Appletons, Jacksons, and others. Because of the great extent of their influence in the region's economic circles, this position came to be the location of power in many businesses and continued thus until recent times. Flather's installation, therefore, represented a much more noteworthy event than simply the arrival of one new officer: the reins of power had shifted. According to the rules of the corporation, the Treasurer, under the direction of the Board, could

> *…receive and disburse all moneys, and have custody of all funds, books of account, deeds and papers of the corporation. He shall sign all notes, bills, checks and drafts issued in the name of the corporation, but the same shall not be valid unless countersigned by the clerk or any two directors.... The Treasurer shall, in all matters pertaining to the operation of the manufacturing plant, property and business of the Company, and its purchase and sale of materials and merchandise, and its employment and discharge of servants and agents, and in all matters of finance and credit (save as by these By-Laws otherwise provided) have full power and authority subject only to the control of the Board of Directors and until they shall by vote otherwise specifically order and provide."*[8]

Between the meetings of the board, and within their overall plan, Flather had great control of the mill, its employees, and its operations. From this position, he bore general responsibility for the success or failure of the factory.

The background of this man chosen to run a cotton mill in Lowell offers interesting commentary on what were seen as the demands of the position. Flather's experience lay in the machine-tool industry. He had worked at Flather and Company, the family firm founded by his father in Nashua, New Hampshire, then served as Superintendent of the Pettee Machine Works, a major builder

of textile machines in Newton Upper Falls, Massachusetts. From there he went to the Lowell Machine Shop [LMS], traditionally the source of machinery for the Lowell mills (and which ultimately merged with Pettee) as Assistant to the Manager. In 1901 he became Superintendent at the McCormick Harvester Company, in Chicago, and then Manager of the Works for the International Harvester Company there until coming back to Lowell and the Boott.[9]

Flather's early career was marked by intelligence, innovation, and ambition. When he went to Pettee in 1887 he brought "not only some practical knowledge of machine designing, but a keen feeling for change which was not always found in the experienced and seasoned machinist" (which he was not). After doing well there, but finding himself blocked from rapid advancement beyond the position of Superintendent, he went to the Lowell Machine Shop in 1893 to help with design and production problems, particularly with the revolving-flat card. He made progress there not only with the immediate problems, but also with the overall operation and equipment of the plant, bringing in new machine tools "'by the freight car load.'" His contributions related to both machine design and mass-production techniques.[10] What he brought from his previous experience to the Boott, then, was not knowledge of cotton textile manufacturing, but experience in managing men, planning operations, and introducing innovation, In addition, he had knowledge of textile machinery and had dealt with cotton manufacturers while promoting the machines with which he had worked.

Obviously, Flather was hired for executive ability, not textile knowledge. The Agent, Superintendents, Overseers, and Second- and Third-hands provided that kind of supervision of the plant's operations and the employees' skills. But neither was Flather a Treasurer of the old style, managing the mill from Boston with only occasional contact with activities in Lowell. On the contrary, he lived in Lowell and visited the mill nearly every morning, arriving early and then going to Boston on a mid-morning train to conduct related affairs (cotton buying, relations with other mills, Directors, bankers, etc.). His Diaries give an idea of how his time at the mill was spent, particularly during the early years of his reign.

One aspect of his style appeared in his Diary in 1910 when he noted he had told the Agent "that the tearing out of the old engine room did not look safe and that I had plenty of money to spend for safety."[11] His factory experience made him cognizant of the potential danger of work done incorrectly and enabled him to recognize such a situation when it occurred. The comment, and his note, reveal an attention to detail, ability to size up an operation, and a respectfulness toward the workers reflected in his concern for their safety.

Managing the people involved on all levels of the mill's operation was also a primary concern for him. For a period in 1917 the Agent, E. W. Thomas, was in poor health and Flather advised him not to be too hasty in returning north (to work), fearing that too sudden a change in climate might produce a shock to his weakened system. At the other end of the spectrum, on the same day he "sent word…that idle men in 6-2 tower cost money and is result of poorly instructed and placed supervisor." As the boss, he did not want to see idleness and wanted others to make sure it did not happen. Nor were the help in the Counting House free from problems: "Holgate was anxious about his health if he remains in his room, which vibrates and is noisy. Told him we all had to put up with something and I was not interested in that question (his real reason I think is that he wants Thomas' office)."[12] The vibration of the Weave Rooms in No. 6, of which the consultants often spoke, was transmitted to adjacent offices. Flather's preemptory and suspicious response to Holgate revealed an aspect of his character, a lack of felicity in human relations.

On other days Flather discussed the weaving in 6-4 in preparation for moving the machinery to #5, making sure everything was in readiness.[13] When there were labor troubles anticipated or ongoing he discussed the situation with those on the spot. And when, in July, he felt that Agent Thomas could return to his responsibilities full-time, he had the Directors approve a letter outlining the situation and returning responsibility for the future to Thomas. With the Directors' approval he gave the letter to him and then, in Thomas' presence, he was careful to note, informed each of the man's primary subordinates of the situation so that the chain of command would be clear, responsibility undisputed. When Thomas tried to stray from this carefully prepared agenda, "He tried to tell me about his troubles," it appeared that he had no success.[14] In each case Flather was attentive to detail, dealt directly with the subordinates involved, yet maintained an aloof posture befitting his station.

The picture that emerges from Flather' s commentary reveals a man of meticulous manner, devotion to his task, ability to play a role of power on the one hand (when at the mill) and subservience on the other (when reporting to the Directors). Competence, but not tact, appears. This opinion gains reinforcement from a note of his upon receiving the news that the elite Union Club had determined not to grant him membership on account of a reputation of "not getting on well with people." Evidence from as far back as his time at the Pettee Works apparently played a role. "To me," he wrote, "it is praise. I do not use my *position for self* [his emphasis]." He went on, "[I am] proud of the things that I have suffered in doing for my employers."[15] Self-righteousness, combined with ability and ambition, had not won friends among all of those he had met along his way up.

The Directors had installed a man of dignity and executive reputation who would represent their interests faithfully. His view of his position combined with his temperament to leave him personally isolated but thoroughly dedicated to his mission.

2. The Agents

Less survives to describe the men who served directly beneath Flather: the Agents. During the early Flather years, one finds A. C. Thomas (1905-1908), John Whitten (1908-1910), E. W. Thomas (1910-1920), Fred Lacey (1920-21), and Benjamin Holgate (1921-?) serving in the position. The brevity of the terms of these men, several of whom died in office, suggests that this stressful position carried its own occupational hazards.

The Agent represented the summit of cotton mill expertise in the administration. He supervised the daily operation of the mill, both in the factory and the offices. He executed the Treasurer's orders and directed the compilation of information from which he would evaluate and report production.

A letter from A. C. Thomas to Flather on June 30, 1905, some months after the mill had been taken over and Thomas continued in his position, indicated the nature of their relationship and the location of manufacturing knowledge. He defined the terms generally used in accounting the mill's weaving operation and described the manner in which the calculations behind the terms were made:

Average Number	is obtained by the sum of the percent of each kind of yarn multiplied by its number.
Production per Day	means 1/6 of the weekly production of 58 hours. This is based on the picks per inch, speed of looms per minute, and a given percent of the possible production.
Price per Yard	is the weaver's standard weekly earnings, divided by his total weekly production in yards.
Percent of Yarns	is obtained by multiplying the weight of each kind of yarns in one yard by the yards per pound.
Oversight per Loom (Per Week)	includes all day help not on piece work, in the weaving department.
General Expense per Loom (Per Week)	includes the dressing room, cloth room, all repairs, supplies, power, mill office, Boston office.
Labor	is the cost per pound for labor of WARP delivered to the dressing department, and FILLING delivered to the weaving department.
Weaving	is composed of the cost of oversight per pound, plus the price per yard for weaving expressed in pounds, both based on the production in pounds, per loom, per week.

General Expense	is the cost per pound, based on the production in pounds, per loom, per week.

Thomas conscientiously explained these simplest of calculations, the most rudimentary accounting, several months after Flather's arrival, under lining the extent to which a Treasurer could operate while divorced from the on-site analysis of the mill. The importance of the Agent's knowledge was emphasized.

One is reminded of the statement cited in the previous chapter regarding Agent Cumnock's importance to the operation of the Boott. While investors might discern opportunity for profit, and the Treasurer might manage the finances, in many ways the buck stopped with the Agent. If he could not coordinate, direct, evaluate, and communicate his findings effectively, the others could not hope to succeed. Conversely, he did not have the power to overcome errors on the part of his superiors.

After the death of E. W. Thomas in 1920, Flather recommended the appointment of Fred Lacey to replace him. His description of the Bradford (England) born Lacey as coming from "mill people" led into a remarkable account of the background of such a man, as well as something of the opportunities open to him and the machinations which could lead to promotion or stagnation in the small world of top administrators:

> *Nine years in Lawrence and Lowell, mostly in Pacific Mills, although two years out of nine were spent at Merrimack Manufacturing, Co.*
>
> *Nine years with Renfrew Mfg. Co. of Adams, Mass., until that mill burned down.*
>
> *Five years at Greylock Mills of North Adams:- 600 looms, 15,000 spindles.*
>
> *Four years Superintendent Montreal Cotton Co., Valley Field, P.Q.:- 2,350 looms, 80,000 spindles, dye house and bleachery, on shirtings, coat linings, l dies' linings and toweling.*
>
> *General Manager (Agent) for 5 years of Montreal Cotton Co., Valley Field, P.Q.*
>
> *Lacey remained neutral and attended to his work during contest for control of Montreal Cotton Co., and in the end was relieved by those in control. In his nine years the mill grew to 4,500 looms and*

180,000 spindles.

He was offered superintendency at Boott, superintendency at Lancaster Mills, Clinton, and charge of Shenandoah Cotton Mills, Utica, N.Y.; also district managership of three southern mills under E. W. Thomas, General Manager Consolidated Duck. He accepted the last but I afterwards assisted him in obtaining his release amicably.

He came to Boott in 1906 as Superintendent under Ariel Thomas, Agent. Then Lancaster Mills offered him Agency, but he was square and remained with Boott.

We intended to make him Agent but the rapid increase in business caused us to keep Ariel Thomas on. Lacey served him faithfully.

Wellington, Sears having a man, John Whitten, under contract but on the loose pulley, made him Agent of Boott. He divided his time between Manchester, where he lived, a desk in Wellington-Sears office, Suncook Mills and Boott Mills. He broke down and at end of his second year died. Lacey served him faithfully.

E. W. Thomas applied to Wellington-Sears for position of Agent and in 1910 was appointed. Lacey was faithful to Thomas, as he was to predecessors, and loyal to Boott Mills.

He owns his home, is a respected citizen, a clean liver, and his heart is in the Boott Mills. He does not run to experiments, knows the Boott Mills and cotton manufacturing. He has always been Assistant Agent in fact. ln Mr. Thomas' absences, by mutual arrangement with Mr. Thomas and myself, Lacey has been Acting Agent, in which position he is now officially regarded by those connected with the Boott Mills.[17]

Flather's evaluation said much about his attitude, the state of American textile knowledge, and factors influencing the Booth's direction. Furthermore, if resumes were available for the mill's previous agents, they would display numerous similar characteristics.

Although the cotton textile industry had operated on a large scale in this country since the 1820s and reached maturity long before 1905, England still stood as the land of experts, the place where agents were made. While Lacey's training occurred in the U. S. and Canada, his lineage was still worth mentioning. And his cotton education

had taken place in the mills. While his jobs were not detailed, they are likely to have been many and varied. By moving from mill to mill, he could match his talent to his ambition as he moved to slots of increasing authority, and he could learn from the comparisons between each of the mills at which he worked. Although mobile, both geographically and upwardly, he maintained a reputation for reliability and neutrality: he knew his place and did not interfere or take sides with the disputes of his superiors. Once educated and recognized as one of the select group which could be trusted to run a major enterprise, many opportunities opened to him. His path crossed that of the other members of this club, such as E. W. Thomas, and his fate was influenced by many things other than his proven ability, but he remained loyal and steadfast. When the pressure of expanding operations made the Directors fearful of a change in command, he was patient. When the selling house, Wellington, Sears, used its great influence to install its own man, he served him, as he did when they gave the job to E. W. Thomas, despite the fact that he seems to have been the Treasurer's choice for the job for some time.

Lacey's path represented one typical for nineteenth-century mill agents. His understanding of the processes was based on experience at performing the tasks associated with them. His allegiance was to the mill and its administrators, but his knowledge was tied to the work experience.

Like Whitten and Thomas, Lacey did not long survive the job; he died July30, 1921. Flather's recommendation to the Directors for Lacey' s successor-to-be indicated the extent to which the mill's management had been rationalized during his administration, particularly as to succession of oversight, and the changing nature of Agent's training or experience at this time. Holgate's career provides excellent insight into Counting House activities and signals a new era in mill management:

> *We have had in our organization for 15 years (since 1906) a man named Benjamin Holgate, age about 47, now Acting Agent, and at the next meeting of the Directors I expect to report his appointment as Agent, subject to a vote of approval by the Directors.*
>
> *Holgate went to work early as operative in an English cotton mill of which his father was manager; then served, still in England, as office assistant, bookkeeper; then in charge of office. He came next to America, where he worked for his brother, an overseer in Hamilton Mills, Lowell; here he learned loom fixing and worked at it for a period.*
>
> *He then joined the staff of Lowell Textile School, worked part time*

> *and studied part time until he passed all the courses they then taught there, as follows: - Cotton Yarn, Manufacturing, Weaving, Designing. At the age of about 32, in 1906, he came to the Boott, established and successfully operated a cost system.*
>
> *In 1910 he took up the maintenance of manufacturing schedules, made the promises of deliveries to selling house and made the estimates upon which selling prices were based. He has designed, or analyzed, and organized the fabrics that we have made since 1910, has handled the complaints from customer, selling house, or from our departments, and stuck to them until satisfactorily disposed of.*[18]

Holgate shared his predecessor's English background but little of his experience, there or in this country. The new man was experienced in office work, only slightly in shop- floor activity. He had learned analysis while working, studied the cotton process in school, and proven himself in areas connected to sales and customer relations. He had demonstrated abilities to handle the "customers' peculiarities," as well as capturing the valuable Woolworth towelling account despite the selling house's failure to do so. Holgate's proofs lay in accounting practice and sales, areas substantially different from the skills of a Lacey or a Cumnock.

The new Agent was fitted to a growing trend in management to rely on careful analysis of figures to plan and evaluate a mill's program, work assignments, and sales plans. His installation reflected Flather's allegiance to this new school. The operations of this approach would be followed throughout the mill's lifespan.

Counting House operations in this period did not always run according to the expectation set forth by an organizational chart for relations between the Directors, Selling House, and Treasurer. At several points in the above accounts of Flather's activities one notes intrusions by the Selling House, Wellington, Sears, into areas normally the purview of the Treasurer. Since they were also a major stockholder, their interventions must have been difficult for Flather to protest, impossible to resist. Eventually the conflict between the two sides and their somewhat different interests came to a head. The ensuing disagreement revealed considerable material of interest about the situation among the mill's hierarchy and the Counting House's operations.

The disagreement over power and direction which had simmered since 1905 became unavoidable in 1914 when the Directors considered plans to inc rease investment in the mill. In pondering how to improve the Boott's operation and competitive position, some of the Board favored raising $600,000 through a stock issue to

underwrite past and future improvements to both machinery and plant.[19] Wellington, Sears, on the other hand, touched off a bitter and often personal dispute when they charged that Flather should be ousted on account of his "extravagant" management. They claimed that he was to blame for the fact that "the goods were costing so high that they were almost prohibitive to go into the market to sell and make a profit for the mill."[20] The mill could not continue until the responsibility for its difficulties could be placed.

The composition of the Board of Directors had changed somewhat since 1905. Wellington, Sears, still held the largest single block of shares, 2300, but Albert F. Bemis, who also held substantial cotton mill investment elsewhere, had become second with 1992, dropping Ayer to third with 1656. Flather owned 250. Bemis and Ayer, who together exceeded Wellington, Sears, in power, had been supporters of Flather, but Bemis had played his role by proxy while he spent most of his time in China. When he returned in 1914 the possibility arose of his shifting his support to the Selling House faction.[21]

To settle the dispute over the mill's management the Director s appointed Cumnock, the previous Agent and now Treasurer of the Appleton Company, to examine the running of the mill. Flather's responses to a letter of questions from Bemis in June described Cumnock's examination and some of the manner of the mill's administration.

Cumnock visited the mill four times and examined the Boott's records both there and in Boston. An effort was made to speed the inquiry in order that the conflict could be settled before Ayer sailed for the Mediterranean.

Flather's letter first gave his version of the mill's direction:

> *Before January 1, 1907, all orders and inquiries were passed upon by me. Beginning with January 1, 1907, and during his incumbency, orders were passed upon exclusively by Mr. Whitten [Wellington, Sears' man], if at all by any direct representative of the Mill. This practice developed as the result of a policy which Messrs. Wellington, Sears & Company wished enforced. Since January 1, 1910, and until a comparatively recent date the same policy has been continued by the Selling Agents with Mr. Thomas with rare and spasmodic exceptions... I have not approved of the character of the business, (with exceptions), furnished the Boott Mills, and have as often as seemed practicable made this fact known to Wellington, Sears & Company. By my direct and amicable dealings with them I hoped we could mutually solve our selling and manufacturing problems.*[22]

From the Treasurer's point of view, the direction of the mill had been taken from him by the Selling House and without regard to types, capacities, and conditions of machines. In effect, the primary stockholder was acting independently and causing conditions at the mill to deteriorate. As a final economy measure, a massive layoff stripped the plant of every expendable employee.

Cumnock's report supported Flather and was quoted at the pivotal Director's Meeting:

> *"These policies have been determined by the selling house and not by the mill treasurer, and if it is true and the selling house has been directing the manufacture of certain goods and a great many varieties of a great many kinds of goods and sizes and threads, with the result that now there is on hand some $450,000 worth of those goods manufactured according to the directions of the selling house which are not sold and apparently cannot be sold immediately, why you may put two and two together and find out where the shoe has pinched."*

It was to the selling houses that the mills had traditionally looked for advice on coming styles or market trends, advice on what sort of production seemed to offer the best return. The unsold inventory stood as a condemnation not only of the advice given the Boott, but also of the temerity which had led Wellington, Sears to take over its direction.

Further use of Cumnock completed Flather's vindication, but it carried within it a warning about the mill's future course:

> *"My complete report will show that the mill physically has been well maintained and much benefited by large amounts of new machinery and other improvements… I think the Mill can make to best advantage an average of 24s yarn, and that it should promptly greatly reduce its present variety of upwards of thirty different warp numbers ranging from 7s to 68s, and twenty- six different numbers of filling yarns ranging from 9s to 55s. Such a large number and wide range of yarns as you are now making means a high manufacturing cost and must make it hard to get and hold an established business. It is also one of the principal causes which lowers the productive capacity of the Mill which during the past year I have proved was only 64.72%. Except, perhaps, for your 'Duck' product, I find that you regularly produce no large lines for wide distribution, although the mill is making in quite large quantities both corduroys and velveteens, but in each of these two cases the distribution is limited to one buyer. In my judgment as large lines as possible which the mill is best adapted to make should be produced and widely distributed and under the Company's own*

brands as far as possible."[23]

Cumnock appears here at length in order to present his defense of Flather and also his warnings about the desirability of producing fairly heavy yarns and thereby increasing productivity while seeking wide distribution under the company's name. His view endorsed the course followed by Flather and the Board in regard to the physical plant, criticized production choices apparently made by the selling house, and offered suggestions based on a combination of productivity through management planning and success through marketing. His testimony was instrumental in saving Flather (and indirectly initiating the new investment program). It offered one more example of the lack of competition between the Lowell corporations which permitted the Treasurer of one to evaluate and advise his counterpart at another. It also stands as a benchmark against which to judge the mill's responses in coming years to his predictions.

3. General Operations

While events in the Counting House were seldom as dramatic as the conducting of an inquiry to decide the fate of the Treasurer, its operations were of dramatic importance for the direction of the factory. The complexity of the operation, involving, as it did, several inter-related production steps taking place continuously in the many rooms of the several buildings, the interplay of a people, machines, cotton, and markets, required precise measurement, analysis, and direction. The office workers provided the basis for the necessary coordination for this system.

A 1907 list of Office employees and their titles provided a preview of these roles:

Willard W. Morrison, Office
H. P. Hunter, Supt.
Fred Lacey, Supt.
Victor E. Pihl, Mechanical Supt.
Edward L. Kirby, Paymaster
Benjamin Holgate, Cost Clerk
Gavin Holt, Clerk
Henry Howard, Clerk
Squire Moss, Belt-man.[24]

The last, a Secondhand, worked in the basement.

First Lacey and then Holgate would rise from these positions to that of Agent. The simple structure suggested by the list indicated the rudimentary nature of the analysis taking place at this time in comparison to what it would soon become.

Seven years later Flather offered an abbreviated list of types of jobs in the Counting House; only "Stenographers" and "Telephone Operator" indicated new positions.[25] Consultants had already begun to recommend changes in administrative structure and additions to the staff, however.

When L. A. Hackett, another outside expert, reviewed operations in 1911, he criticized the practice of the Treasurer in keeping his office in Boston rather than at the mill, contrasting that with "modern mill" practice; using a selling agent rather than selling direct also appeared unwise to him. Beneath the Treasurer, the Agent dealt with every department of the mill and supervised a Superintendent of the Works, the Master Mechanic, and the Office Manager to oversee the three main divisions of the operation. In turn, the Master Mechanic directed "Yard Men, Machine Shop, Power House, Carpenter Shop, and Supply Room." The Office Manager oversaw the "Paymaster, Cost Man, Bookkeepers, Messenger, and Stenographers;" beneath the Superintendent one found separate departments designated as "Cloth, Picking, Carding, Ring Spinning, Mule Spinning, Spooling, Twisting, Dressing, and Weaving." Hackett described the operation of this structure and found little of which to approve:

> *With respect to line and staff, the organization of the Boott is noticeably imperfect… Each overseer is in charge of a department, for which in a general way he is responsible in its operation. The payrolls are kept separate for the departments and even divided so as to show the cost of manufacture of many operations and a small part of the burden expenses, is obtained from them as well. The supplies consumed are chargeable on requisition orders where used, but this applies only to the smaller items. Over the control of stock of material, the overseer has no very comprehensible method of knowing whether the weight which was received into the room, with the weight leaving the room, plus the customary amount of waste, will check up or not. He is in no way brought face to face every month with an accounting with what has been accomplished in his room, except oftener than every six months, and this is too long a period to become any incentive for him to keep bettering his previous record.*[26]

Accounting for power consumed, supplies used, or other aspects of the "burden expense," the costs associated with production in a given room, appeared speculative at best. Clearly the Office could not make the assignments, analysis, and predictions which were needed, nor could the Overseers measure the degree of success in their own rooms.

The office was the source of all the detailed information needed by those in any way related to activities in the mill, information that those involved in the process, whether Overseers or Treasurer,

could not determine without the calculations of the Counting House. If no system existed to control and measure the flow of material, however, no one could determine this needed data. Hackett indicated the lack of coordination within and between the various levels, and this in an operation where each part had to act in precise relationship to the others.

In 1916 the firm of Valentine, Tead & Gregg, Industrial Counselors, of New York studied the Boott's operation and produced yet another set of descriptions and recommendations (hereinafter identified as the Valentine Report). This report provided further development of and explanation for the shortcomings in the operation of the Counting House. Its description of the organization suggests that some changes had been made in the five years since Hackett's visit, but still found conditions in disarray.

This report, one of the prime sources for study of the Boott operation, is noteworthy for its attention to the role of the human element in the operation of the mill, reflecting as it did the movement toward "humanist" labor management popular at the time, a belief that heightened productivity could result from improved treatment of the workers and more attention to their relationship to one another and the physical structure.

This study faulted the decentralization of power on the level of both Treasurer and Agent for creating "confusion, constant shifting of policy, and delay.'' Its comments on relationships between employees in the Counting House said a great deal about what conditions there were like and gave its view of their implications for the mill as a whole:

> *There is friction between the sales and accounting departments, between the superintendent and efficiency man. The superintendent wants control over the master mechanic and hasn't got it. The superintendent has no clear cut conception of his duties. The purchasing agent is uncertain as to his authority in regard to stores. There is a slight conflict of authority between him and the accountant in regard to the payroll clerks. The office clerical force is discontented with the frequent shifting of responsibilities. They do not know from whom they are to get final directions. The coordination between day and night overseers is not good.*
>
> *All this results in friction, lost time, lost energy, dulled initiative, indifference, impatience and discouragement. The tone of the main office force is lax. It is reflected in the tone of the whole mill. The workers suffer in morale, wages and poor working conditions.*[27]

This report reflected a new sensitivity to the issues mentioned and represented a far cry from the traditional management attitude toward the workers in these mills. In essence, it described a result of poor organization in terms of worker performance as well as management control.

In addition to those purposes already indicated as being served by the Counting House, it also held a planning department and had to respond to the sales department:

> *Scheduling is rendered very difficult by the frequent changes in orders received from the sales department. Overseers are occasionally asked by the planning staff to deliver quantities that are beyond the capacity of the equipment at their disposal. This is unfortunate and causes some resentment.*[28]

Not to belabor the point, but scheduling represented the sole opportunity for creating and maintaining the necessary balance between the production of the many departments in order that they have the needed materials in the proper quantities for uninterrupted work. The sales department worked with a advertising agents and on other sales promotion work.[29]

The Valentine Report also faulted the number and location of clerical help. The Superintendent worked without benefit of a clerk to "handle routine papers, keep records, and answer the telephone." Clerks for the Overseers of the various departments, on the other hand, generally were found in the Counting House: "Overseers wanting to give them work have to leave their rooms and go to the office."[30] Further complicating the Overseers' relationship to the Office and to their tasks were difficulties in their relationship to the Accountant and his functions:

> *The accountant has shown cost figures to the overseers, but little interest was created. He has now begun plotting cost curves. The overseers understand these more readily. Cost curves give a sense of movement and proportion wholly lacking to figures. Any method that will give vividness and meaning to costs in the eyes of the overseers will be of great value.*[31]

The Overseers' difficulties in dealing with the figures involved becomes easier to understand, the accountant's work easier to appreciate, and the process for figuring costs more meaningful if weaving cost may serve as an example. First, hours came from the loom hours book, production from the cloth room account, and then related payroll amount s were calculated. Indirect labor included the "supervisor, inspector, hurlers, fixers, oilers, bobbin boys, filling carriers, truckers, room girls, battery hands, scrubbers,

sweepers, cleaners, supply man, elevator men, and misc." Direct labor included loom changers assigned to the style. Pounds (of cloth made) or picks (of the shuttle) were added to payroll and calculated according to the style. Pounds were estimated on styles where piecework rates were based on picks by dividing picks per yard to get total yards, then dividing by weight to get pounds. These results were then posted to labor distribution sheets at the end of the month.[32] The overwhelming complexity and occasional nature of this process made careful control over the many styles of cloth difficult, if not impossible. The directions noted dealt only with one aspect, labor, of one operation, weaving, and had to be repeated for every process, material, and style in order for the mill to know how to price the cloth and whether or not to continue to make it.

Other areas were similarly imprecise. The Treasurer purchased cotton, burlap, machinery, and coal, while routine supplies and parts were the provenance of the Purchasing Agent, who was responsible to the Treasurer, not the Agent or the Superintendent. Lacking a good system of keeping track of supplies on hand or of reporting same to the Purchasing Agent, his work must have been somewhat hit or miss.[33]

One reason for the lack of accountability regarding supplies was the state of the Store Room in the basement of the Counting House. Too small and not centrally located, it also had no inventory control. In addition to materials there, "many cams and gears are piled in the various rooms, passageways and stairways throughout the plant."[34]

The inability to keep track of gears and other supplies, like most of the items in these reports, was of limited importance in its own right, but the accumulation of such inabilities led to significant uncertainties.

For more basic accounting, the Office moved into the mechanical age by 1913, when tabulating machines such as the "Millionaire" were purchased.[35] For some time thereafter the new technology seemed to lag behind earlier practice: "Calculating machines break down and delay of getting them repaired at once suggests impracticability of their use for us. Our girls actually went through pay-roll faster by hand then with change machines."[36] Old methods and expectations did not always move gracefully aside in the Counting House operation.

Overall, the period from 1905 to 1930 did see the passing of certain traditions and expectation in the Office. The most basic shift was from direction by an Agent knowledgeable about cotton mill practice, as had been the case for nearly a century, to a desire for accounting, marketing, and sales-related skills at the top of the organization.

Movement in this direction contributed to the situation in which the Selling House/Stockholder could confuse its two roles and take over direction of the plant for what it perceived as its own, rather than the mill's, best interest. This potential for conflict was not a new one, and had arisen in various guises at many mills over time, but at this moment in history the potential for misdirection was accentuated by the new faith in marketing expertise as the hope of salvation for troubled plants.

Similarly, successive consultants provided increasing analysis of office procedures as key ingredients for the Boott's future success, and their advice was the more welcome in the light of other comments indicating that nothing could save the plant itself. If new practices, rather than new machines and/or buildings, were the key to success, it might be accomplished without great expenditures.

In any case, little expenditure was made on the Counting House itself. In keeping with Flather's self- denying or frugal nature, the offices appeared plain: "The office would greatly benefit by fresh paint and calcimine. At present it is unnecessarily cheerless. To callers at the mill it gives an appearance of indifference to appearance and lack of prosperity that is most unfortunate."[37] Even for those whose work was most like his own, Flather offered little in the way of comforts, or "window dressing," as such things had traditionally been seen. If there were to be any display, it would be in Boston.

In any case, the first part of the twentieth-century was a great time to make money in textiles, particularly during and just after World War I. None of the difficulties the consultants found at the Boott could prevent it from making money, nor could faulty office machines prevent them from recognizing the fact. As presented to the Board of Directors, the profits before depreciation amounted to:

1915	342,648. 44
1916	463,241.14
1917	652,785. 34
1918	565, 48. 03
1919	674,183.26
1920	1,716,741.13 [38]

The Boston investors who had seen continuing prospects for profit in the old mill were being proven correct despite all the dire predictions of the experts.

D. Activities: Courtyard

Any items entering or leaving the mill passed through the Courtyard, either on tracks or on horse-drawn wagon. People

coming to the mill, unless they stopped at the Counting House, also moved through the yard.

Trolley tracks remained in the yard until at least 1927, probably later. Cloth appears to have left via rail, and machinery, parts and supplies also presumably entered the mill by this route.

Workers entered the mills through the yard after crossing the bridge by the Counting House, the only access other than rail. Bell-time crowds thronged this entranceway, and throughout the day a mixture of horse-drawn vehicles and people would have moved back and forth through the area on a variety of errands. The mill itself maintained horses, including the one purchased from Wheeler, McElveen & Co. in 1914 for $350.49. Regular charges for veterinary fees indicated continuing care for the animals.

A 1919 list of "Help for Yard-Mechanical and Power Departments" offered an indication of many of the workers whose jobs did not tie them to a particular spot and many of whom could have been expected to have appeared in the yard from time to time:

		PER HOUR	WEEKLY WAGE	
1	Second hand	.6325	30.36	
13	Carpenters	.35 to .5802	16.80 to 27.85	
4	Painters	.4771 to .5339	22.90 to 25.63	
1	Mason	.703	33.75	
1	Helper	.4483	21.52	
1	Sweeper	.3306	15.87	
1	Supply man	.4439	21.31	
1	Second hand	.6325	30.36	
12	Machinists	.3407 to .6162	16.35 to 29.58	
1	Sweeper	.3833	18.40	
3	Pipers	.4483 to .5964	21.52 to 28.63	
1	Helper	.3646	17.50	
1	Blacksmith	.667	32.02	
1	Helper	.4194	20.13	
3	Beltmen	.4194 to .5280	20.13 to 25.34	
1	Tinsmith	.5923	28.40	
1	Helper	.5384	25.84	
77	Elevator men	.3728	17.88	
1	Oiler- Night	.3726	19.28	51 3/4 hrs
5	Oilers	.3726 to .4485	17.88 to 21.53	
2	Wheelmen	.4612	23.41	50 3/4 hrs
1	Wheelmen	.4612	22.14	48 hrs
1	Watchman	.3664	30.78	84 hrs
6	Watchman - Night	.3281 to .3418	27.56 to 28.71	84 hrs

2	Draft men			
		1@ .5511	26.45	
		1@ Flat	25.00	
6	Electricians	.4801 to .6924	25.69 to 37.04	53 3/4 hrs
1	Electricians	.4762	24.17	50 3/4 hrs
1	Welder	.64	30.72	
2	Mechanical helpers	.4483	21.52	
1	Water wheel tender N.	.461	26.05	52 1/2 hrs
1	Second hand	Flat	22.77	
12	Yardmen	.3780	18.14	
2	Teamsters	.3729 to .4681	17.90 to 22.47	
1	Assistant Engineer	.6505	38.55	59 1/4 hrs
1	Oiler	.461	27.26	59 1/4 hrs
			40.00	66 hrs
1	Fireman	.553	36.49	66 hrs
1	Fireman – Night	.553	36.49	66 hrs
1	Coal passer	.378	24.94	66 hrs
1	Coal passer – Night	.378	24.94	66 hrs [39]

This list indicated some of the many tasks not associated directly with cotton-making necessary for the mill's operation. Craftsmen to maintain the buildings, the machines, plumbing, and belts, twelve men to work in the yard itself, teamsters to handle the horse and wagon work, a whole series of skills continuously available for the mills. These positions help put the scale of the operation in perspective. The skills and numbers of people involved were t hose of a New England village.

By 1916 a Smoking Shed for the workers in the yard appeared in an insurance plan, and by 1928 a Shipping Shed stood against the side of #6 in the yard. Fire danger led to a ban on smoking in the mills, and the general lack of space there made the removal of any peripheral functions, such as shipping, from the mill floors desirable.

As had been the case in the nineteenth century, watchmen still patrolled the yard to watch for fire, horses and trains moved in and out with necessary goods, and people flowed through the mill's gates on a regular basis. Little had changed amid the neatly planted and ordered Court Yard of the Boott Mills.

E. Activities: Building #6

1. Technological Change and Its Effects

The new Boott Mills began business with the equipment of the old Boott Cotton Mills corporation, but the program for Mill #6 changed very quickly. In order to best follow these developments, changes will be treated chronologically rather than by process.

During the first six months of 1906, workers moved the Carpenter Shop, the Blacksmith Shop, the Paint Shop, as well as the Machine and Wood Shops to other locations in the complex.[40] All consultants had recommended consolidating the shops at a more appropriate location, and the new managers were quick to act on this advice.

No. 6, as noted, was in the process of becoming part of the Fine Mill, producing the lighter weight yarns and fabrics, including corduroy. Other buildings produced the heavy ducks and bags made in part from the waste from this operation. Furthermore, it was being converted to a spinning and weaving mill.

The fixed-flat cards installed in #6 when it was first equipped, along with the railway heads accompanying them, were on the verge of obsolescence when installed and had been thoroughly out of date for decades by 1905. Recognizing this situation, management bought the next generation of equipment, revolving-flat cards; none of these went to the old Card Room in #6, however. Instead, there were notations on several occasions of labor expense for breaking up the old cards in the 5th floor Card Room of #6. Rearrangement of machines into a more coherent pattern of distribution, another constant recommendation, was also taking place.

While nothing on the order of the introduction of automatic looms occurred in weaving, the Boott was quick to see the advantages of two new inventions. During 1906 they were buying Barber knot-tying machines:

> *This little machine, invented by an American in 1900, is a small affair, worn on the hand of the girl who tends the spooler. When a thread breaks, the two ends are put together in the machine, and by pressure of the thumb the ends are tied and the loose pieces cut off. The knotter saves at least ten percent in the time of spooling. Moreover its economies do not stop there, since it ties the ends better than they are tied by hand. Consequently in warping the yarn of its tying, there are fewer breaks, and less time is lost in piecing. In weaving, its effects are no less apparent, since bad knots are very likely to cause imperfections in the cloth. The percentage*

> *of "seconds" in weaving is cut down by its use. Last but not least, the knotter not only reduces the labor cost by saving time, but also makes possible the employment of less skilled labor by doing the work which required most skill on the part of the operative.*

These hand-held devices followed the usual trend, and goal, of textile innovations by utilizing less of a person's capability and thus permitting the hiring of less expensive, more easily replaceable, labor. They were also typical in their pyramiding effects, as improvement in the accomplishment of one task led to better quality work at succeeding stages of production, permitting the speeding up of work there as well. The draw-back to this progress lies in the fact that the work became less skilled, more monotonous, and more stressful, because of the new pace.

The Boott also quickly adopted the new Barber warp typing machines, first available in 1904. These machines connected the tail of one warp, still in the loom's harnesses, to the beginning of a new one:

> *When it is desired to weave another piece of cloth of the same pattern, the harness, with these ends still in it, is brought to the tying machine, which ties together, one by one, the ends of the old warp and those of the new.... It ties about two hundred and fifty knots per minute, and does the work of twenty girls. Drawing in by hand had always been a relatively heavy expense to the manufacturer: by the use of this machine the labor cost is cut down two-thirds... The machine cannot distinguish colors. Hence it can be used only on plain work. But those mills which make only three or four styles of plain cloth are not hindered by these disadvantages.*

These machines also speeded production while eliminating skill and jobs at considerable savings to the owners. The increasing number of styles produced in #6 diminished but did not eliminate its usefulness.

The drawing-in machine represented the third of the new Barber developments to come to the Boott early in the reign of the new administration. These machines actually pulled the individual warp threads through the eyes of the individual heddles which were manipulated by the harnesses to form the pattern or construction of the cloth. They, too, represented significant savings in labor - costs and jobs:

> *Yet it does effect a marked saving over hand labor, since one man operating a drawing-in machine will draw in about six times as many warps per day as a girl can draw in by hand on the same grade of goods.... Like the tying machine, the drawing-in machine*

cannot detect differences in color. Hence it, too, can be used only for plain work. Girls are still employed for drawing in the warps where there are threads of different colors.

These drawing- in machines eliminated six jobs apiece, jobs that Melvin T. Copeland, the source of the above quotations, described as "a severe strain upon the mill workers."[41] Drawing-in had long been known as work to which the operatives tried to move on account of the clean, quiet, even calm atmosphere of the job in comparison to others in the mill (see, for example, Henry Miles' description of the work in Lowell As It Is and As It Was.)[42] In any case, a source of employment had been displaced by a machine which ran less expensively, and with less likelihood of resisting direction, than people.

Minor changes also went on steadily. In 1908 nearly $2000 went to changing over spinning frames from Sawyer spindles to Rabbeth, following consultant Sheldon's recommendation.[43] These types of alterations could improve performance slightly without a heavy outlay f or new equipment and appealed to those trying to increase efficiency with a limited capital investment. During a time of little innovation in a particular branch of textile technology, as the early years of this period were for spinning, such a plan could maintain competitiveness.

In another move responding to the consultants' recommendations, humidifiers from the American Moistening Company were being installed in #6 during 1907.[44] Steady and high relative humidity was essential to good spinning and weaving operations, yet the Boott had never maintained adequate levels. Increasingly fine production accentuated this need.

In the years 1912- 1913 significant new machinery relating to the conversion to a spinning and weaving mill for fine counts began to be installed in Mill #6. In 6-5, the one-time Card Room, 42 old spinning frames were scrapped and removed (likely in pieces, out the window); these frames presumably had been installed as part of the reorganization of spaces after 1907 when the cards there were scrapped. In their place workers installed 40 new frames from Howard and Bullough (H&B), part of an order of 48 frames costing $31,912.[45] H&B, an English machine builder, had recently set up a U.S. branch, Howard and Bullough American Machine Company, Ltd., in Pawtucket, Rhode Island. On the floor below, 6-4, 8 mules went out as scrap, to be replaced by looms. But mule spinning did not end then. On 6-3, 2 pairs were started up, installed along with shafting, pulleys, and hangers for about $150, apparently with available parts. No record exists of a purchase at this time, so these mules must have come from another building. Eventually 12 mules ran in this space. While spinning yarn on the mules for the coarse

mill did not recommend itself, using the best of the mules still made sense for the Fine Mill.[46]

The years 1912-1913 saw comparable replacement and upgrading of machinery in the mill's weave rooms. Incomplete information indicates that in 1911 there were 294 Draper 40" looms on 6-1; 356 LMS looms, all but 40 of them dobbies, on 6-2; 156 LMS looms on 6-3, along with 12 mules totalling 7968 spindles; 6- 4 held 55 spinning frames.[47]

While not all records permit interpretation with regard to the placement of new looms, purchases at both the Lowell Machine Shop and the Draper Company brought new machinery for the production of fine goods and some certainly went to #6. In 1913, 108 Model K Draper looms, along with the requisite shafting, went into 6-4.[48] These looms were similar to the "E" Model, standard for the time, but could accommodate a 24-harness dobby head. The more intricate patterns they were capable of weaving was in accordance with needs of a fine mill.

On 6-3 sixty- four new dobbies were added to looms already in place, increasing their capacity. New 44" looms also arrived there, possibly from LMS. The Boott also bought and installed dobbies in 6-1 (105) and 6-2 (40). One hundred forty-inch Drapers went into 6-2. One hundred twelve dobbies went onto Draper looms on 6-1, along with new temples, take-ups, and adjustable warp beam heads, all for velvet production in 6-1 West.[49] All these changes indicate continuing upgrading but relate to only a portion of the equipment on each floor. Still, the mill's capacity to produce finer and more varied materials was being steadily augmented (despite the advice of various consultants to stick to a few simple materials).

Another significant technological change at this time was the installation of a time clock from International Time Recording Co., along with 2500 time cards.[50] No longer would time-keeping be a responsibility of a person. Instead, precise and centrally located information would be available to payroll and costing personnel.

Even more significant was the installation of Veeder 3-shift pick counters on the looms. These devices recorded every throw of the shuttle across the loom during each shift. Measuring a weaver's production now became easy and precise, as did determination of a loom's downtime, for whatever cause, mechanical or human, during each shift. The time clock gained an important ally.[51]

The time clock and the pick counters substantially increased the management's ability to measure the performance of the workers and to tie their pay to their production. Installing these devices was of a piece with the overall movement toward productivity through

measurement which had been part of the heritage of the textile industry and which was gaining currency throughout American industry through the efforts of Frederick W. Taylor's espousal of "scientific management" and by his many followers (some of whom will appear among the Boott's consultants, below).

A 1914 equipment summary permits a recapitulation and appraisal of numbers and ages of machines on each floor of No. 6. It also underlined the thoroughness of the transition of the building's program to spinning and weaving:

WEAVING DEPARTMENT

Kind of Machine		Make	Units	Mill	Floor	Years in Operation		Year Installed
Looms	32″	Draper	108	6	4	2		1912
Looms	40″	Draper	278	6	1	12		1902
	40″	Draper	229	6	2	13	16	1901
						11	16	1903
						2	100	1912
						1	97	1913
Looms	44″		96	6	3	2		1912
Looms	40″	Lowell	156	6	3E	35		1879

RING SPINNING DEPARTMENT

Warp	Frames							
46	2 ½″ Gauge	Lowell	10560		6	2	41	1873
3	2 ½″ Gauge	Lowell	528	6	4	29		1885
53	2 ½″ Gauge	Lowell	11872		6	5	28	1886
6	2 ¾″ Gauge	Lowell	1536	6	4	39		1875
40	3″ Gauge	H & B	11040	6	5	2		1912 [52]

Although the summary omitted mules, others indicated they were still present. Most of the looms appear acceptable, even current, with the exception of the 156 LMS looms occupying space on the third floor east. LMS looms built in 1879 had no place there, nor did spinning frames from 1873, 1875, 1885, and 1886; one assumes these frames account for much of the ring frames listed in average and poor condition in another 1914 report. Since it claimed the 156 Lowell looms deserved an average rating, one suspects the agent who prepared the latter report, E. W. Thomas, was lenient in his appraisal of the equipment for which he had been responsible for maintenance.[53] The 593 Draper dobbies in #6 in 1914 produced

corduroys, moleskins, scrims with leno borders, and velvet.[54] By 1919 the LMS looms had disappeared from reports, and 593 Draper dobbies ran on the first three floors of #6; 252 plain looms by the same maker ran on 6-2 and 6-3. The Lowell looms no longer ran, nor was there weaving on 6-4 at that time.[55]

A 1920 machinery report indicated that 6-4 contained only ring spinning, as did 6-5.

Mill	Floor	Frames	Size	Gauge		No. Spindles	Make
6	4	36	224	2 ½	1 ½	8064	Lowell
		35	276	3	2	9660	Saco-Lowell
		1	240	3	2	72 240 17964	Saco-Lowell
6	5	40	276	3	1 ¾	11040	H & B
		2	176	2 ½	1 5/8	352	Lowell
		1	192	2 ½	1 5/8	192	Lowell
		1	208	2 ½	1 5/8	208	Lowell
		39	224	2 ½	1 5/8	83 8736 20528	Lowell

Of the 154 frames listed, approximately equal numbers were built before and after 1912. All told they turned 38,392 spindles.[56]

Alterations in the power system began in the pre-war period. Electrification of the drive system for #6 had begun in 1912. Motors did not drive individual machines; instead they powered the existing shafting and machines continued to be driven by pulleys and belts in most cases (Photograph 25). In this way electric power could be used to supplement water and steam power without changing machinery over to direct motor drive. When waterpower was plentiful, it could still be used. On the other hand, large electric motors on each floor provided dependable power.

A new Testing Department was also installed on 6-3 and held a full set of equipment:

1 Emerson conditioning oven #139	Emerson Apparatus Co.
1 Cloth breaking machine - elect. power	H. L. Scott
1 Cloth breaking machine - hand power	Riehle
1 Yarn Testing mach. power	H. L. Scott
1 Yarn reel	Brown & Sharpe[57]

Both yarn and cloth from around the mill came here for testing of tensile strength, consistency, and conformity to standards.

Attempting to make the most of the equipment and space available meant a constant juggling of machinery from one place to another,

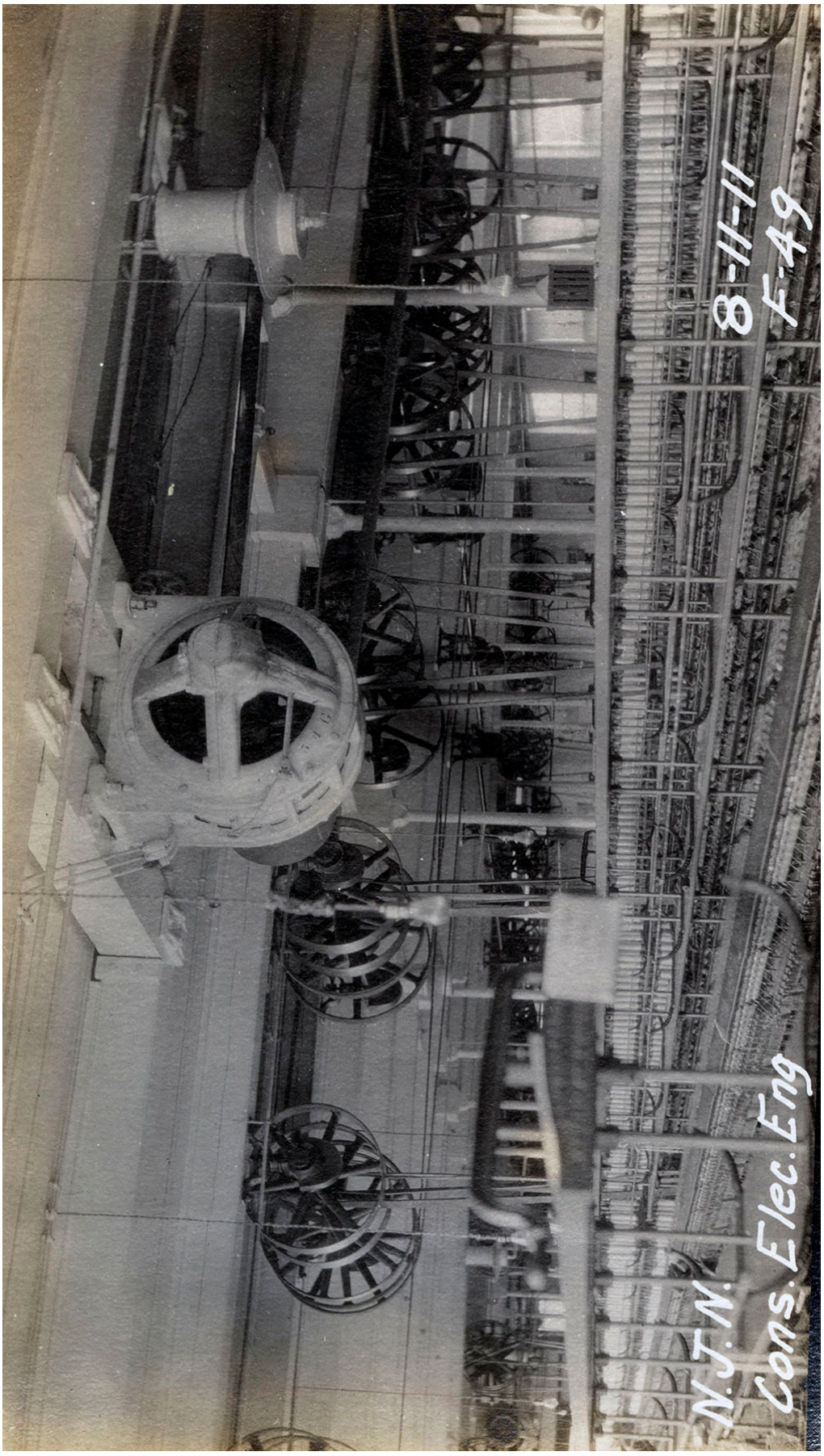


Photo 25. Electric motor powering belt drive for ring spinning in #5-4 east, 1911
Source: UML, CLH, LHS, LM, Flather Collection, Box 30, F-49

purchase of new technology in bits and pieces, which perpetuated the problems it was intended to solve, and installation of various parts of machines to bring advantageous new developments to the mill without acquiring expensive new machines. For example, in one short period of 1923 workers moved looms from one building to another, brought new equipment to 6-3, installed new 16-harness dobbies in 6-2 and 6-3 (both Stafford and Crompton and Knowles dobbies were applied during the teens and twenties), inserted new feelers, or sensors to trigger bobbin changes, into the looms, and plumbed new humidifiers.[58] Constant installations and adjustments to changes taxed all concerned.

The Treasurer continually approached the Directors with proposals for improvements, but either from inate caution, limited expectations, or belief that the plant itself did not merit thorough re-equipping, he moved timidly, as in this modest proposal:

> *We are running 2,138 looms, mostly Draper*
>
> *There are idle 359 plain looms*
>
> *2, 497- total number of looms.*
>
> *We require more Draper looms in order to use idle carding and spinning.*
>
> *We have no Draper looms wider than 44", although the goods market requires such. The market also calls for goods that would occupy additional looms of our present widths.*
>
> *We need 112 Draper looms to replace 48-40" and 64-30" Lowell looms. 112 Draper looms would require 11 weavers, in place of 22 weavers at present. The looms produce about 22,400 yards per week. The cost of weaving could be reduced 1c per yard, or $11, 000 per year.*
>
> *The Treasurer does not advise the purchase of 700 looms to balance the mill, which might cost $250,000. For the present authorization is desired to purchase not more than 200 looms, either new or second-hand involving not over $70,000, if and when market seems to demand them.*[59]

F. A. Flather stressed the limited nature of his proposal, its advantages, and contrasted it with the far more costly alternative recommended by consultants.

The combination of foresight and hesitancy, insight hampered by partial implementation, appeared again near the end of the period under consideration. In 1927 the Boott experimented with a new technology, which indicated an ability to recognize the potential of such advances, but at the same time called attention to an inability to come to terms with them or really get the plant working properly with regard to known, long-term difficulties. In November they equipped "One Ring Spin. Frame with V.T.R. System of Longdraft." Long draft spinning represented one of the major advances of the era, the first major change in spinning since the introduction of ring spinning itself:

> *It has been said that the development of long-draft cotton spinning was one of the only three important advances in the art of cotton manufacturing made in the last hundred years--the other two being the high-speed spindle of the 1870s and the automatic loom of the 1890s. (Some might add to the list the high-speed spooler and warper and the tying-in machine developed by the Barber-Colman Company.... Long-draft spinning and roving was nothing more nor less than realization of an ancient ambition to reduce the number of steps through which yarn was processed to reach its final size and strength. If the drafting capacity of the spinning frame could be increased, one or more of the roving frames employed in the processing which preceded spinning might be eliminated.*[60]

Problems associated with dealing with a natural fiber such as cotton made the attempts to produce greater drafting very difficult to solve while maintaining quality. The fibers, while passing through the drafting rolls, had to be under control in order to maintain a given weight of product, but they could not be drafted more rapidly unless they were sufficiently free from control to accept the greater attenuation, a seeming contradiction. Fernando Casablancas, a cotton mill superintendent working near Barcelona, Spain in 1913 devised a system which would better control the fibers while permitting greater drafting, so much so that the final of the three roving frames could be completely eliminated while higher quality yarn was produced. Although World War I delayed the spread of this invention, its merits were immediately recognized and various machine builders worked to develop their own versions.

Casablancas' and others' technique was to use short endless belts in conjunction with three sets of drafting rolls. It appears that the Boott experimented with the Howard and Bullough approach, presumably on one of their new H & B frames, rather than the Saco-Lowell technique which parallelled Casablancas'. New "middle

fluted rolls" they ordered would have been used in conjunction with the three sets normally present to produce the four-roll system H & B adopted. The result of all systems was the same.

Instituting such a novel device in 1927 in this country was a progressive step, well ahead of its general adoption. It parallels the prompt experimentation with the other major inventions. On the other hand, this experiment was hampered by existing conditions in #6. It led to two attempts, one in November and one in February, 1928, to install a humidification regulation system to facilitate the operation of the trial going on in 6-4. All spinning required high relative humidity, and previous installations should have provided it. To need a new humidification system for this experiment indicated that the room did not function as it should have. In fact, a 1928 report showed that relative humidity in 6-1, 6-2, and 6-3 ranged from 42 to 82 percent relative humidity (RH) on a given day.[61] Humidification in weave rooms ranked a close second in importance to that of spinning, so it becomes apparent that the mill as a whole was not atmospherically controlled to the degree that it had to be to make the best use of existing equipment, let alone new inventions.

Similar problems persisted regarding the use of the advanced Draper automatic looms purchased during the early part of the century. While the Boott had been quick to adopt them in the beginning, in 1928 they all still ran off belts and at speeds of just 142 to 152 picks per minute, well below acceptable levels.[62]

The final factor relating to the capability of installed technology related to the condition of the equipment. This area underlines the inter-related nature of the operation, since the efforts of managers, fixers, and operators all affected the state of the equipment. Both employees and consultants addressed these questions regularly and efforts were made to mitigate the effects of noted inadequacies.

Every loom received scrutiny as to its condition in terms of a 41-point checklist in 1928. Some representative samples:

> *The loom brakes were in fairly good mechanical condition but were not set properly. All brakes should be set so that the shuttle will not stop in the shed...*
>
> *The driving gears should be greased with medium grease weekly. Many of the gears were dry…*
>
> *The feelers were in good mechanical condition, and fairly well set…*

The warp stop motions were in good mechanical condition and well set…

The bobbins were in fairly good mechanical condition. The green bobbins were not as good as they should be, which caused considerable trouble in the Weave Room. Many were worn short, causing them to fall out of the battery. Throughout the mill, many bobbins had a slight difference in diameter; many loom stops are caused by this condition as all that filling runs off the bobbin. The feelers are set to a bobbin of a certain diameter. If some of the bobbins are of different diameters all the filling runs off, or a greater amount than is necessary is left on, causing excessive waste.[63]

The loom-fixers' practice and performance varied, as did management's in acquiring the bobbins, with a result of excess waste and unnecessary difficulties for the weavers. The performance of each party affected the work of others.

This review of machinery and conditions also considered the condition of every spinning frame in the mill and critiqued them individually. Some general comments on possible gains in efficiency:

Correcting of machine conditions, especially steel rolls, spindles, cap bar nebs, thread guides, builder cams, rings, front saddles, and the same driving pulleys for the same yarn number…

The frames appeared to be fairly well in line and level. Due to the vibration and uneven floors in some of the rooms, it is felt that the machines should be watched closely to see that they do not get out of line and level…

Belts that are dirty cause slippage which results in variation of speeds and loss of production.

Belts should be cleaned at least once a week when running days, and twice a week when running night and day. They should also be dressed when necessary.[64]

These consultants had found every sort of difficulty, real and potential, from worn parts to mismatched gears and conflicting shop-floor practices. Their advice admonished all levels of those involved by pointing out the ways their practice could be improved, whether that meant buying repair parts, adjusting frames consistently, or caring for the power system.

The condition of the machines also related to the degree of danger involved in working with them. One employee noted that one group of spinning frames was "open head and dangerous" because of their exposed gearing. Those were thrown out later in 1926, the year of the report.[65]

Efforts were being made in other ways to eliminated danger at this time, as well. The Valentine Report had drawn attention to the hazards of both exposed gearing and belt drives in 1916, noting that the latter "adds to the workers' sense of insecurity and hence decreases their liking for the work," on account of the ease with which a person or a person' s clothing might be caugh t in the belts.[66] Throughout the twenties some looms and other machinery in #6 were being converted to individual electric drive.

During 1929-30, management worked to implement a number of the recommendations of this and earlier reports. Individual electrification of machines received priority: "Modernizing 6-5 spinning room by removal of all large motors, pulleys, shafting, and bearings to install individual motor drives.... Modernizing weave rooms,--re-arranging looms to improve quality of the weaving and increase safety of the belts." These efforts were in part stop- gap, as was indicated by the continuing effort to make belts less dangerous, rather than eliminating them. Motorizing machines, as was done with the looms in 6-2 and 6-3, both improved these operations and increased safety.[67]

Individual motors also facilitated the rearrangements of looms and spinning frames which improved transportation of materials and work in all the rooms, fulfilling a recommendation that had appeared repeatedly in nearly every consultant's report. Wider aisles had been needed in most of the rooms. The aisles affected the workers greatly: besides preventing the free flow of work, lack of space made cleaning and repairing difficult and interfered with proper lighting. Wider aisles improved trucking, changing and repairing machines, doffing and cleaning.[68] Without individual motors, such rearrangement had posed difficulties, required major reorganization of not only machines, but also the system of shafting and pulleys which drove them. Suddenly, individual electric motors made it easy, and it began to be accomplished.

The adoption of certain new technologies, and experimentation with others makes it clear that the mill's managers were aware of current trends and pursued them selectively. The inability of the mill to make wholesale changes, or in some cases to fully utilize the benefits offered by changes introduced revealed a limited approach to the problems involved, primarily related to amounts of investment they were willing to make, but also part of a management problem which tended toward stop-gap measures rather than thorough

solutions. Even where labor costs were highest, in weaving, the automatic looms were only partially adopted and, belt driven, only partially utilized. Inexpensive knot-tyers were quickly purchased, but long-draft spinning was an experiment, and mill conditions blunted its effect. Similarly, electrification meant driving shafts with big motors for many years before individual motors were attached to the machines. One cannot fault past management for what they did not know, but one cannot help but note the occasions when they failed to make use of significant opportunities with which they were closely acquainted.

2. Work Environment: The Building

When the new owners took over the Boott Mills in 1905, they inherited a situation which included buildings, machines, their arrangement, and existing relationships between workers, management, machines, and buildings. None of these elements was created altogether consciously. The buildings had grown incrementally, work had developed in relation to changing machinery and traditions, and the overall organization was not only the product of management choices, but also an accretion of innumerable events, a product of the history of the mill and of the industry, including the long-time interaction of management and labor.

Many of these elements were not susceptible to quick change. All involved could resist alteration of relationships, some more strongly than others. Consultants called to the mill investigated many aspects of this situation and both described it and offered advice about how to improve it. Their commentary suggests that management was neither particularly sensitive to nor quick to change basic working conditions.

In 1911 Hackett wrote:

> *The other matter of perhaps slight comment is the question of lockers for the operatives' clothes. In almost all the rooms of the Boott Mills, the common practice was to hang the outer garments on a nail or hook, nearby the machine on which they were engaged. The odors arising from these clothes, especially of a damp morning is considerable, if allowed to hang in the work room unprotected, and it is anything but sanitary.*
>
> *Factors like the above with those of light, heat and washing facilities, all have their influence toward elevating or depressing the attractiveness of employment at the mill, and so the better - operative relegates the dingy shops to their distant foreign relations.*[69]

Advisors continually related the general work experience to the quality of workers who would be attracted to and held by the Boott. Later consultants found similar conditions, however, which implies that little had been done to alter them.

Valentine's Industrial Audit of the mill 5 years later produced a continuation of these complaints. It noted that the ramps connecting the floors of the mills and their different levels were oil-soaked, slippery, and "offer an excellent chance for a fall." Warp beams, empty and full, scattered about the floors of the weave rooms also invited falls, particularly those left in unlighted entrance ways on the lower floors. Windows in such poor condition that panes fell out, particularly when they were opened or shut, posed a danger and led to frequent cuts. The knives worn by workers in the spooling and spinning rooms for cutting away yarn and roving from the bobbins also produced numerous such injuries, and the old and scarred flooring put splinters into the feet of those who went barefoot, a tradition (born of heat and fear of sparks from hobnails) among the mulespinners. These conditions represented more than the apparent sum of their parts:

> *These dangers are obvious to one who goes through the mill only occasionally. Those who are there constantly lose the sense of risk. Habituation to dangerous surroundings dulls the natural spirit of caution. When fatigue sets in the nervous tension of carefulness is not maintained.*
>
> *For these reasons we believe that although a large portion of accidents in cotton mills are due to carelessness of workers, this does not relieve the management from all responsibility nor make its interest in preventing accidents any less. The fact that the insurance company under the state accident compensation law takes care of the financial liability insured has tended, we fear, to lessen the care taken by the management in this respect.*
>
> *In the six months prior to October 27, 1916, 1029 days of work were lost because of accident. One man died from injuries received at the mill. There were numerous injuries mostly in the nature of cuts, lacerations and bruises of varying seriousness. When people are living on a narrow margin eventhough protected by accident insurance, such risks have a more serious aspect than they would under other circumstances. The result is that the most foresighted ones, whom the industry can least afford to lose, gradually tend to turn to other less risky occupations.*[70]

The report indicated some of the dangers and implied that they should be still more obvious and of more urgency to those habitually in the mill. That they awaited a consultant's visit to

receive attention carried unsettling implications about the mill management's priorities. The suggestion that state regulations, initiated in response to overly exploitive conduct on the part of industry, might have led to reduced concern for worker safety on the part of management carried a heavy irony. The accident toll, as indicated by the days lost, not to mention the death (which one hopes was more exceptional than the injury toll was likely to have been), implicated the operation as one significantly more dangerous than were others at this time. One can only assume the correctness of the consultant in anticipating a continuing flight of workers to find other opportunities.

These hazards were increased by the poor lighting which heightened danger and lowered spirits. Quality and speed of work suffered. Dark interior walls minimized the light admitted by the small windows. Most of the machines were arranged lengthwise in the rooms, blocking natural light, whereas aisles and machines arrayed across the rooms would have admitted it. The windows' once-yearly washing did not adequately address the problem, and "light reflectors are rarely cleaned."[71]

Artificial lighting was not used to remedy these difficulties to the extent which it might have been: "In most rooms the lights are hung too high or too low and have either deep bell shaped shades, flat shades or no shades at all. Tungsten lamps predominate but there are a good many old type carbon filament bulbs. The result is a combination of glare and shadows that is very trying to the eye."[72] Available equipment which management failed to apply to the mill offered solutions to these deficiencies.

Ventilation of the rooms was equally poor. No artificial ventilation system brought fresh air into the low studded rooms. Cotton dust and "fly" in the spinning rooms of #6 permeated the air. Although there was comparatively little understanding of the extent of the danger at the time, a general deleterious effect was recognized. Now its connection to byssinosis, or "brown lung," has been amply demonstrated.

Cotton fly, among other things, made smoking in these mills expressly forbidden. At the same time, habit and the dust (and accompanying dry throats) led to very widespread tobacco-chewing, creating further problems: "The lack of cuspidors increases the number of bacteria stirred up in the air from dried floor dust."[73] The effects of the constant tobacco spitting must have been appalling.

The antiquated steam heating system did little to improve conditions: "Room No. 6-1 is reported cold in winter, the thermometer sometimes reading 45°.... All spinning rooms tend to

become too warm. At the east end of No. 6-1 weave room there is a blank wall. Without windows it is dark and hot. The second hand finds it difficult to keep weavers there."[74] Hardly surprising, but on the other hand hardly new, as these problems persisted for many years.

Humidity, which played an important role in cotton processing as well as in working conditions, varied widely, as noted. Mechanisms to produce and regulate humidity functioned badly:

> *Humidity is produced crudely by a type of atomizing apparatus known as a drosophore, also by live steam. There is a hygrometer in each room which is supposed to be read several times daily. The hygrometers are cared for by a man in the master mechanic department and filled with water by him on request. They are supposed to be read by someone in the planning department. This division of control seems unfortunate. Most of the hygrometers inspected were dry and one was broken. Hygrometer records, such as they are, are saved for the State inspector as required by law but do not seem to be used in regulating the action of the drosophores. The drosophores frequently get clogged and refuse to work. When running they are manipulated usually at the will of the overseer. It is a very rough and ready attempt at control.*[75]

Despite awareness of the importance of maintaining a high relative humidity, appropriate steps were not taken, and the effect on cotton processing and on factory labor were significantly detrimental. Energy of workers was sapped, discomfort increased, and motivation to perform the hard work at hand greatly diminished. Along with the excessive fluctuations in temperature, respiration became congested, and mucous membranes became increasingly sensitive to the dust and dirt in the air. Workers were left "more liable to colds, catarrh and grippe infections. If these conditions are prolonged the appetite diminishes. The result is undoubtedly a decrease in vitality and energy of the workers and a substantial amount of lost time from illness." Proper conditions facilitated processing, generated more work, and attracted and retained the best workers:

> *With improved ventilation, less dust and well controlled heat and humidity the workers would be much happier, more comfortable and would turn off much more and better work. The improvement would more than pay for the maintenance, depreciation, increased taxes and interest on the cost of a better system of air control.*[76]

The managers, for reasons which cannot be determined, were slow to implement the alterations suggested. In fact, they never fully treated these glaring deficiencies.

Chilled water from "bubblers" throughout the mill supplied one want, but even there no attempt had been made to apportion the drinking water according to the number of people in various rooms. The lack of planning in such regards does not seem reasonable and again shows little foresight by management.[77]

Similarly, no attention had been given the problem of changing clothes for work (despite the five years intervening since its citation in a previous report) and little attention to the related topic of proper toilet facilities:

> *There are no dressing rooms for either men or women. Work in most rooms is dirty and often hot so that a change of at least outer clothing is necessary. At present employees make rather extensive changes of clothing in the work rooms. Human decency requires better accommodations than this. Such conditions drive away good workers.*
>
> *There are a few cupboards on walls which serve as lockers, but most workers have to resort to hanging their clothes under strips of cloth on the wall wherever space can be found. This is hard on clothes and women's hats. It makes the temptation to stealing too great. Privacy and security of one's clothing is appreciated by everyone.*
>
> *In this connection it seems probable that Chapter 115 of the Acts of 1916 applies to at least certain rooms in this mill. If so, lockers in such rooms are required by law.*
>
> *TOILETS:*
>
> *Most of the toilets are in fair condition. The number of urinals in men's toilets is wholly insufficient… The ratio between the number of toilet conveniences and the number of people using them as required by law is not lived up to in all rooms. Toilets are all marked for men or for women. Such signs would be more useful if printed in other languages as well as English.*
>
> *In each toilet alcove there is a long sink for washing. Basins are few. Neither soap nor towels are provided by the mill. There is no provision of warm water.*
>
> *Until the mill provides dressing accommodations, thoroughly satisfactory toilets and ample washing facilities it cannot hope to attract a much better grade of workers nor can it expect that they keep themselves, the work and the mill as clean as right working*

standards require.[78]

The existence of such conditions despite the obviousness of their effects on worker dignity, as well as performance, speaks poorly of the management's attitude toward the labor force. As such an indicator, it gains more significance than one might initially accord a factor in some ways peripheral to the plant's purpose. However, an employee had every reason to expect more respectful treatment than this in a mill of this period.

Well before this time (1916), many companies had become aware of the significance of providing amenities for their workers. Many new work places, including textile mills, evidenced careful consideration of employee comfort through their attention to lockers, clean, pleasant toilet facilities, and much more, and in older factories, particularly of this scale, better met standards of decency. The Boott lagged behind the times and certainly its workers noted that.

Seventeen years after Hackett's comments, twelve after the Valentine Report, a 1928 evaluation characterized the situation and the attitude on the part of the mill's management which would permit it to continue:

> *There are several laws which are not fully carried out by the mill. The laws forbidding excessive humidity in certain rooms cannot be enforced because the hygrometers are not properly cared for, nor are the drosophores kept in good working order or so controlled as to maintain right conditions. Just recently the State inspector found that records of the number of minors at work in the mill were not being kept up. Regulations of the State Board of Labor relating to toilets are not lived up to, as hitherto pointed out. Notices required to be posted in the rooms and still in force are often found covered up with other notices. lf, as seems probable, Chap. 115, Massachusetts Acts of 1916, relating to a place for operatives to change their clothes applies to this mill, no steps have been taken to follow it out.*
>
> *These instances are cited merely to reinforce our belief that the mill needs more positive action from the management in regard to the administration of labor laws. The management will gain much goodwill among the workers if it not merely carries out the law to the letter but also carries out suggestions of inspectors and acts in harmony with the whole spirit of the law. No mill management can afford by such omissions to provoke private or public resentment.*
>
> *Industrial legislation in this Commonwealth represents minimum community standards below which we may safely say it is poor*

business policy to operate. Sometimes legislation is unwise and may even not express the will of the permanently effective majority of the community. Yet there are many instances where legislation at first seemed unwise to businessmen and then turned out to be sound. A generous and thorough trial is surely the best business policy.[79]

Citing the same conditions, the same law, and indicating that the same attitudes continue to shape conditions at the mill, the reports demonstrate that consistent disinterest. Humidity laws, child labor laws, changing room, toilet, and other regulations, all were being ignored. Not only had work on the humidity system shown little effect, the consulting firm looked for a novel way to appeal to management while recommending a trial of fulfilling the mill's legal obligation.

This negligence, which suggested both disrespect for the workers and lack of insight into mill management, was also apparent in the area of cleaning and caring for conditions in the mill. Valentine laid out a chain of circumstances in 1916 which illuminated this point:

Although floors in the mill are swept at least once and often more times a day, dust, lint and waste of processes gathers faster than it is taken away. The mill floors are washed once a week, but they are so old and full of cracks that very little water can be used. If used with any liberality it drips through and spoils the work in the room below. As a result scrubbing is exceedingly superficial...

Cuspidors are rare. In several rooms signs are posted threatening the person who spits on the floor with a lawful fine of twenty dollars; but as the signs are printed in English and most workers in those rooms are Greeks, Portuguese and Poles, and there are no cuspidors in sight, the whole thing is absurd as well as dangerous. All this greatly increases the risks of colds, grippe, pneumonia and tuberculosis.

The importance of cleaning is greatly underestimated. Dust and dirt causes machine bearings to wear out more rapidly, results in an increased use of oil, increases the fire risk, makes more bad yarn and imperfections in the cloth, increases the chances of staining and spotting yarn and cloth, increases the chances for disease and consequent hardships and loss of time, drives away the best workers, makes those who remain uncomfortable and disgusted with their jobs, makes it necessary to pay them more as a recompense for the disagreeable parts of their jobs.

An interesting example of how this works out is this. The looms in most of the rooms are so close together that they are difficult to get at

> *for cleaning or repairing. It is difficult to get enough cleaners of the right sort on account of the low wage paid. There are no cuspidors near the looms and loom fixers have to kneel down,--often lie down on the dirty floors in order to make the necessary changes in the still dirtier machines. The superintendent complains that the loom fixers shirk their jobs and want more money![80]*

It seems more surprising they could find fixers than that they sought raises. A deteriorating building made cleaning more difficult, which led directly and indirectly to waste, of labor health, yarn and cloth, of machines; it cost money. None of these factors led to efforts at correction.

Passages such as those of the consultant, above, are particularly important in keeping before the modern examiner of industrial history the importance of the fact that so much of the extant record was created by the managers and owners. The filth in which the loom- fixers worked never appeared in their accounts, while their "intransigence" and "uncooperativeness" were recurrent themes. Typical sources, products of management's point of view, carry a particular prejudice.

Not only did the Boott's operators fail to alleviate known conditions detrimental to people, cloth, and machinery, they took steps which added to these environmental problems. As the mill's machinery became faster during this period, noise and vibration also increased, particularly in the weave rooms. Conditions there were literally deafening, a cacophony causing hearing damage to any who worked in the area. Furthermore, these conditions were "irritating and fatiguing." While the earmuffs of modern weave rooms were not available, rest periods, which were not permitted, could have eased conditions noticeably. The noise of the shafting system could have been eliminated by individual electric motors for the looms.[81]

Higher speeds also increased vibration. While Flather belittled its effects, Valentine did not:

> *Vibration is a factor to be considered in respect to the well being of workers as well as machines. Floor vibration is excessive in rooms 2-2, 2-3, 5-3 and 6-5. It causes power losses, bad adjustment of shafting, increased repairs, liability to maladjustment in machines, probable crystallization of metal with decrease in life of the machines, and lowered quality and quantity of work. It causes discomfort, fatigue and occasional timidity among the operatives. It may have a bad effect on certain organs of the body similar to the kidney affections among street car motormen and conductors. These results tend to increase labor turnover. In this connection we call attention to a pamphlet on the subject of vibration recently issued*

by the Aberthaw Construction Company which brings out more fully foregoing points with many special references to textile mills.

The consultant, in fact, specifically noted the difficulty in working in the rear office room of which Holgate had complained.[82] Both the comment itself and the pamphlet cited provided evidence that such complaints were not novel, but were very much a part of the awareness of the time. The demand was not for innovative treatments, but for the type of conditions being provided by other companies.

In fact, the Boott's situation made it less able to absorb the disadvantages associated with such conditions than many mills. The plant's lay-out accentuated the problems. Transportation of materials represented continual difficulty for management and labor, the former in planning and controlling work, the latter in accomplishing it. Narrow aisles impeded transport, impinged on cleaning, and hampered repairing. Poor transportation routes delayed delivery of the supplies needed for work to proceed whether in spinning or weaving and caused loss of wages and discontent to the employees attempting to earn a living on piecework in those rooms.[83]

While the original Lowell mills had gone to great lengths to separate themselves from the image of English factories in order to be able to draw workers, the Boott had indeed become a dark and dangerous place to work, like the dark satanic mills of the romantic poets to which earlier investors had contrasted their buildings. The conditions reflected badly on owner intent, hampered and discouraged workers effort, and generally hindered the mill's operation. All associated, from top to bottom, suffered from these effects.

3. Work Environment: Job Descriptions

Within the environment described, each worker pursued a prescribed set of tasks. Inter- relationships between departments, and between workers, remained of utmost importance at all times. Efforts by management to define individual roles more precisely in the period 1905- 1930 enables one to assess with increasing precision the particular activities of the people laboring in #6.

Time spent in the mill had not changed much from earlier days. The hours of work in 1916 added up to 54 hours of straight time, 6:45 A.M. to 12:00, with an hour's stop for lunch, then 1:00 to 5:30 P.M., with work ending at noon on Saturday. Also, much overtime was expected, with no break between regular time and extra. Employees ate supper at their machines. The night shift ran a 60- hour week

beginning at 5:30 A.M.[84] This schedule did not differ from that of other Lowell mills in outline (contrasts in the mills' regularity of employment will be considered in relation to wages, below).

American industries at the turn of the century were in the process of attempting to apply the time spent at work more efficiently to the tasks at hand. Taylor' s popular "scientific management," made famous in his experiments in steel mills and machine shops, utilized concepts long part of the textile mill mentality: division of labor (specialization), measurement of work, piecework or incentive wages, and job analysis by management intended to enable it to understand and define tasks and workloads. Textile mills were hardly immune to the new fervor with which these ideas were being applied.

The Valentine Report in 1916 described another view of the importance of attention to the role of labor in efficient production:

> *Considering what a tremendous amount of capital is tied up in… machines and the number of people in the industry in... [shop floor] jobs, it is surely a problem of importance. The operating efficiency of a spinning frame or loom depends in large measure upon the frequency and length of stops. These in turn depend largely on the efficiency of the person tending the machine. The problem of what is the most efficient ratio of the number of machines to a worker is one containing many variables. It is capable, however, of much more nearly accurate solution than that hitherto attained. There is evidence tending to show that perhaps too many for efficient work are imposed on one worker. One of the overseers, for instance, stated that English speaking weavers are very reluctant to work on Draper automatic looms where they are asked to tend as high as twenty looms. They flock to Lowell looms where one person tends six machines. That is, in his opinion, the most intelligent weavers consider tending Draper looms too hard. Clearly the capital investment here is linked up closely with human questions such as source of labor supply, selection, training, fatigue, physical working conditions, speed of work, etc. The existing attempt to work out the problem contains too much guess work.*[85]

The consultant s suggested that only careful study and analysis, not guesswork or tradition, could properly apportion the application of labor to technology in the mill and ensure efficient use of expensive machinery. The "many variables" involved in making such determinations indicated the need for objective analysis of conditions in order that workloads could be set rationally at the optimum level, theoretically without causing more s train on the workers than that to which they were accustomed. A major tenet of these engineers was that proper conditions, and loads, as determined by increased management understanding of conditions, permitted

increased assignments (stretch- outs) without increased effort by labor. Labor tended to disagree and resist, for reasons associated with its different outlook, workplace traditions, and ideas of which aspects of the work made it more or less satisfying, stressful, and remunerative.

4. Weave Room Labor

a. Weavers

A weaver's work was defined primarily by the number of looms to be tended, along with the range of tasks associated with weaving assigned to the weaver or to other employees. As the previous quotation from Valentine indicated, weavers did not always readily accept new technology and its changing requirements. In part because of the traditional ideas about what formed an acceptable load, experienced weavers resisted the new type of loom-tending demanded by the new Drapers. They resisted the "stretch- out," the textile industry's continual tactic of devising ways whereby one operative could tend increasing numbers of machines and thus lower labor costs. The Draper automatic looms offered one of the most notable opportunities for such change in the history of the industry. While defenders of the new technology argued its ease of operation, the weavers disagreed with the idea of more work without more strain, as evidenced by their effort to remain with the old Lowell looms, without bobbin-changers. Despite the various ways in which the new looms were more automatic and therefore easier to run, the workers avoided them. One assumes they found work on the "Automatics" more stressful. Similarly, work at increasing numbers of looms reduced a person' s sense of actually making cloth, of producing something rather than simply being another cog in an overwhelming operation unaffected by a worker's input.

Looms per worker varied not only according to the type of loom operated, but also the variety of cloth being woven. As noted above, the Boott produced moleskin, repp, velvet, scrim, and duck simultaneously during this period. Weavers tended 18 looms on moleskin, from 6 to 12 on scrims, 20 to 22 on velvet, and between 6 and 20 on duck, the lower numbers in each case representing assignments on Lowell looms. Battery hands, replenishing the bobbins in the Draper automatic looms' magazines, served between 22 and 65 looms, depending on the speed with which the weft was used up, a product of the loom's speed and the weight of the yarn. Ideally, the battery hand would find each battery 3/4 empty each time he/she reached it.[86] The level of difficulty of these tasks cannot accurately be assessed from this distance. However, the contrast between assignments on the two types of looms, as much as 6:20, underlines the extent of the difference made by the new machines

and suggests the degree to which they must have altered the work. As much as the technology had taken the actual making of cloth away from the individual during the near century of Lowell's operation, these looms caused a quantum change in work, as they had in technology.

But the new looms did not define jobs, and equipment could not dictate conditions to the overall operation. In 1928 the Textile Development Corporation Report, the latest in the long series of such documents, indicated an overload on weavers:

> *The stops per loom per hour as shown by the actual tests taken during the survey would indicate clearly that under the present conditions the weavers have too much work to insure a high production, and good quality. However, by following the recommendations throughout the mill, the stops per loom per hour should be quickly reduced, not only to the point where the weavers can run their looms well, but it is reasonable to expect that it should be reduced sufficiently to allow a weaver to run more looms with less work than they are doing at present.*

Because conditions in the mill's production before weaving in the process were below standard, and because the looms were not maintained as well as they might have been ideally, weaving errors stopped the looms too often to give the weaver full benefit of the machine's technological capability and thus blocked the mill from taking advantage of their full potential. If broken warp threads or minor machine malfunctions led to the loom's stop-motions halting its production, the "stops" prevented efficiency on the part of worker and machine alike. It was typical of these reports to anticipate increased production without increased effort by labor, implying an expectation of calm labor acceptance of the planned stretch-out. The contrast between current excessive loads and the generally higher proposed loads under improved conditions underlined the connections between conditions and work throughout the mill.

Weavers' duties varied according to the numbers of looms tended. In some instances they were their own battery hands, some "picked out" or corrected, errors and doffed the cloth made, while those with more looms only drew in broken warp ends and doffed cloth. Weavers on the automatic looms would respond to a loom stop, indicated by one of the stop motions (rather than detecting it themselves), repair the problem, such as a broken weft, and restart the loom.[87]

Weavers, regardless of the type of loom operated, had to guard against many of the causes of seconds, or imperfect cloth, for which they were paid much less, although only a part of the causes of seconds were their fault. The mill made some distinction between

the different departments responsible for problems. A description of a few of the types of defects found in the material once it reached the Cloth Room indicated the potential for error and the number of sources from which seconds flowed:

1. Filling Bunches
   Many of the filling bunches were caused from the dirty condition of the loom. Lint had accumulated around the filling forks, racks, and shuttle boxes; the batteries were dirty also.
   When the shuttle leaves the shuttle box, the filling slackens somewhat, and jerks up dirty lint, which causes bunches.
2. Mispicks
   Many of the mispicks are caused by the weaver not finding the pick properly, when the filling breaks.
3. Thin Places
   Many of the thin places are caused by faulty loom fixing. When rocker shafts and boxes are badly worn, it is very difficult to set a loom so it will change filling correctly; this causes thin places. The crank arms were found loose on many of the looms; this s a defect that causes the lay to run unsteady. When the lay runs unsteady, the filling fork will not stop the loom as it should when the filling breaks.
4. Oily Spots
   Many of the oily spots are caused by oil dropping from the hanger, or shafting. The oil runs along the shafts, and drops on the warp. The loom cleaners make considerable oily places, when cleaning the looms.
5. Wrong Draws
   Generally the wrong draws are made by the weavers, and they should be held responsible for this defect.

These five problems are indicative of the variety of a much longer list which defined defects and assigned the fault for different types, some of which were traced back to the Card and Spinning Rooms. Here again, the interactions, between departments of the mill, people in the departments, people and the machines and even the structure itself (as when floors leaked scrub water onto cloth or shaft hangers dripped oil) comes to the fore. The extent of this list is impressive not simply because of its size, but also because defective cuts, or pieces, of cloth were incredibly common, ranging from 24% of the corduroy, 39% of the moleskin, 36% of the scrim, and an astounding 80% of the velvet, [88] or velveteen as it should be known (velvet actually being a silk material, though the term was often used for cotton and is often found used that way in the Boott records).

An efficient mill did not produce or tolerate such levels of failure. Such a performance makes it clear that no part of the operation,

no group within it, achieved the levels of production, whether in terms of efficiency, wages, or profit, that a mil l expected at this (or any) time.

b. Loom Fixers

The other people primarily involved in weave room work were the loom fixers. Their work also was significantly affected by the new Drapers being installed throughout this period and the continual application of improvements to them. Draper noted some effects and claimed they meant "fewer calls for the fixer on these new mechanisms":

> *The new brake with cork inserts was made to stop the loom with the shuttle in a certain position. To do this it had to be a good brake, one that does not get out of condition. The corks outlast a dozen of the old leather linings. Oil does not lessen their effectiveness.*
>
> *Boxes for the two main loom shafts were formerly bolted horizontally to the loomsides. They are now set in pockets on the loomside, resting on special shelves, to which they are vertically bolted with 9/16" bolts and lock washers. They do not loosen up, do not tip up on a bang-off and need little attention from the fixer. They "stay put."*
>
> *The new replaceable bushings in the Rocker Shaft Boxes prevent wear on the rocker shaft and eliminate the fixer's old troublesome job of shimming up the Lay.*[89]

Specific improvements made the loom a stronger, more precise machine as its speeds increased and its automatic functions grew more numerous. As the number of looms assignable to a weaver increased, so should those per fixer. Even small improvements such as the new warp stop-motion, the Stafford thread cutter (which clipped off the trailing end when the bobbin was changed), and the Midget Feeler (which sensed the amount of yarn remaining on a bobbin, triggering a change) adopted at the Boott during this time improved operating circumstances for weavers and fixers.

Given the innumerable variables in operating conditions involved, in addition to the steadily shifting technology, fixer workloads were a continual area of disagreement between these skilled men and management. In the weave rooms on 6-1, 6-2, and 6-3 a loom fixer took care of 98 Draper looms or 89 Lowell looms in one case, just 78 in another.[90]

Given the obvious skill and importance of the fixers, the industry's efforts to make their jobs more measurable, more susceptible to

management analysis, understanding, and, therefore, control and assignment, was readily predictable. Despite the effort to make each job in a textile mill as simple as possible, these men still dealt with a wide range of problems, the difficulty of which was indicated by the fact that the loom had some seven separate but inter- connected motions, each one of which had to be not only correctly adjusted but also timed in accordance with its relationship to the other six. Altering one aspect of the loom's operation affected its interaction with all the others.

The diversity of tasks, further complicated by varieties of looms and cloth, made the elimination of skill difficult, and the fixers' performance remained a major factor in this significant and labor-intensive portion of a mill's operation.

Loom Fixers at the Boott did not receive high ratings from the consultants who visited. Their work, given the number of looms they were responsible for, did not meet the expectations of the 1928 study. In general, they were faulted for only reacting to loom malfunctions, rather than inspecting and maintaining the looms on a regular basis. A brief extract from a lengthy inspection schedule provided by the consultants suggested the number of concerns facing a fixer:

Parts to be Inspected	How Often to Inspect It	What to Look For
Batteries	" 3 "	Clearance of shuttle box, bobbin support, feed pawl, bobbin disc, thread guide hold back pawl, and top holder; does battery turn freely, and does it need the eccentric bolt back stud.
Filling feeler	Weekly	Too close setting; not set close enough; knocking out too many bobbins; is it centering slot, and not touching shuttle; general condition.
Shuttle	Weekly	Loose and crooked grip; loose and dull point; rivet cutting reed; loose or rough eye; rough or rounded shuttle; condition of bristle.
Transferrers	Every 2 weeks	General condition of transferrers; does bobbin go deep enough or is it going too deep; does it center the shuttle, and is shuttle in position to receive bobbins; undue strain, and timed correctly; latch finger.[91]

These four, of thirty-eight, items begin to show the extent to which reliance was upon judgment rather than definition, feel rather than measurement. The number of things which had to be checked, often in several ways, indicated the complexity of maintenance and repair. The recurrence of such terms as "general condition, general examination, too large, worn enough, freely, too much lost motion" revealed the necessity of experienced eyes, ears, hands, and minds in these jobs. Both individually and through their organization, the Lowell Loom-Fixers Club, these workers remained figures to be reckoned with.

b. Cleaners and Oilers

Working closely with the Weavers and Fixers, but in very limited roles, were the Weave Room's Cleaners and Oilers. The cleaner in the weave room kept the machinery free of lint, dust, and other dirt. Each day, every loom was cleaned with compressed air. Whenever a warp ran out, extra cleaning was performed and oil and grease wiped off. The cleaner had to use care in "blowing off" or dirt would be pushed onto the cloth or yarn and damage it. The looms also needed regular oiling, daily for some parts, weekly for others.[92] Because of the number of moving parts and the speed at which they turned, hour after hour, lubrication could make the difference between early or late replacement of machines.

The Weave Room stood as a microcosm of the mill as a whole, with management and workers dependent on one another in complex ways, responsibilities difficult to sort out with finality. Levels of skill were diverse, and efforts to minimize them continual.

5. Spinning Room Labor

a. Section Men

Work in the spinning rooms of #6 received detailed study which offers precise information on activity there. Section Men generally oversaw the spinning frames' operation, kept them in good running condition, changed the tapes, or bands, which turned the spindles, oiled them, and changed travelers and top rolls as needed. Each man tended a fixed group of frames: in #6-4 and #6- 5, two tended 25 frames, or 6900 spindles each, and one had 26 frames, 7140 spindles to mind, higher loads than found in other mills in the complex.[93] This load indicated better machine condition, better arrangement, or both in #6 in comparison to the other mills.

b. Spinners

Spinners tending the warp spinning in #6 minded ten sides of frames on 24s to 50s yarns, 138 spindles per side, 1380 per spinner. Spinners tended the creel by putting a new supply of roving on bobbins onto skewers in the top of the frame to be drafted and spun; they were criticized for removing roving bobbins before they were empty and cutting off the remaining roving, wasting processed material, ruining the bobbins, and endangering themselves. Since they worked by the piece, the Spinners cared primarily to maximize production and did not share the mill's concern for the waste or the bobbins. They also did some oiling on the frames, cleaned the creels, and picked the top clearers three times a day, removing cotton errantly winding itself around these cleaning rolls.[94]

c. Doffers

Doffers worked in pairs, removing bobbins full of yarn from the spindles and replacing them with empty ones and piecing up the broken ends resulting in order to continue spinning on the fresh bobbins. On frames in 6-4 on 23s yarn, a doffer tended 18 frames and doffed each one 7 times a week, lifting and replacing 34,776 bobbins in that time. On the finer 30s yarn (30 hanks per pound) on 6-5, the bobbins filled up less quickly and a doffer t ended more frames, 22, doffed each 5.75 times per week, and lifted 34,914 bobbins. On 60s yarn on 6-5 they doffed forty-two frames each, 3 doffs per week, 34,776 bobbins.[95] Regardless of the yarn weight, all doffers lifted about the same number of bobbins, although they covered widely varying numbers of frames to do so.

d. Associated Help

A chart prepared for the Boott in 1928 described the numbers of people involved with spinning in #6, their tasks, and the numbers of workers in each position. It enables one to determine the complement of workers assigned to the rooms for all purposes, not only the obvious tasks of spinning and doffing:

Mill		Position	Rate	Rate per Week	Duties
	1	Overseer			Has charge of spooling & twisting also.
	1	Supervisor		36.00	Has charge of Mills #6-4, #6-5, and twisting in #7-5. These are assistant overseers, and watch the help in their rooms.
	4	Front bobbin cleaners	$.0608 per 1000 bobbins	14.00	Clean the filling bobbins.
	2	Back bobbin cleaners	$.0304 per 1000 bobbins	14.00	Clean the filling bobbins.
	4	Pulling-off yarn	.14 per 1000 bobs. old feeler .105 per 1000 new feeler	16.50	Pull yarn off filling bobbins by hand.
6-4	1	Third hand*	$.506 per hour	24.89	Does third hand's work in Mill #6-5 also.
6-4	1	Fixer	$.545 per hour	26.16	Fixes frames, bands, and oils.
6-4	1	Roving man	$.4006 per hour	19.23	Lays up roving, and takes down empties.

6-4	1	Trucker	$.4006 per hour	19.23	Takes yarn to Spooling Department of Mill #1-5, and trucks empty bobbins back.
6-4	3	Sweepers & cleaners*	$.308 per hour	14.78	Sweep floors, clean frames.
6-4	2	Roll pickers	$.3375 per hour	16.20	Clean top and bottom rolls and oil them; help in changing.
6-4	1	Scrubber*	$.285 per hour	11.12	Scrubs in Mill #6-5 also. Works only 39 hours per week.
6-4	1	Oiler-waste man*	$.336 per hour	16.13	Picks up the waste. cleans overhead, fills fire pails, also sorts the waste and carries it out.
6-4	2	Doffers		24.00	
6-5	1	Fixer	$.545 per hour	26.16	Duties same as other fixers.
6-5	1	Roving man	$.4006 per hour	19.23	Duties same as other roving men.
6-5	1	Trucker	$.4006 per hour	19.23	Trucks yarn to Spooling Department of Mill #1-5, and trucks back empty bobbins.
6-5	3	Sweepers & cleaners*	$.308 per hour	14.78	Duties same as other sweepers and cleaners.
6-5	2	Roll pickers	$.3375 per hour	16.20	Duties same as other roll pickers.
6-5	1	Shaftman - oiler*	$.336 per hour	16.13	Picks up waste, sorts and weighs it, then carries it out, also fills fire pails and brushes down overhead.
6-5	2	Doffers		22.00	

* B rate, all others A rate.

Twenty- four workers, in addition to spinners, were assigned to the two Spinning Rooms in #6; their endeavor was supplemented from above by an Overseer and a Supervisor; hierarchically and monetarily beneath the other workers toiled bobbin cleaners and yarn pullers removing tail ends of yarn from bobbins ejected from the automatic looms. Their pay varied according to which type of feeler was being utilized to determine when to eject the bobbins, the new Midget feelers presumable signaling the change nearer the end of the yarn supply on a bobbin; thus did technological change affect even the lowest worker on the mill's employment ladder.

The chart presents the full range of input and allows one to picture activity within the mill's top two floors. The Roving Man received carts of full roving bobbins from Carding Rooms elsewhere via the elevator and moved through the room piling them on top of the frames, on a shelf above the creel, and removing the empties in carts filled by the Spinners as they creeled the roving. Doffers placed full bobbins of yarn in hand trucks for the Trucker to push into the elevator and then to #1-5. Other "specialists" swept, scrubbed, and oiled and cleaned the frames.

While the work of these places was spinning, there were more people attending to the spinning than actually doing it. The amount of oiling and cleaning was particularly noticeable. Top rolls were cleaned with a brush every two hours, as were the thread boards, the roller beam twice a day, and top clearers picked three times a day. Other parts required daily or weekly cleaning. Several of the workers in the room had some cleaning responsibilities. Oiling similarly proceeded on a daily schedule for certain bearings, for other parts less often but regularly. Here, as in the Weave Room, inspection of the operation was no simple task and a checklist for inspection listed 58 separate items to be checked.[96]

In any account of the work in a given room, there is a tendency to omit the incidental and indirect labor that is required. Cleaning and oiling represented a part of this work. But much more such work went on routinely at the Boott while leaving little record. A list of parts purchased during six months in 1913 suggested some of this activity.

Machinery parts were needed for every class of equipment in the mill. Looms, for example, while receiving no major new parts during the time in question, required temples, shuttles, picker sticks, binders, and crank shafts. New pulleys, hangers, bushings and bearings helped maintain the power transmission system. The spinning rooms needed new separators (to keep the yarn being spun on one spindle from becoming entangled with that on the next), cutter blades, chain, top roll springs, bolsters, nails and bolts, brackets, studs, spindles, and filling cutters. Kew piping

and valves were installed, the adding machine and the two-horse truck repaired, new parts for the steamers and elevators purchased, a new die bought, sprinklers fixed, among other things, and at the same time unlisted items of less than $2.00 value purchased amounted to $7696.83, indicating that a great deal more than can now be itemized also took place during this period.[97]

6. Testing

The final type of work going on in #6 in the 1905-1930 was carried out in the Testing Room on 6-3. Albert A. Abbott presided there in the early twenties, assisted by Mrs. Laird and Willie Adams. They tested both yarn and cloth and compared samples brought from the weave rooms to the customer's sample the mill attempted to match. In one case, 60, 000 yards produced to match a small sample resulted in the return by the customer of 30,000 yards as unacceptable. Microscopic examination, strength testers, twist counters and related instruments enabled these workers to determine precisely what the mill was turning out.[98]

Their work varied from testing tensile strength of both yarn and cloth in a machine that pulled until the material broke, to counting the number of twists in a given length of yarn, to weighing samples of roving and yarn on precise gram scales to insure that production met prescribed standards. This meticulous, at times microscopic, work stood in stark contrast to the mill's general mechanical operations, but at the same time in its manner demonstrated the preciseness of results which the mill needed to strive for if it were to achieve the production it aimed for. In other words, while the machines were not always as precise as desired, while they appear somewhat primitive according to modern computerized standards (and eyes accustomed to such), they produced results at a level of preciseness that required minute analysis to determine the extent to which a standard had been achieved or missed. This great hulking machine of a mill aimed for and attained production of precisely defined and measured products.

7. Oversight

Just as the combination of job definitions, position charts, and parts lists can combine to suggest the workers' roles and activities in Spinning and Weaving, so can accounts of their supervision on the floor illuminate these areas. Particularly, descriptions of the oversight and its relation to employee performance help bridge the gap between definitions of work and its conduct.

At the early part of this period, and century, the Overseers in #6 were Robert W. McAllister in Weaving and Samuel Worth in

Spinning.[99] They would have been found on the stairs a good deal of the time, since their departments were divided between floors in just the way the consultants were wont to decry.

Working to control and direct operations in #6 after World War I were Overseers Drew, Joubert, and Verville. In a 1924 ranking they rated Good or Average in both Appearance and Management of Idle Stock, and Good in Cooperation in Curtailing Problems.[100] These people worked in the forefront of the interaction between capital and labor, employees themselves, but representing the point of view of those in charge. Their jobs are described, in a sense, by considering those beneath them. A consideration of their place within the factory organization, however, can illuminate the nature of their work.

While they reached their positions through seniority and knowledge, much of what they did, and of what they managed, was also the product of experience and tradition rather than the product of study and analysis. While their knowledge of the processes they oversaw was likely to be based on long experience and understanding of that part of the cotton process beneath them, they were subject to management direction and followed orders originating in the Treasurer's Office and the Counting House. When the higher-ups failed to perform well, the Overseers bore the brunt of the effect mistakes had on worker-management relations. Furthermore, in addition to working at the front lines of the ongoing confrontation between work and its direction in these mills, the men in charge of Weaving and Spinning in #6 worked at or near the top of the mill's production line, placing them at the top of the pyramid of accumulating effects from errors made anywhere in the cotton process.

Regarding the first area, relations with the workers, the Valentine Report described time-keeping, the most basic aspect of the relationship:

> *There is no uniform method of adequately informing the workers as to the time of stopping work at noon and night. There are fifty-one rooms with several ways of egress in each. We found much laxity in the matter of going and coming, especially at night. In many of the rooms there is so much noise that the sound of the mill bell is inaudible. We found no written rules in any of the rooms nor are there any oral rules except as to the time of starting and s topping work. There is much hanging around the doors, waiting for the bell to ring at noon and night.*
>
> *The problem of securing prompt attendance, steady application to work, avoidance of quarrels and frictions, cannot be solved by setting*

> *arbitrary and inflexible rules. The worker's attitude is inevitably influenced by evidences of inadequate management to the extent that more definite standards of control must in a measure wait upon improvements in operating methods. If workers find that lax management puts obstacles in the way of regular work in the form of poor transportation and all the other difficulties, if the company's disposal of waste is careless, if work is not ready for workers when they arrive in the morning, if the work day with the addition of overtime is too long to make it possible to sustain effort throughout the working period - it is impossible to expect workers to maintain a rigid system in all these matters.*[101]

With no control over the operation of bells or overall procedure, it was still the Overseers who had to cope with the effects on the workers. Despite their best efforts, the mill's practices spoke louder than their works (or its bells). Bad conditions begat bad habits. The fact that the noise of the rooms was so loud as to drown out the mill bells serves to remind one of a constant, overwhelming aspect of the situation in the mills.

Relative to the other aspect of their burden, the cumulative nature of mistakes made in the mill, one finds that the mill initiated its efforts to prepare the help poorly. Its general lack of attention to the workers extended to the problem of training them to do their jobs. While some workers came with experience, others had none, and the mill's conditions did not tend to draw the more knowledgeable. Because they were poorly trained, they produced disproportionate amounts of waste and seconds. Frequent changes in style combined with lack of skill to produce between 6% and 9% seconds in the weave rooms. Overall, waste accounted for 15% of the cotton entering the mill, or 4 /7 of the total profit for 1916. This performance represented a level 50 percent beyond the "acceptable." Bobbins dropped on the floor where they became greasy, or doffed before they were empty (wasting the remaining yarn), dirty hands handling the yarn or cloth, bobbins run empty in the looms, bobbins roughly handled so that the yarn become tangled; innumerable little mistakes multiplied as the errors made in one place passed along and contaminated further work. Carelessly tended machines, indifference to detail, mix-ups of different types of yarn, errors in spinning leading to difficulties in the warping department, over and over the same types of mistakes took an enormous toll on the work and the workers:

> *Slovenly cleaning leaves dirt which forms into webs. These get stirred up in the air and fall on the roving, yarn or cloth. Poor oiling causes dust to accumulate. Feelers in Draper looms if poorly adjusted cause much waste of yarn on bobbins. Careless handling on greasy floors in the weave room makes grease spots on rolls of cloth. Oil cans put in waste boxes makes oily waste. Work by*

> *untrained operatives is slower, spoils more, is less adaptable, causes more machine repairs, causes interference with transportation and lowers production.*[102]

In nearly every case, mistakes negated the effect of labor previously expended on the cotton, and in many instances they persisted and damaged further work before they were discovered or because they could not be overcome. When things went badly because of these failings, everyone suffered, demoralization set in, wages were lost on piecework, and a vicious circle was created.

The Overseers must have felt at times that they were at the center of this circle, helpless to affect its course. Because of the many uncorrected problems and the poor attitude on the part of management they bespoke:

> *Tightening of discipline is not the remedy at present. Until physical working conditions and wages are improved and greater managerial efficiency is introduced an attempt to enforce strict discipline in wholesale fashion would be apt to drive away many workers - - more than the mill could afford to lose. Until workers surely know good methods from bad methods, it is unfair to treat them as if the mistakes were intentional. One of the weaving overseers stated, for instance, that the weavers feel that under present conditions they have done their best and that merely showing them the seconds they make is sufficient to cause them to walk out. Under the circumstances they resent a call down.*

The workers reacted to the conditions they observed being created, the environment in which they were expected to play their roles. They were knowledgeable about what conditions were supposed to be and responded to the situation as they found it. Given poor conditions, they did not feel they could be called to account for errors they could not prevent. The Weaving Overseer was advised, in effect, to await a general improvement before he could expect one on the part of labor.

So restricted had the situation made their power, in fact, that they did not even believe they could justifiably dismiss an employee in any but the most extreme situations: “Drunkenness, stealing, insubordination, flagrant vice, fighting, physical violence, continued quarrelsomeness and cheating” were cited by them as the only sufficient causes for firing a worker.[103] Reflection upon these terms gives rise to a picture of a mill with conditions, as have been described, of general unpleasantness punctuated by incidents of truly abhorent character. The difficult position of the Overseer stands as a metaphor for all workers’ situation and must be kept in mind relative to all aspects of the Boott’s operation.

F. WAGES

All the work at the Boott, regardless of job-description, hierarchical position, or working conditions shared a common goal: pay. The bottom line for everyone's work, wages, continued to show dramatic changes during this period. While Boott wages formed part of a Lowell and New England continuum, they did vary in some ways from those at other mills, and both the general pattern, as exemplified by the Boott, and its place in the region deserve consideration.

The first indications of wages in the Boott for this period come in a listing of current terms and an advance to be made in June, 1907.[104] Wages in carding, on 6-5, showed increases from $11.25 to $11.80 per week for a Fixer, up fifty cents to $11 for the two Grinders, with most of the other 18 carding workers earning between $5.35 and $6.75 after raises of about $.25. Workers tending the speeders and roving frames also in 6-5 received piece rates which were likely to be comparable to the general pay level noted. All workers served a 58-hour week.

Ring Spinners on the 4th floor gained similar increases:

	Old Rate	New Rate
1 Fixer	13.50	14.00
1 Band man	6.60	7.00
1 Roving man	6.60	7.00
2 Cleaners	5.50	5.75
1 Scrubber	5.25	5.50
2 Doffers	8.00	8.40
Spinners # 65 Warp	0.76	.80 per 100 Spindles 58 hours

Spinners here produced 65s warp yarn, light by Boott standards, and received 80 cents per 100 spindles run.

Wages in Mule Spinning on the 3rd and 4th floors indicated the great range of wages in that department, with back boys (who placed roving into the mules creel from the back) among the lower paid workers in the mill while the mule spinners were some of the better paid:

	Old Rate	New Rate
Overseer	No change	
1 Fixer	13.50	15.00

1 Fixer	13.25	13.90
Filling Carrier	7.50	7.85
1 Roving man	6.60	6.90
5 Back Boys	6.00	6.30
2 Doffers	8.10	8.50
1 Doffer	7.60	8.00
1 Roving boy	7.85	8.50

All this help assisted the room as a whole, not particular mulespinners. The Roving Man brought the product of the Card Room to be spun and the Filling Carrier transported the yarn to the Weave Rooms where it was used as "filling," or weft.

Boys in the Mule Room had traditionally hoped to move up to mulespinner positions in time. By the early 1900s, such an advancement had been made unlikely by the imminence of the mule's abandonment.

Rates for mulespinners indicated a range of piece rates proportional to a production of from 7s yarn (made from waste) to 90s, an indication of the versatility of these machines. They also showed that on only the 1100- spindle mules (2200-spindle pairs) were spinners and piecers (two levels of assistant) employed to assist Mulespinners in the task of reconnecting broken ends; elsewhere a Mulespinner minded two machines alone. Prices per hank varied according to both the size of the mules and the yarn weight and aimed at providing comparable wages to all members of each classification.

Raises in the weave rooms in 1907 paralleled those elsewhere in #6. The great disparity in different weavers' rates according to style suggested the varying degree of difficulty in producing the different fabrics and, presumably, reflected the contrast in amounts of cloth produced on the Lowell looms and the Draper automatics (highest rates would have been for complex, fine cloth made on one of the slower Lowell looms, lowest for the pieces made on a weaver's larger number of Drapers rapidly producing a coarse material):

#6 Mill 1st Floor Weaving

	Old Rate	New Rate
1 Overseer	same	same
Second Hand	$16.50	$17.00
Scrubber	6.50	6.80
3 Fixers	13.55	14.20
1 Bobbin Man	8.00	8.40

2 Cleaners	6.50	6.80
1 Room Girl	9.00	9.50
	Weavers	
Style	9	.30
	151	.40
	145	.47

#6 Mill 2nd Floor Weaving

	Old Rate	New Rate
4 Fixers	$13.55	$14.20
1 Room Girl	9.00	9.50
1 Filling Man	7.70	8.00
	Weavers	
Style	1	.22
	9	.55
	330	1.25
	252	1.53
	8	.36
	151	.73
	328	.36

#6 Mill 3rd Floor Weaving

	Old Rate	New Rate
1 Room Girl	$9.00	$9.50

#6 Mill 3rd Floor Duck

	Old Rate	New Rate
2 Fixers	$13.55	$14.20
Room Girl	9.00	9.50
Filling Man	7.00	7.35
	Weavers	
Style	381	2.54
	265	.68

The intention of all these rates was to pay comparable amounts for work at machines capable of producing cloth at very different speeds, particularly where weavers tended markedly different numbers of looms.

Individual weavers could have a significant impact on their earnings through their effort, assuming rates were fair and machinery conditions equal.

Less than a year after these increases, on March 30, 1908, wages were cut to levels lower than before the 1907 increase. Reductions of more than 10% appeared throughout the mill, and city, as the workers absorbed the effect of yet another economic downturn. By September, 1910, wages still had not recovered their early 1907 level.[105]

Slowly increases came, but significant improvement had to await further developments distant from the mill. By 1916 war work had brought changes to the mill. Work was plentiful (particularly on duck for the military), workers scarce, and wages advanced twice, 10% in January and 8% in the spring. Because of the narrower range of goods and increased production, the first wage increase was overcome, or canceled out in terms of cost, quickly. In management's terms, it had not cost them anything. Had more help been available, still further production could have been sold.

Because of the increases for hourly workers, 2½ percent of profits were appropriated for distribution to about 50 employees who did not get the wage advances. $5000 was distributed in amounts of $15 to $500, with the latter presumably going to Agent E.W. Thomas who was making nearly $135 a week, $7000 a year, in marked contrast to hourly workers earning between $6 and $35 a week.[106]

A 1916 report broke down earnings in another manner and indicated the numbers of people, male and female, who worked at the different pay levels at the Boott:

Earnings	Number of Workers			
	Males day	Males night	Females	Total
$ 6. - $ 7. 99 incl.	103	--	194	297
$ 8. - $11.99 incl.	487	167	373	1027
$12. - $14.99 incl.	231	112	65	408
$15. - $17. 99 incl.	155	62	7	224
$18. - $35.	36	35	--	71
Totals	1012	376	639	2027[107]

The lowest-paid group of males appeared to be boys ("males day") unable by law to work at night, as were the women, the only others to earn so little. Women's wages showed marked concentration in the lowest groups. Even among men, earning over $15 a week

occurred rarely, and the $35 maximum lies $100 per week below the pay of Thomas.

Overtime work added to the pay levels of adult males, particularly for those in carding and weaving. Four hours a night for five nights a week occurred regularly for some of the employees. Protective legislation written in sex-specific ways thus limited the earning capacity of those it aimed to protect. Those working overtime increased their pay by about a third.[108] The differences in earnings between those at the lower end of the scale and the overseers, foreman and second hands were accentuated by overtime and occasional bonuses for the latter, as well as by the fact that those doing piece work suffered because of the delays in production occasioned by frequent style changes and transportation delays related to the mill's lay-out. In other words, several factors in addition to the wage rates themselves combined to heighten the disparities in income between the male and female workers. Skill, access, independence from the moment-to-moment flow of materials, and legislation all perpetuated the male advantage which had its origin, here, in the plans according to which the city had been erected.

The problem of maintaining the separation of the male elite, the salaried, who did not share in the hourly raises, from the other men, led to a rare recorded disagreement between the Treasurer and his Board. F.A. Flather, who was not enthused about the across-the-board bonuses at times resorted to, gave discretionary bonuses of $25 to $100 to various personnel, for example when certain production goals had been reached. In one instance, when "a man made a supreme effort in straightening out a strike based on ignorance and misunderstanding and I gave him $100."[109] Doling out the money this way gave Flather personal credit for the largesse as well as enabling him to reward individuals rather than classes of employees.

In 1917, however, the Directors voted:

> *That the Treasurer be authorized to offer and to pay salaried officers continuing with the Boott Mills, whose compensation is on a monthly salary basis, additional compensation contingent upon any declaration of a cash dividend on the Common Stock of the Company from September 2, 1917, to September 2, 1918, inclusive, the amount of such additional compensation to be determined by multiplying the present annual salary or regular compensation by three times the percentum rate of the dividend declared, and such additional compensation to be payed on the same date as the dividend is payable to the stockholders.*

This profit-sharing plan for salaried employees was repeated in 1918, but not the next three years, and resumed in late 1921, when

$3447 was divided between 19 employees. Apparently Bemis, the primary stockholder, supported and led efforts to institute this plan. The supervisors' raises insured that they were paid at least 10% more than previously and also 10% more than those they supervised.[110]

The May 14, 1917 wage increase had represented the culmination of a series beginning in 1912, which, according to Flather: "Counting the I.W.W. strike [discussed below], we have raised wages 10 plus 10 plus 8 plus 10 plus 10 percent" (from 1912 to 1917). At the same time they had eliminated overtime and other "subterfuges" previously used to pay more than the alleged scale in areas where "labor difficulties" had made it necessary.[111]

A Schedule of Number of People Employed with Rates Per Hour, along with a Schedule of Piece Rate Prices, both corrected to indicate a September 20, 1919 wage increase, gave a good indication of the situation at the end of World War I at the Boott. It revealed not only the pay, and the new 48-hour week, but also a substantial increase in personnel involved, particularly in cleaning. Presumably part of the change reflected the lesser ability of some of the wartime help available, but greater attention to the problem appears to have been a factor as well.

The overall increases in numbers of workers may also have reflected a decline in skills, although added Fixers could have been a response to aging equipment run hard to take advantage of government orders. Replacement would await post-war shifting of machine builders back to making textile equipment. The situation in Weaving closely paralleled that in Spinning. Loom speeds had not increased, and workloads were comparatively low, indicating a lack of skilled weavers, and perhaps the close inspection of government work tending to reduce the load in order to reduce seconds.

The 15 fabrics listed represented the product of Mill #6, the Fine Goods mill. The increases in numbers of fixers, cleaners and oilers indicated a redistribution of available skills to keep things going despite the disruption of standard job distribution such changes represented and the problems they might (and did) pose in the future.[112]

May, 1920 saw another raise, 15%, for a total of 229% since 1912.[113] Intense competition for labor during the war, and steady inflation along with a steady flow of government contracts, had necessitated these wage increases. Later that same year, as the national economy once again struggled, the Directors implemented a 22-1/2% reduction in pay across the board and wages reverted to the November, 1919 level.

ln April, 1923 all the Lowell mills agreed to a 12-1/2% wage increase at the end of the month. The Boott had not joined a January, 1922 wage reduction attempt of some New England mills, a cut foiled, ultimately, by the refusal of the giant American Woolen Company and the Fall River and New Bedford mills to participate.[114] By the end of 1924 weekly rates for Spinners were projected as $21.63, Doffers $25.42, Weavers $22.42-$25.20, and Loom-Fixers $32.81.[115] These rates would result from full weeks with sufficient production, one assumes, and the many possible causes for interruptions to production already discussed must be considered in evaluating these wages. In 1925, time and a quarter for overtime appeared.

G. Earnings and Costs

In addition to the rise and fall of wages which occurred at all the Lowell mills and generally followed the national economy, several other factors must be considered in evaluating the pay of the Boott Mill workers: work available, cost of living, and type of pay system. Earnings were not a function simply of wages, but also of hours worked. For example, in 1920 the Boott operated on a three day week for a time, closed for a period in 1921, and in the spring of 1924 ran 1 or 2 days a week while business was dull.[116] No unemployment insurance compensated Boott workers when business trends made it more economical to suspend than to operate. Savings or earnings from family members working elsewhere had to be relied upon while the workers carried the weight of the economy's difficulties, whether expensive cotton, a weak market for cloth, or poor management of the mill.

Living costs rose dramatically during the war years and the ability of wage increases to keep pace are, and were, hard to determine. Contemporary estimates offer intriguing views of the estimators. For a couple with three children, F.A. Flather believed the minimum cost of living to be $1000 a year; Thomas guessed $600; both the Superintendent and Mrs. Gilman, who had been working in the office on payrolls for 25 years, handled accident and sickness cases, and had a familiarity with the workers home situations, suggested $750. Scott Nearing's 1911 Financing a Wage Earner's Family assumed a $750-$1000 income was needed for a decent living, whereas U.S. government estimates called for $691 to $732 minimums in 1911, depending on the nationality of the families! Price increases for the five years before 1916 amounted to 19 percent, with a 13 percent increase for the year preceding August, 1916, with staples such as beans, onions, and potatoes rising over 60%. Other prices advanced accordingly. In 1913 the average income of cotton mill employees in Lowell was $454, middling compared to cotton workers in other Massachusetts cities, but well below the $625 of boot and shoe workers or the $692 of machine-shop employees, and well below the amounts needed for subsistence for a family.

Since individual employees did not, in fact, earn enough to support one person, the Valentine Report noted that "the mill is making heavy drafts on the physical reserves of a large proportion of its workers."[117] Wages at this level of deprivation offered a strong stimulus to the perpetuation of the extended family since smaller units had trouble making ends meet. The distance between incomes and cost estimates, even by Management, demonstrates a startling consciousness on its part of the insufficiency of the pay it offered.

Furthermore, the Boott's position relative to other Lowell textile mills (not to mention other wartime employers such as U.S. Cartridge, a major competitor for local labor) heightened its employees' difficulties: "Since the work is more irregular at the Boott than at several of the other Lowell cotton mills, this mill is at this added disadvantage." The mills as a whole attracted only the "poorest grade of workers." None of these workers could "maintain what could seriously be called an American standard of living." While doing little to alter this situation in any general way, the owners did vote in 1917 "to fix the minimum compensation of girls who are paid by the week at $10, unless they are learners." No change in piecework wages nor any minimum for those receiving them accompanied this wage floor. On the contrary, at the same meeting the Directors voted raises for supervisors, to match the recent wage advance, and bonuses for department heads ''by reason of the company's exceeding goal established by a Director; [and] to change conditional portion of department heads' salaries into part fixed and part conditional"[118] (based on the production of those they supervised).

Paying labor on a piecework basis had long been resorted to in Lowell in an attempt to maximize production while minimizing labor cost. It reflected several areas of weakness on the part of management, indicating that they could not convince labor of a shared interest in production (thus inspiring them to exert full effort for hourly wages), that they could not adequately measure an acceptable performance and then expect or demand it, ultimately that they could not control the production process fully and could only attempt to coerce an acceptable level of effort through low wages tied to attainment of minimum goals. Workers retained some control over their activity on the shop floor through their ability to affect the rates set for jobs and then through the degree to which they would attempt to attain the hoped-for goals in a given day, hour, or week. These are weak and negative elements, obviously, but they indicated that management had not taken complete control of the situation.

The practice of paying, in effect, piecework rates to supervisory personnel dated from the mid- nineteenth century in Lowell and marked one of the major steps in the increasing subjugation of the textile worker for which that period is infamous. Income based

on the production of the people whose labor supervisors directed was known to significantly increase the pressure on the workers to maximize speed, even at the expense of working conditions or safety. The institution of such a system in the 1840s represented shifting in the owners' attitude toward labor or a revelation of the nature of the operation of the Lowell system, according to one's attitude toward the owners. To continue this approach of conditional wages for supervisors indicated a readiness to pay for production despite inherent drawbacks, a willingness to employ every tactic to coerce, rather than inspire, effort.

During 1928 and 1929 production increased, with two and even three shifts running. However, working conditions remained poor and losses in income because of changes in machines and the conditions noted (above) depressed earnings to a level below other Lowell mills, to which Boott workers continued to go whenever possible.[119]

A final note on wages gives perspective on the relative position of some of the players. In August, 1923, John Rogers Flather (JRF), son of the Treasurer and recent Harvard graduate, went to work in the Office of the Boott Mills. For the first month he served without pay, presumably learning the ropes. After that month, he began to receive $24 per week, or the pay of a worker with significant skill and experience. While his starting salary was not as lofty as that of a few men who had spent many years attaining their positions, neither was it subject to the irregularities of shop floor work.

Whatever the relative amount of justice involved in this situation, the arrival of the young Flather signaled the initiation of a voluminous daily record of mill operations kept by him; a rare diary of daily events which contributes greatly to the ability of a modern student to discover the story of the operation of Flather had become a part. In this way he made a significant, unique contribution to modern textile history.

H. Labor-Management Relations

The conflict, in the largest sense, between labor and management in this mill was so dramatic that throughout this period labor's ability to perform in these mills was called into question. The basic working conditions at the Boott exemplified the extent of the conflict. Sheldon described the burden the mill's lay-out and condition placed even on management:

> *It takes a great deal better talent to run a mill like yours with these handicaps to overcome than a modern mill. It means constant and close scrutiny everywhere all the time, and this makes it hard work,*

even for a man who is especially adapted for this kind of a mill. In other words, I think it is more difficult to procure the kind of talent that is needed for this kind of a mill than it is for a modern mill, and I think there are few men who would like to undertake the job, because it means hard work, and even then not the best of results.[120]

These cautions applied as well to the work force which had to deal directly with the mill's inconveniences and the loss in production and wages they entailed.

But given such a warning, did the management provide the scrutiny and planning called for? For nearly ten years after the takeover the selling house, Wellington, Sears, controlled a majority of the stock and seems to have run the mill to suit its fancy, to facilitate its sales, without regard to the internal problems inherent in the operation and which their policies of short runs of many styles exacerbated.

The report Hackett made on operations in 1910 suggested little had been done by the "new" owners of over five years to improve operating conditions. In spinning, various antiquated machines of different makes ran side by side; they fit together poorly, prevented proper aisles for transportation and work, required duplication of change gears, repair parts and the like, and through their variety presented an obstacle to the dexterity to be acquired by the employees. Consequently, "those tending them did not appear as industrious or careful as they might have been." The toilet rooms there were "small, dark and dirty," supplies lay about the machines, lighting was poor, and finally, "The spinning room as a whole did not anywhere but give indications of unfavorable management." Some weave rooms offered similar conditions, where looms 25-30 years old ran without any modern attachments, lacking even warp stop motions and temples. On the other hand, in the rooms of Draper looms the equipment (but not the room) was up to date.[121]

Hackett was as free as Sheldon in his characterization of the nature of management thinking at the Boott:

For a long time and today the mills have been inclined to belittle the matter of the human element of the employees, as a factor in organization, and undoubtedly many causes have conspired to bring this about. The cause may be perhaps largely due to the jealousies by which positions of influence are guarded so carefully in cotton manufacturing, not only in this country but in Great Britain as well. The spirit of monarchy rule rather than that of democracy has for many years engendered a feeling of this kind, the consequence is the new methods of scientific management has still had to give way on account of the hereditary line of advancement which has so long held sway and at the expense, too, OF what might otherwise be accomplished in more economical methods.[122]

Arbitrary authoritarianism had left little room for consideration of the employees, even though such efforts could have served both the people and the production.

E.W. Thomas, the Agent, admitted the importance of considering employee welfare but found it impractical to give any attention to it. At the same time, he asserted that the "class of operatives… was drifting from bad to worse, and even the worst were becoming hard to retain." Instead of the American, Irish, or French Canadian of the past, the class of workers "has degenerated so that only the Poles, Italians, Portuguese and Greeks are being attracted." Ironically, the complaint was that these "degenerate people" recognized the nature of their situation: improved machinery requiring diminished skill was being used to minimize wages amidst poor working conditions, with little opportunity to increase income through harder work, and only slight chances for advancement; all in all, a lack of incentive for trying.[123] Dingy rooms, poor lighting, and foul air combined with the rest of the conditions to make this a recognizably poor place to work.

In keeping with the "racist" nationalism of the time, attention to the nationality of the Boott's workers appeared repeatedly. Thomas provided the fullest study in a 1912 letter to Flather. His figures, which also divided the employees by sex and occupation, are of interest in tracing movement of immigrants into the mill and its various departments. They must be used with care, not only because their reliability is unknown, the prejudice which produced them certain, but also because rooms of employment may be misleading as to the quality of jobs held. For example, the Poles and Portuguese in the Mule Spinning may be expected to have been found more often in the low-paying jobs of Back Boy rather than in the prestigious and independent Mule Spinners' slots. Similarly, in the Weave Rooms one would find Weavers of both sexes, but all of the better jobs, such as Fixer, were held by males. Still, the statistics are of interest because they were compiled, and for their content:

Nationality	Males	Females	Total	%
American & English	123	114	237	15.3
Irish	85	189	274	17.69
French	238	172	410	26.46
Greek	228	91	319	20.59
Polish	104	76	180	11.62
Portuguese	72	21	93	6.00
Belgians	2	0	2	.13
Italians	4	0	4	.26
Lithuanians	1	0	1	.06
Turks	13	3	16	1.04
Russians	3	0	3	.19
Germans	1	1	2	.13
Swede	6	0	6	.40
Syrians	2	0	2	.13
	882	667	1549	100.
Percent Males	56.94			
Percent Females	43.06			

SUMMARY BY OCCUPATION & NATIONALITY

	American & English	Irish	French	Greek	Polish	Portuguese	Belgians	Italians	Lithuanians	Turks	Russians	Germans	Swede	Syrians	Total
Picking	5	1	1	1	5	13					1				27
Carding	34	28	27	49	61	33		1		4					237
Ring Spin.	12	13	98	111	5	1				3	1		2		246
Mule Spin.	8	14	6		4	10									42
Spooling	8	9	56	32	5			2							112
Warping	8	8	9												25
Draw-In	5	10	5	4	1					4					29
Slash & c.	4	4	4	2	4					1					19
Quilling		1	2	6	0										9
Twisting	16	11	27	26	1										81
Winding	2	3													5
Weaving	79	105	150	86	81	28	2	1	1	1	1	2	1		538
Cloth Rm.	10	60	5		10	2				3			2	2	94
Yard & c.	46	7	20	2	3	6							1		85
	237	274	410	319	180	93	2	4	1	16	3	2	6	2	1549

SUMMARY OF MALES AND FEMALES BY OCCUPATION

Department	Males	Females	Total
Picking	27	0	27
Carding	120	117	237
Ring Spinning	138	109	247
Mule Spinning	40	2	42
Spooling	17	95	112
Warping	4	21	25
Draw-In	11	18	29
Slash & Beaming	19	0	19
Quilling	9	0	9
Winding	0	5	5
Twisting	39	42	81
Weaving	324	214	538
Cloth Room	49	45	94
Miscellaneous	85	0	85
	882	667	1549 [124]

Objectively considered, the nationality of the employee could have had some effect on operations since about a third of the 2066 workers in 1916 were said not to speak English and the mill had no interpreters. A partial breakdown by national background at that time listed 637 Greeks, 194 Portuguese, 204 Poles, 370 French and 30 Turks, thus indicating the rapid influx of the newer immigrants, as well as the French, to meet war-time production demands. Instructing those who do not speak English, then, would have to have been done by a country-person, tending to concentrate nationalities by trade. Furthermore, textile mills generally segregated workers by nationality in order to place another obstacle in the way of organization. Since signs regarding hours of employment of women and children, liability insurance, and other notices were posted in English only, communication with many of the employees was limited and little was done to alter the fact.[125]

In part because of the lack of effort on anyone's part to teach English to the new and large waves of immigrants which arrived up until 1914, they also learned little of the details of cotton mill operations. Perhaps the disregard for their understanding of the process which this neglect suggests was intentional, born of the belief inherent in the industry that workers who knew only the limited task they performed would be less able in any way to influence the production of the mill. On the other hand, "It is unfortunate that a false notion of the slight amount of ability required to operate cotton machinery has been so dominant." Trained help suddenly becoming unavailable at the time of W.W.I., the mill had none to fall back on, and its value became apparent. Because of the low wages

offered by the Boott, they competed for workers at a disadvantage, creating a shortage of labor, inefficiency, high turnover, and lack of interest in production.[126]

Compounding this difficulty was the attitude on the part of management that the role of capital outweighed that of labor in production. Significant improvements in machinery accentuated this type of thinking. As a result, there was little of the reciprocity in dealings with workers that was seen in other industries. The importance of payment for capital outweighed that of payment for labor. Technology seemed to offer solutions for all problems, and dividends came before other considerations. However, as the consultants pointed out to Boott management, payment for labor had to be sufficient to maintain its physical and mental well-being throughout the year, or the business was insolvent:

> *The workers are in reality far more in need of regularly assured income than most capital holders. Workers are able to save little if any out of present wages. They have no property to fall back on. Rents and grocery bills must be met within the week or month. Most unskilled wage earners are not over four weeks from destitution if employment is suspended. These reserves of health, strength and energy constitute the workers' investment precisely as the capital reserves constitute the capital holders "investment."*[127]

The Boott workers, obviously, existed in a tenuous position. Their pay was low, far from assured, and offered little leeway to allow for the risks of sickness, unemployment, and reduced capacity in later years. Furthermore, since textile wages were not "family wages," but assumed that all members of a family would work and pool their income to "eke out an adequate family income," the impact on the quality of life of the family and its future had to be considered as well.[128] The degree of the subjugation of these workers to a system which did not work efficiently and which they could not correct through their efforts is striking.

> *One indication of the dissatisfaction among workers at the Boott came in information about the numbers of employees who left the mill. While figures were not kept, estimates made in 1916 were suggestive:*
>
> *One weave foreman estimated that he had lost from his room twenty to thirty workers in the last six months out of a normal working force of forty-three. An overseer in charge of spinning and spooling estimated that he had lost two hundred and fifty in the past six months. The overseer formerly in charge of carding estimated his last year's loss at one hundred out of a force of approximately four hundred. Most of the overseers declared that they could not estimate*

the amount of turnover among workers in their rooms.

From our observations we are convinced that the number of manual workers going and coming must be very large. We learned definitely that among the group of office clerks varying from thirty-six to forty-two, twenty-four left in the year previous of Oct. 1, 1916. Since Jan. 1, 1914 forty-one overseers, foremen or second hands have left. The normal number in that group is indefinite on account of night work and changing methods of supervision.[129]

These accounts, reflected an extreme situation. Since the most qualified workers were the ones most able to find work opportunities elsewhere and exercise choice, the extent of loss became enormous. The numbers of office help leaving cannot be ignored, and the flight of supervisory personnel must came close to total turnover in that extremely important area.

Training workers represented an obvious cost of turnovers, and training supervisors cost a great deal more than training laborers. Included in these costs were time spent training, record-keeping, accidents, errors, production losses, damage to equipment, and idle machinery. Causes of the unusually high turnover at the Boott included "irregularity of work, poor physical working conditions, and low wages." Style changes, inadequate transportation of material, and poor coordination between departments aggravated the situation and caused workers to be laid-off temporarily or to loose money on piecework, leading to discontent and relocation. Management acted at times as if there was no relationship between these problems and labor, no need to consider that factor. Higher earnings available at other Lowell cotton mills and the much higher pay at the U.S. Cartridge Company there, encouraged this costly migration.[130]

Despite these conditions, the impoverished and slightly skilled workers had little ability to combat management. Unions existed among the Spinners, Slashers, Weavers, Loom-Fixers, Machinists, Carpenters, and Firemen (tending boilers, not extinguishing fires). The heavy turnover and arrival of inexperienced workers held down the percentages of members in each area involved, but the Slashers and Firemen were entirely union, the Spinners (that is the Mule Spinners, not the Ring Spinners) perhaps a third, with the Loom Fixers the strongest.

According to the Agent, the unions had raised members wages (the superintendent doubted it), reduced the numbers of looms per fixer, insisted upon sobriety among members, demanded strong evidence from a member to initiate a grievance, and steadied the output of the mill. The agent dealt cordially with the unions,

though only when they initiated contact, advised them to organize more classes of workers, and knew personally the Secretaries of the Loom Fixers' and Weavers' Unions, the latter affiliated with the American Federation of Labor.[131] Unimpressed by certain advantages to management itself, continued to resist organization.

Despite the poor working conditions and low pay, and probably because of the high turnover, strikes seldom occurred. A notable exception took place in 1912 as an aftermath to the famous Lawrence strike led by the Industrial Workers of the World (IWW), advocates of one union of the working class and also known as Wobblies. It began in January, 1912, after yet another wage reduction, this one occasioned by the limitation of women's and children's hours to 54 per week, a reduction of 2 hours. When the new law went into effect shifts were shortened and wages cut. The resulting strike, with its famous battle cry of "Bread and Roses," caught the attention of workers and others around the world. Lowell papers followed its developments, approving the cause but not the tactics. Lowell's police and militia assisted in Lawrence's efforts to prevent labor action.[132]

IWW organizing in Lowell increased dramatically at this time; 1525 Portuguese workers were said to have joined. William "Big Bill" Haywood and Elizabeth Gurley Flynn, IWW leaders, encouraged strike talk in the city.

In March, 1912, after the strike's successful conclusion in Lawrence the Lowell mills announced a wage advance to equalize Lowell and Lawrence's standards, but it was readily apparent that they offered significantly less than the 10 percent increase won in Lawrence and elsewhere in New England. The IWW moved first against the management of the Appleton Mills, where a majority of the employees were members of the union. The Appleton responded with a lockout, closing the mill. Workers then drew enough employees out from the other mills to lead their owners to extend the lockout to all the major corporations on March 26.

The IWW immediately called in Haywood, Flynn, and William E. Trautmann from Lawrence, set up picket lines, and organized a strike committee along ethnic lines, as had been done with success in Lawrence. Demands included 15 percent wage increase, double pay for overtime, the right of Weavers to weigh their own cloth, and reinstatement of all workers without discrimination. Committees made of the employees of each mill presented these demands to the agents of the mill at which they worked. E. W. Thomas of the Boott refused to meet his workers' committee. The agents announced they would instead meet with the craft unions, Mule Spinners, Loom Fixers, and Weavers affiliated with the United Textile Workers (UTW). This devisive strategy had been attempted

in Lawrence, and UTW President John Golden came from there to Lowell with AFL organizer Carl Wyatt. They contacted their 1903 ally, the Lowell Textile Council, now merged with the Lowell Trades and Labor Council, and together they condemned the IWW while issuing demands similar to the Wobblies'. The two groups represented about 25 percent of the mill workers.

IWW members picketed and paraded. On one occasion they marched through the Belvidere section of Lowell, where J.R. Flather later remembered watching as the family's chauffeur direct the workers away from the Flather house.

Other textile cities had granted the 10 percent raise won in Lawrence, returning to the pay of 1907. The New England Association of Textile Manufacturers censured Lowell for not joining in the increase. On April 13, after Flather met with representatives of the other mills in Boston, a 10 percent hike was announced for an April 22 reopening. The UTW and the Greek community, which had been allied with the IWW, announced acceptance. The IWW had little choice but to go along, but did so with the reservation that other issues must be settled between the employees and management of each mill before the return. Shop committees formed at each mill to act as go-betweens in disputes between management and labor. The confrontation had been successful for the workers, who achieved a degree of recognition from the owners for the first time.

The ensuing period saw occasional outcroppings of protests over wages and conditions. Some involved the whole city, others only the Boott, as far as can be determined. In January, 1917, Flather referred to demands by the Loom Fixers, but no action seems to have been taken. In March of that year he reported on a conference involving a Greek interpreter "in view of settling the strike. Gregg [a consultant in the Valentine Company] turned around from the telephone and said the Greeks have joined the union which I am glad to hear."[133] The Greeks had traditionally acted independently from other organizations, though often in concert with them, and this incident could either indicate an independent strike on their part or just a simplification of the situation with which Flather had to deal.

When the Boott's machinists threatened to strike during the war, Federal intervention settled it:

> *The Government Industrial Relations Department... because of goods urgently required have requested Boott to avoid an impending strike by settling with machinists, and warn us that we shall otherwise be taken over by the Government. Do directors advise settling before to avoid being taken over, or to let the taking over proceed and settle afterwards?*[134]

No record of the takeover emerging, it appears they settled. Heavy government production during the war meant high profits, enabling the mill to meet demanded pay increases brought on by a skyrocketing cost of living and higher wages elsewhere.

In June of that year, skilled workers affiliated with the UTW demanded a 15 percent wage increase and struck when the mills agreed to only 10 percent. While 30 percent of the workers struck on July 1, increased support from less skilled workers led to a 70 percent walk-out the next day. Soon both sides agreed to arbitration by the State Arbitration Board which considered cost-of- living increases, which more or less equalled pay increases, and the fact that Lowell workers earned less than textile workers in other Massachusetts cities and granted the 15 percent, with the debilitating proviso that strikes were forbidden for the duration of the war.[135] For a 5 percent raise the owners took away labor's bargaining chip.

While evidence suggests that in many ways the Boott's situation represented a typical standoff, with management trying to get the most work for the lowest cost and workers resisting, believing they shared little of management's goals, management made certain efforts which it interpreted as demonstrations of concern for employee well-being. Along with other major corporations it supported the local hospital where low- cost treatment was available to employees and their families. They also, in the years around 1912, rented Boott Camp on a pond near Lowell where female employees could go for a week's vacation or a weekend during the summer. Some learned to cook and to,

> *care for bedrooms in a way which they never knew before... Mothers who work at the mill were allowed to come and bring their children, and many of the English speaking women of the Carding and Weaving departments took advantage of that... We cannot tell how much good has been done through this "fresh air" home as yet, but many women and girls who are steady reliable workers at the Mill were exceedingly sorry when the season ended.*[136]

The letter, by Mrs. Gilman of the office staff, raised questions as fast as it answered others: how had these people cared for bedrooms before, and how had they gotten along without Mrs. Gilman's methods? What did the non-English speaking women do during their idle hours with their children, and why? Just what "good" was expected, and how did the unreliable workers feel about the season's ending? While the camp reportedly was occupied to capacity, it does not appear that great numbers of employees were able to enjoy it.

Mrs. Gilman also played a role in the Working Girls Club, a Boott Mill organization which in 1911 thanked Flather for a new piano in

the Recreation Room in 6-2: "It will furnish us a great deal of pleasure during the noon hours and can be used for our entertainments in the future."[137] The Club, which seems to have had the same officers as the camp, used the Rec Room for Annual Meetings featuring entertainment, lunch, and remarks by several speakers, including Flather and Thomas. They also had a Christmas party, and put on a play, "Rebecca's Triumph," there. Names suggest its members were largely of English and Irish extraction. What role all this played in the life of the mill's employees cannot be determined, but it must have helped keep alive among some the ideal of the famous "Lowell mill girls" who combined work and intellectual or artistic expression.

In terms of more fundamental contributions to the labor-management relationship, a number of factors presented obstacles to management initiatives. High indebtedness resulting from the takeover, infrequent dividends, and "the wide discrepancy between capital and assets" presented obstacles which even the $716,534 profit of two years from 1914-1916 (before the best war years) could not overcome:

> *The result of all this on the workers has been unfortunate. The management has deferred many improvements in physical working conditions, the desirability of which it was perfectly aware of. Needed improvements in plant and equipment have been postponed. Faulty accounting methods have made knowledge of waste less effective and created a slight feeling of insecurity in the management. Wages of workers, supervisors and office staff have been kept as low as possible. Management, staff and supervisors have all been worried and spent too little time on improvements in methods and forms of organization. The Treasurer has hesitated to enlarge the size and functions of the office staff as he wished to. Slackening of initiative, inefficiency, discontent, and high labor turnover have resulted.*

The next year, 1917, the Treasurer sought authority to carry out the recommendations of the Valentine Report for "lockers, toilet rooms, wash rooms, dressing rooms, lunch room, filter, sanitation, hospital (first aid room) cost $25,000." Yet every consultant's report thereafter repeated the same type of comments on the mill's condition, and after another such report a painting project was described to the Directors: "A systematic effort is being made by painting the interior of the mill to improve the surroundings and thereby the morale of our people and the quality of our work. This work may be considered also as maintenance for by keeping our property clean and well painted it lessens the tendency toward depreciation and obsolescence."[138] These efforts presented constant examples of too little too late, and failed to come to grips with the nature and extent of the difficulties, whether in terms of physical conditions, machinery, wages, or general relations.

Consultants did not find demonstrated a great deal of skill in dealing with employees at any level and a 1916 recommendation for an Employment Office quickly met approval. This office, it was hoped, would give employee relations more importance, know and deal cordially with all sources of labor supply, direct hiring and training, transfer, promotion, and discharge. "In order to avoid resentment, jealousy and opposition among the overseers it is planned at the start not to interfere with their securing and hiring workers just as formerly." In 1920 a woman was added to deal with employment issues with women. A 1923 letter implied that weaning the overseers of exercising their prerogatives in hiring did not proceed with ease.[139]

Another item from that year suggested the need for the new office. J.R. Flather, in notes obviously kept for himself, described an incident: "Secured a bunch of keys for Jim Doherty (5-1-W) which he lost and were found in a bag of waste at the Merrimack Utilization. I was glad to help him out. The smile of gratitude on his face was worth it and showed that the laborers are as human as anyone else."[140] The comment revealed both distance and lack of understanding, at best.

The Lowell mills, the vociferous opponents of labor unions which preferred the lockout to dealing with organized labor, held no such reservations about organized action on their part. The Treasurers belonged to the Arkwright Club, along with their counterparts across New England, "'to promote good understanding and united action upon affairs of general interest'" such as cotton buying, tariffs, and other legislation. They also meet as occasioned to discuss and act upon wages and politics. In 1919 the Associated Textile Industries was revived, and the Boott joined at a maximum liability of $16,000 per year. The Boott's contribution to this organization after a strike in 1888 was noted, above. And the Agents of the Lowell mills meet monthly as Trustees of the Corporation Hospital, and

> *after discussing hospital matters, the mill agents confer in regard to wages. There is a long standing "gentlemen's agreement" between them as to the maximum rates to be paid to certain classes of operatives in lines of work in which the different cotton mills compete. This agents' association also hires a detective who works in all the different mills in an endeavor to suppress stealing.*[141]

The use of a detective, or labor spy was not unusual among the anti-union cotton industry.[142] Given the indignant rejection by these mills over the decades of the idea of labor organization, their conduct in these regards not only gave new meaning to the term "gentlemen's agreement," but also disclosed the arrogance which permitted them to define their rights in a manner so totally different from those they granted labor. It revealed the extent to

which paternalism reduced its "beneficiary" to a less than fully human status.

I. Conclusion

This period which saw new beginnings, particularly in the Boott's ownership and management, also saw the continuation of the old in many ways, from horse-drawn conveyances to antiquated equipment, from inefficient use of space to incomplete efforts at modernization, from paternalism to organized opposition to labor organizing, from worn-out outmoded facilities to operation with an eye only for the bottom line (and that considered primarily in the short term, as well). Workers continued to be the last aspect of the operation to be considered, except as a problem.

There were new things, and the many consultants fell under that heading. That they were consistently ignored, particularly with regard to working conditions and employee treatment, represented a continuation of the long-time Lowell attitude, however. Workers had been intended to be the most easily replaceable part of the system there and were still assumed to be.

In part, the situation at the Boott was part of the Lowell pattern of cheap labor and plain cloth. But at the same time that the Boott was diverging from the original idea of long runs of a few simple materials, it was also diverging from the other mills in the extent of its mistreatment of its labor force. The consultants did not simply point out that conditions in the mill were dark, dirty, ill-ventilated and dangerous in a variety of ways, but that they were more so than at the mill's counterparts elsewhere in the city and the country. The contrast with non-textile operations was still more striking.

Nor was it only the physical environment that compared badly. The attitudes of management and, as a result, labor were also notably poor, and so were the earnings of the workers. Management's attitude toward the workers left their interests out of most planning; worker response to this treatment produced little interest in anything more than minimal fulfillment of assignments. In addition to bad attitudes on both sides, the mill's condition presented an obstacle to accomplishment which affected all involved.

In such a context, the purchase of a few new machines from time to time had little impact on operations. If the floors were so deep with tobacco-spittings that Loom Fixers were reluctant to do their work, it made little difference whether or not the looms involved were current models: they were likely to be neglected. Typical of the way in which such problems developed through trains of effect, the poor condition of the floors prevented adequate scrubbing to alleviate

the difficulty. Any real effort at cleaning resulted in leakage of water through the floor onto cotton in process on the floor below and caused damage. In addition bad, uneven floors increased the rate of machine failure. The chain of difficulty also extended in the other direction, up the chain of command. If looms were not fixed promptly and adequately, scheduling became impossible, production lagged, and income to the mill, for both investors and workers, declined.

Several answers to these problems were pursued. The ideal of increased production through study and analysis proved repeatedly tempting. Its vogue coinciding with the shifting of management's background from processing expertise to accounting and marketing skills heightened the mill's receptivity to outside experts when it came to mill operations. Given the extent to which the consultants came to produce a litany of continuing complaints, rather than revealing changing conditions, one must assume that they were not often heeded, that their advice was sought almost as a talisman, something which could cause circumstances to change, conditions to improve, without the expenditure of meaningful amounts of money.

When new technologies became available, it was not the consultants who brought them to the attention of the mill. Knot-tyers, automatic looms, and Casablanca long- draft spinning were all introduced independently, by the managers. They were aware of current developments in their field and moved at least to examine them. The simplest and least demanding technologies could be readily adopted, and the knot-tyers appear to have presented only advantages to management. The automatic looms had more demanding requirements, and the Boott was unable to make full use of their potential. Dark, vibrating, unventilated, climatically uncontrolled work spaces in which congestion clogged traffic flow and the total environment impeded worker contribution blocked the hoped-for contribution of the partial introduction of the Drapers. In the case of the experiment with the Casablancas, the environment presented even greater problems, revealing the extent to which it had represented a constant difficulty hanging over everyone's efforts for years.

The worker's efforts become defined during this period because of the consultants' attention to what they should be doing and the various things which could hamper or affect their performance. Just as they listed machinery and its condition, they described job assignments, inspection checklists for both tasks and cloth, and indicated much of the work associated with but not directly involved in making cloth. At the same time, they took turns over the years repeating the continuing reasons why labor could not perform well at the Boott, why other mills had more attractive work environments, and why Boott pay was both too low and too

irregular to attract or hold the most able workers. Management's lack of response to these complaints indicated continuing disinterest.

In fact management's lack of response to conditions harmful to worker performance made the strongest statement about its attitude toward labor. Even though conditions hampered oversight and direction, as well as the actual work, they refused to take remedial action. The factory environment was allowed to become physically and morally repulsive.

Directly in keeping with Lowell traditions, those who controlled the mills united in various ways to strengthen their ability to prevent the workers from doing the same, to prevent them from exercising even the most minimal control over their work. Having thoroughly alienated the workforce, they could only attempt to exercise authority over it through coercion. In addition to the collective arranging of wages, mutual support against "labor unrest," and organized support of mutual interests in the areas of tariffs, cotton prices, and such, they employed an undercover operator to keep tabs on labor activity in the mills. In other words, their paternalistic faith in their own authority to regulate the economy, and the workforce, in their own interests continued unchanged from Lowell's earliest days. They assumed the existence of two very different codes of behavior, one for owners, another for workers.

These attitudes led to the confrontations one might expect from so one-sided an arrangement. In general, these confrontations demonstrated the extent of management's advantage, in terms of power, over the workers. Occasional successes by labor hinted at coming change, however, as if the forces arrayed against labor were finally beginning to produce resentment and then unity within a workforce which would not leave the mills, would not be supplanted by continuing waves of new immigrant workers, but would join together to work for an accommodation of interests which would lead to acceptable working conditions.

The continuing of old traditions and the rise of these new factors in the mill's operational equation represented the working through of the themes inherent in the Boott's history. They will form the subject of the next section on Occupation and Use, the Boott from 1931-1954.

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3. Lowell Daily Mail.

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8. Directors Report (DR), 11/1937.

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36. DR, 12/28/1907.

37. Valentine, P. 37.

38. DR, 1/26/ 1921.

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61. DR for 11/1927 and 2/1928; Textile Development Corporation Report, (TDCR) 1928, FC (n.p.).

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67. DR, 1929 and 1930; also Valentine.

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80. Valentine, pp. 48- 50.

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129. Ibid., pp. 55-56.

130. Ibid., pp. 56-59.

131. Ibid., pp. 123- 124; 128.

132. Mary T. Mulligan, "Epilogue to Lawrence: The 1912 Strike in Lowell, Massachusetts," SHT, pp. 82-83; my account relies heavily on this essay.

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136. J. M. Gilman to FAF, FC, 10/7/1912.

137. Working Girls' Club to FAF, 6/7/1911.

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139. Valentine, pp. 160- 162; DR, 7/28/1920; BM to Mr. Abbott, 11/28/1923, FC.

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IX. PHYSICAL HISTORY 1905- 1930

A. The Counting House

Changes made at the Counting House during the period 1905- 1930 were primarily limited to a rearrangement of the interior. A 1911 description identifies uses at that time as "vacant attic at the top floor, office rooms on the second, and in the basement, supplies and a belt shop."[1] Treasurer's reports beginning with June 1906 and continuing through November 1909 list various improvements made at many of these rooms (Appendix F). The most often mentioned improvements occurred at the office space, which included the introduction of a cotton sample room in December, 1906.

Valentine commented in 1916 on the somewhat tawdry appearance and inefficiency of the Counting House: "A coat of paint on the mill office floor would help the cleaning problem there... the office would greatly benefit by fresh paint and calcimine… store room in basement too small, not centrally located, it had no control of parts removed."[2]

Additional minor interior work was carried out at the Counting House in 1927 and 1929 but a recommended 1930 change in the basement calling for removal of the existing fireproof vault was not completed.[3]

Documented changes to the exterior of the Counting House are few, except for the important alteration to the front entrance at the west bay, second floor, south elevation that is reached by a footbridge next to the canal bridge. Prior to 1930 (Photograph 26) the entrance was protected with a flared metal hood and had a wood door with a single glass upper panel. The hood was removed, the opening altered and a new door installed by September 1930, as evidenced by the Treasurer's Report of that date: "Part payment for supplies in altering masonry in office doorway $73.38." Also, at some time between 1889 and 1928 (Photograph 26) four flat skylights were installed at the front edge of the south roof just west of Mill #6.



Photo 26. "Boott Mills Looking East, March 1928" Mill Number 6 is at right, with Counting House in front of it.
Source: LNHP, Museum Collections, LOWE 8658

B. Mill #6

1. Exterior Changes

a. General Conditions

Despite the recommendation of two highly respected engineering firms to tear the existing Boott Mill buildings down, the first made in 1902:

> *Your old buildings have perhaps served well their purpose in the past, but they were long ago out of date, and are of no value now even if they can be considered safe to work in.*
>
> *I therefore recommend the entire demolition of the present structures, or at least so much of them that are dangerous to work in, or would in any way interfere with the best arrangement and construction of a first class new mill.*[4]

And in 1907:

> *For the best results on the present site, we believe that as fast as the finances of the Company will admit all of the buildings with the exception of the storehouses and the No. 7 Mill should be destroyed and new buildings erected in their places.*[5]

A report made to the Directors in 1914 by A.G. Cumnock states: "My report will show that the Mill (No. 6) physically has been well maintained."[6]

Cumnock's appraisal of the condition of the mills was apparently short lived, since by 1926 serious concern had been voiced by management and concurred with by consulting engineers regarding vibration at "Building #6" (Appendix I). Charles T. Main and Company, Engineers was asked to prepare a survey of structural conditions at this time, and they filed a letter report on June 11, 1926. The report cites the need for repainting, the replacement of a stone lintel and two slabs in the foundation, and the need for underpinning of part of the wall along the canal. Boott Mills contracted with Locks and Canals to make the repairs suggested in the Main Report (Figure 17A). A letter dated August 10, 1926 from Locks and Canals to the Boott Mills outlines the work performed to that date:

> *The blueprint accompanying Mr. Main's report showed one cracked*

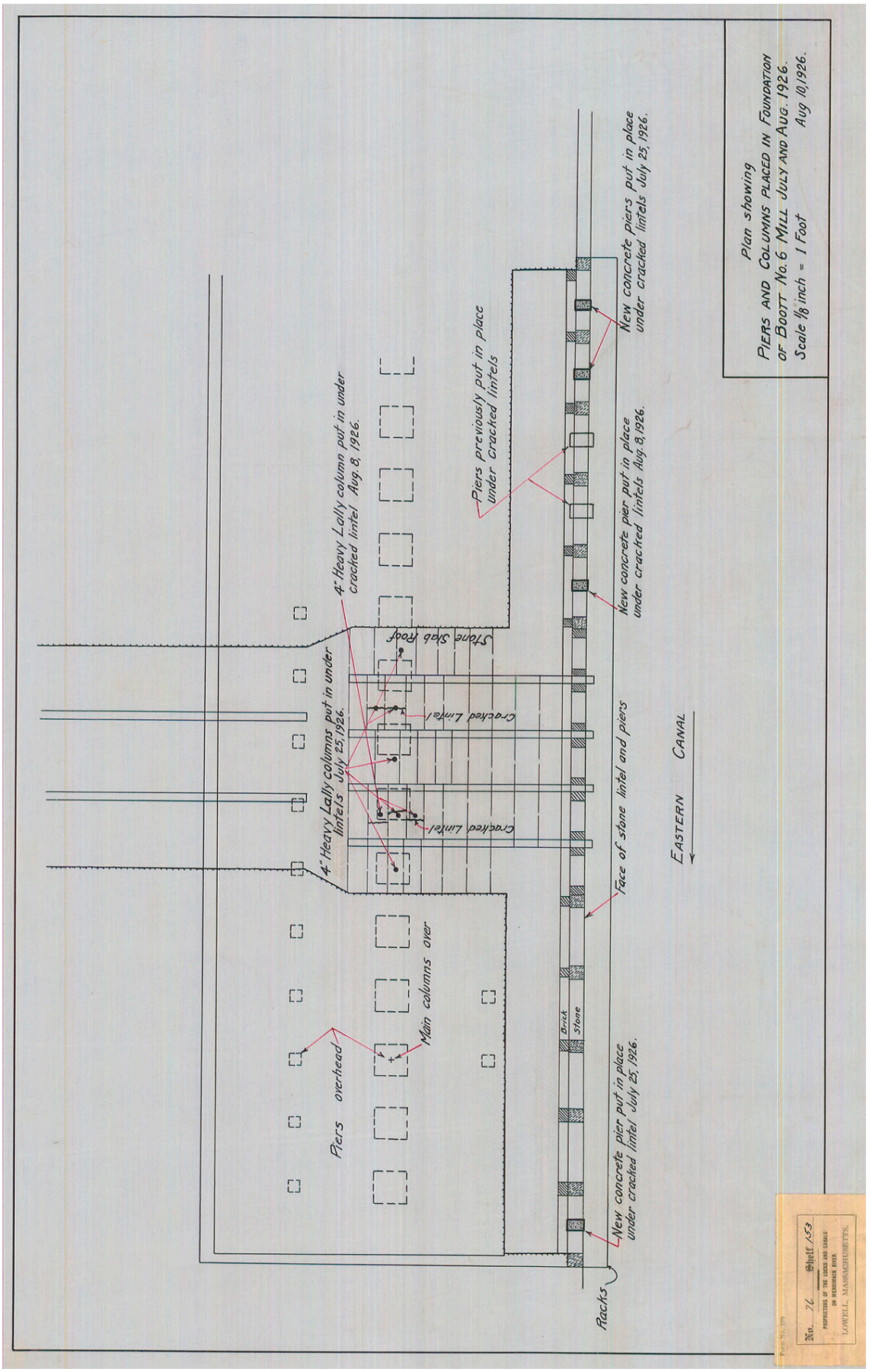


Figure 17A. 1926 plan showing repairs and replacements to piers and columns at Mill Number 6
Source: LNHP, L&C, Plan Number 153-076

lintel under the wall bordering the canal and two cracked lintels in the second and fourth penstocks underneath the center line of the columns. We found that three additional lintels were cracked under the wall bordering the canal and put in concrete piers, 24" x 17", in all cases. These concrete piers were put down to a solid foundation from 18" to 36" below the plank flooring.

In the penstocks under the main columns we placed 4" Heavy Lally Column s, putting one in under each of the cracked slabs shown on the blueprint accompanying Mr. Main's report, together with one in each of the other three penstocks as a precautionary measure. An inspection on Sunday, August 1, disclosed that a third lintel had cracked in the fourth penstock and a similar column was put underneath this on August 8. These 4" Lally Columns are about 6- 1/2 feet long and will carry from twenty to twenty-five tons if centrally loaded. We also pointed up the brick work where it reinforces the lintels at the upper end of the penstocks.[7]

C. T. Main and Co. reinspected the mill in June, 1927 and reported that there was still some sway and vibration present. Main forwarded a detailed report on July 15, 1927:

This building is about the same as we found it on our last examination. The conditions have been greatly improved since the general repairs were made, as suggested in our report of 1925, and the turning around of some of the looms. Tie rods at the junction of the west tower seem to be holding well.

We made an examination under the 1st floor for the purposes of determining the "jump" in some parts of the floor. It seemed to be due almost wholly to the 3" planking and is not serious. The 3" planking is rather springy. We tried to plumb bob on the walls and they did not appear to have changed any recently.

There is still some sway to the building as a whole, and eventually it may be advisable to stiffen the walls on the canal side anyway, with beams or pilasters.[8]

b. Foundation

A 1928 study recommended the addition of a row of intermediate piers and the replacement of a rotted post to support and stiffen the first floor structure, thereby reducing the vibration problem, but the piers were not built at that time.[9] Other recommendations included in this study were accomplished however, as recorded in the Treasurer's report of August 3, 1929: "repairs suggested by John

A. Stevens, for bolting, stiffening and strengthening steel plates on wooden beams, $72.12."[10]

c. Walls and Fenestration

The most significant alteration to the exterior walls and the pattern of fenestration to occur during this period was the result of the construction of a six-story tower to house an elevator at the courtyard side of the intersection of the east and west sections of Mill #6, described below. This caused the blocking of all windows in the two southern most bays of the east section and the two eastern bays of the west part in 1917. A second and as yet unexplained and undated alteration of this period occurred at the seventh bay of the second level of the north wall, west section, where the original window had been altered to a door, opening onto a fire escape landing and a straight run of iron stairs leading directly to the courtyard below. A textile lab and display room had been installed in this space by 1920; it has been suggested that the new door provided direct access to this facility. (The door was changed back to a window in 1978).

d. The Coal Pocket

Alterations to the original entrance to the Coal Pocket at the easterly end of Mill #6 along the canal were first contemplated in 1917, when the treasurer requested "authorization of expenditures for improvements" totaling $80, 000 to "enlarge the coal pocket and (thereby) save rehandling of coal."[11] However, negotiations in earnest did not begin until September, 1926 (Appendix J), for a discussion of the need for the larger entrance, negotiations regarding the reconstruction of the railroad bridge and other correspondence). A memo prepared by Locks and Canals on September 13, 1926 proposed certain alterations required to accommodate the new and larger coal cars and engine requested by the Boott Mills:

> *The height of 10' 10" under the timbers is sufficient for the 80000 lbs capacity cars, leaving a clearance of about one and one half feet. The larger cars could not be used without a greater height. Furthermore the locomotive of the Massachusetts has a height of 13' 6", over 3 feet more than the space available. The only feasible way of obtaining the clearance required for a switching engine seems to be to either raise or take out the second floor of the mill, preferably the latter. This would mean extending the brick wall between the passageway and No. 6 mill up through the second floor, and also moving two rows of looms on the second floor, as well as the store room in No. 6 and 7 connection. By adding the second story to this passageway a height of something like 24' will be obtained, and the second story window openings on Bridge Street should afford plenty of ventilation in the passageway. If it is not feasible to include*

the second story then either a cable and windlass would have to be used to haul the cars down to the coal pocket and back, or possibly a special gasoline driven locomotive could be obtained. A cable and wind lass would be fairly expensive and it is extremely doubtful it its operation would be fully satisfactory.[12]

Discussions with the Boston and Maine Rail Road (B&M) regarding the redesign of the new service track were finalized in December 1926, permitting Frederick Flather, Jr. of the Boott Mills to request of A.T. Safford, Engineer at Locks and Canals that " in view of our conversation today [December 24] we would be very glad indeed to have you begin work on the remodeling of our coal pocket Monday morning, December 27, or at your earliest convenience."[13]

At the recommendation of Locks and Canals, Boott Mills requested, in a memo dated February 23, 1927, that the Boston and Maine lay the new track (Figures 18, 19, 20).[14] The B&M responded in the affirmative on May 23, 1927. The engineers estimated the cost of the track work at $3700.[15] Locks and Canals also contracted with the Hayes Appliance Company for a "Type W Bumper"[16] and with the New England Structural Company, Everett, Massachusetts, for steel girders needed for the new bridge.[17] Final cost estimates were presented on February 17, 1928:

Estimate of Cost Boott Coal Pocket Extension

Concrete	225 cu. yds.	@ $16.00	$3600.00
Excavation	50 cu. yds.	@ 2.00	100.00
Structural Steel	30,000 pounds	@ .05	1500.00
Track	50 linear feet	@ 8.00 per ft.	400.00
Wire lath and plaster partition	700 sq. ft.	@ .60	420.00
Plastering ceiling	1600 sq.ft.	@ 30.00	480.00
Shoring and labor putting in I beams			500.00
Erecting steel for track			300.00
			$7300.00
Engineering, contingencies and incidentals		@20%	1460.00
			$8760.00

or say between $8000 and $10000.[18]

As a result of the above agreements, the entrance was widened to the west to 14'0" and raised to a height of 23'4". This required the elimination of a window in the first floor and three at the second level (Photograph 27). The bridge girders were put in place on July

21, 1927. The rolling steel door (Photograph 26A), "Type C.G. 0.11, for the entrance to the Boott Coal Pocket" was provided by J.G. Wilson, Boston.[19] The winch and motor at the rolling door was manufactured and installed by "Mead- Morrison-Boston," patent date April 3, 1923.



Photo 26A. Boott Cotton Mills Coal Pocket Entrance
Source: LNHP, Museum Collections, Lowe 8643

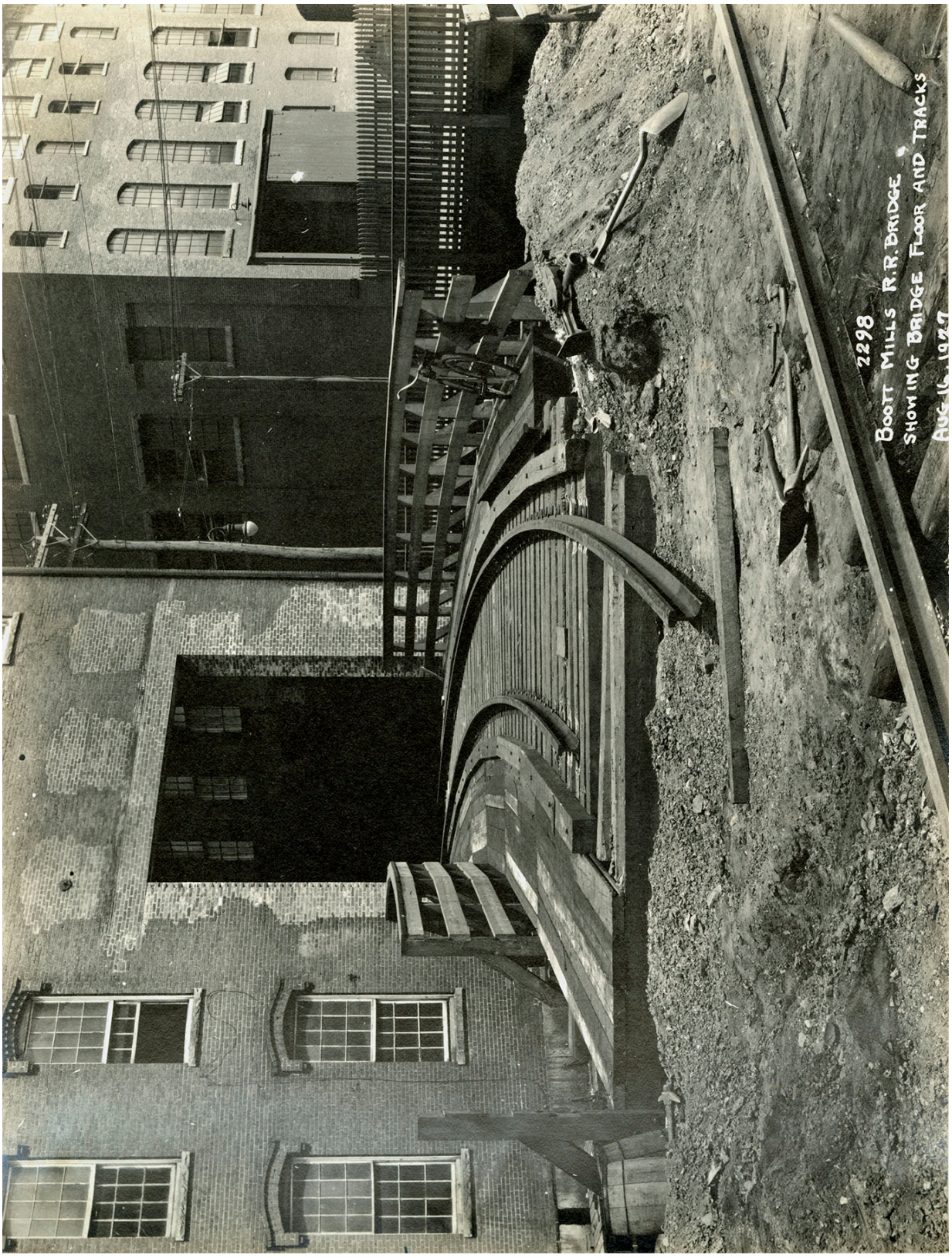


Photo 27. "Boott Mills Railroad Bridge Showing Bridge Floor and Tracks, Aug 1927
Source: LNHP, Museum Collections, Lowe 8581

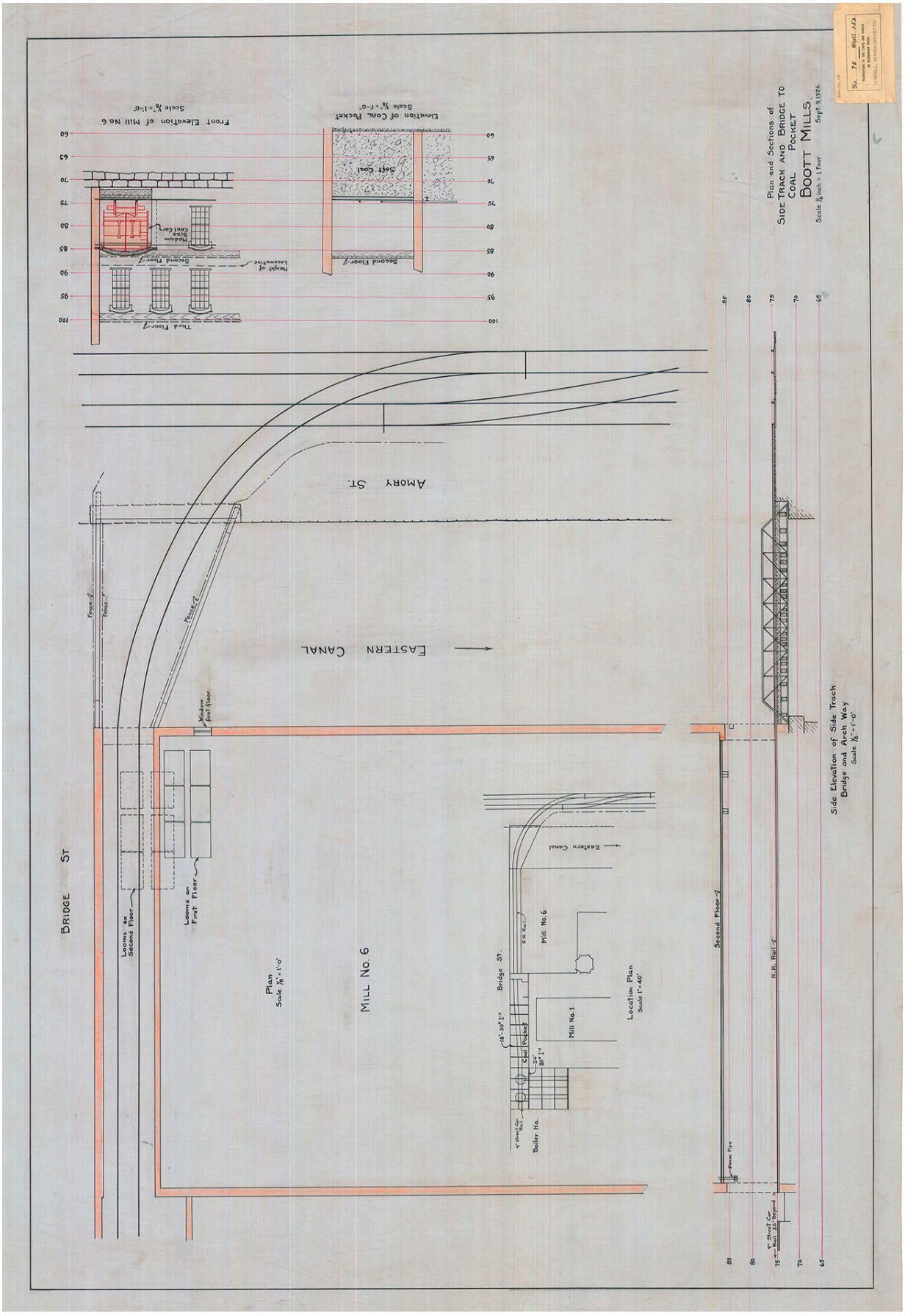


Figure 18. Layout of tracks to serve Coal Pocket of Mill Number 6, Sept. 1926
Source: LNHP, L&C, Plan Number 153-070

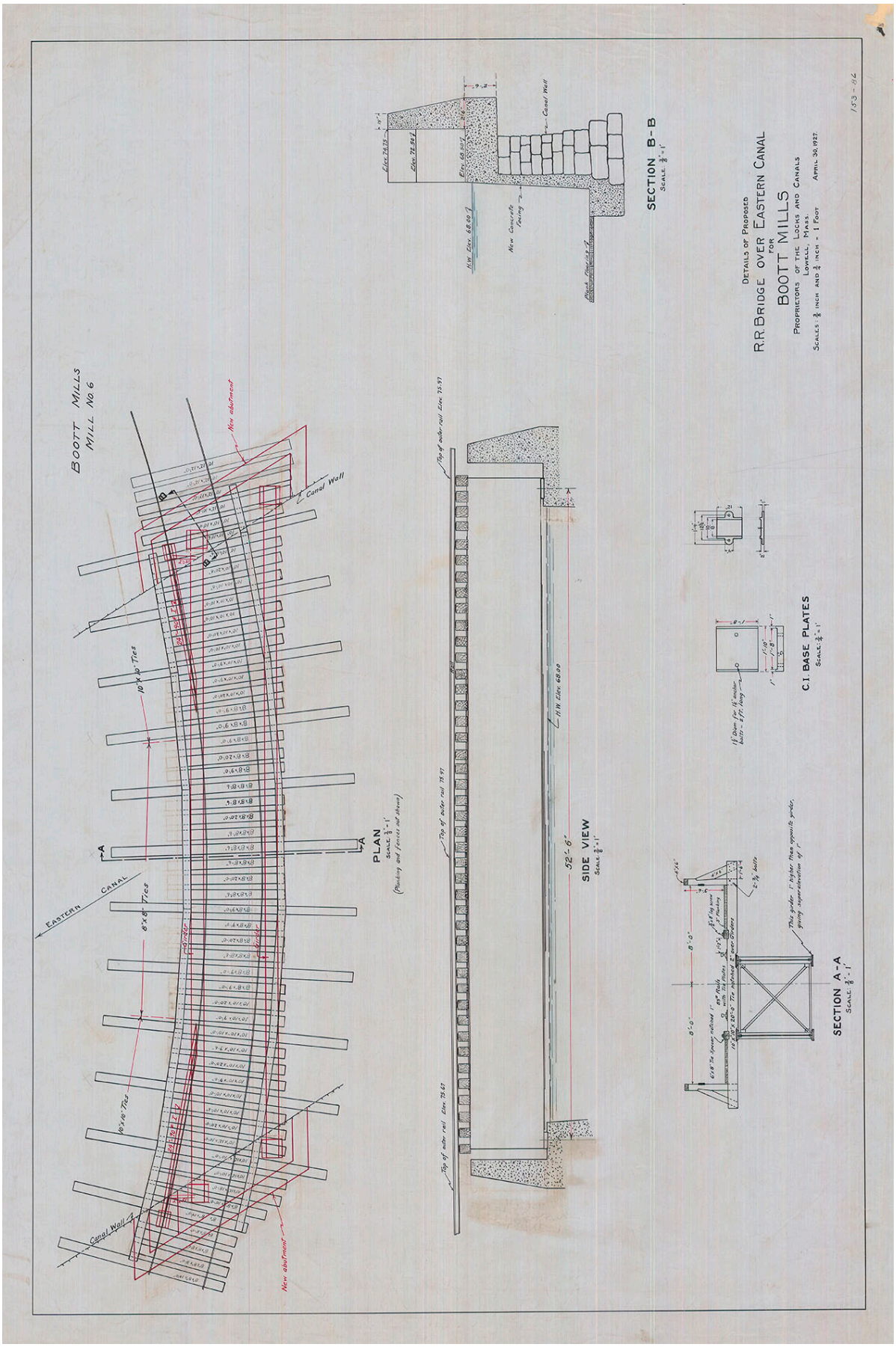


Figure 19. Details of Proposed Railroad Bridge over Eastern Canal, April 1927
Source: LNHP, L&C, Plan Number 153-086

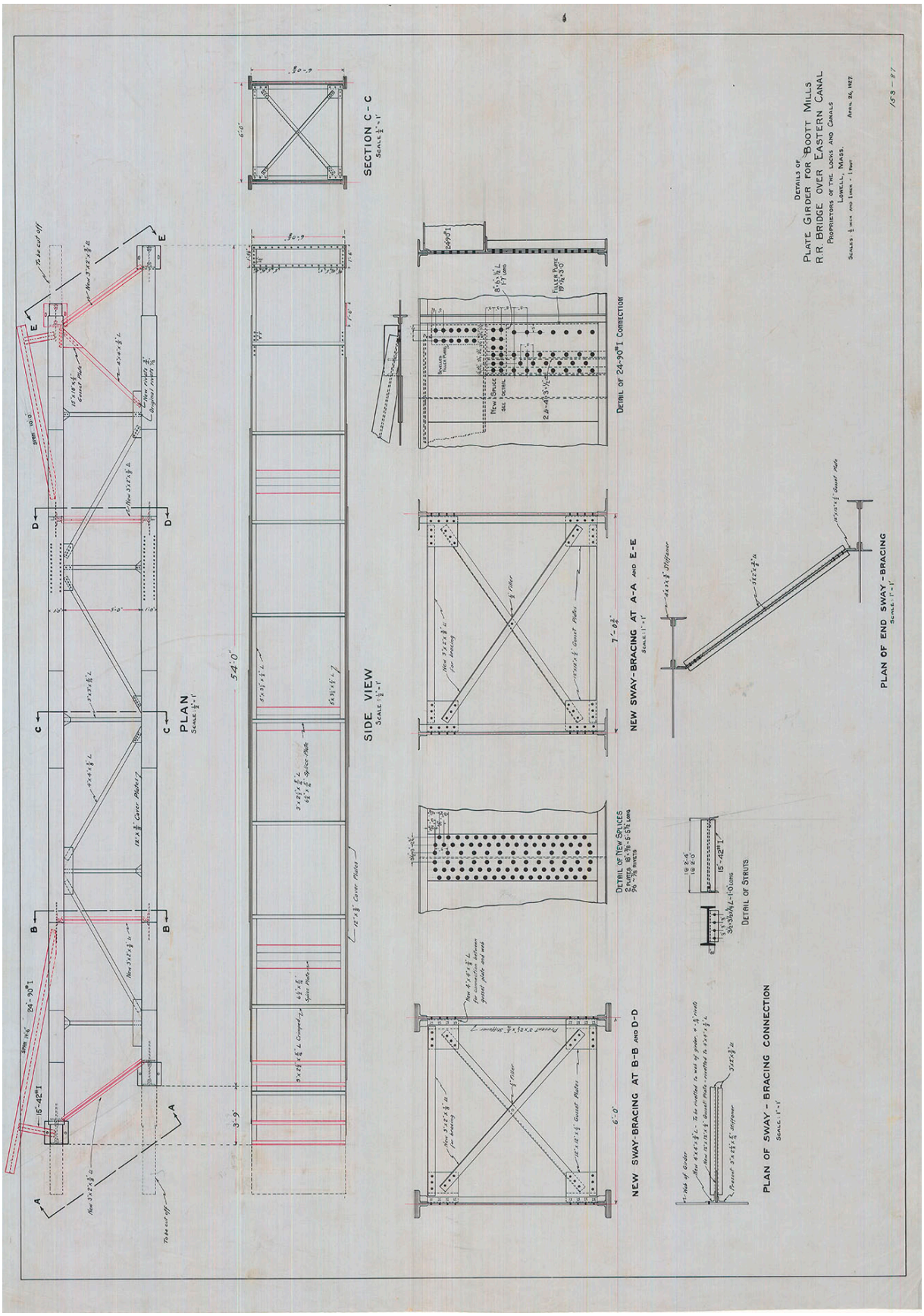


Figure 20. Details of Plate Girder for Boott Mills RR Bridge over Eastern Canal, April 26, 1927
Source: LNHP, L&C, Plan Number 153-087

e. Stair Towers

Reporting in a letter dated November 23, 1925, C.T. Main Co. remarked that: "the tower in the north west end wall continues to show cracks which open up after each pointing and painting of the surface."[20] Stevens, writing in July 1928 commented further on the condition of the west tower, referring once again to the vibration problem that would persist until 1950:

> *There is an octagonal stair tower at the southwest corner of No. 6 mill in which the upper deck is rapidly deteriorating. The planking of this deck has rotted badly, and the sash and window frames should be pointed at once. This upper room of the tower has evidently been out of use for some time, but the floor and floor framing acts as horizontal bracing. As there is considerable lateral vibration of the tower at this level we believe that it should be repaired.*[21]

On the advice of Mr. Stevens, new tie rods were installed at the first, second, and third floors in the southwest and south walls of the east tower, and at the south wall, third, and fourth floors in the west tower. Also, large (8" x 16") plates to secure additional ties were placed at the fifth floor window heads of the east tower. Costs associated with these repairs are noted in the Treasurer's Reports: "March 1929 - - repairing mill towers 262.08; May 1929 minor repairs to stair towers 3.44; September 1930--repairing tower #6 Mill 222.46."

f. Elevator Tower.

The second major alteration to Mill #6 was the installation of a freight elevator, as recommended in the Treasurer's Report to the Directors dated March 28, 1917. The elevator was housed in a six-story tower tucked into the southeast corner of the "L" formed by the east and west sections of the mill, with the mechanical hoist in a sixth floor penthouse. Built by the Salem Elevator Works in 1917, the elevator was a belted, four-ton capacity freight model, and as installed, opened into the first, second, and third floors at the northeast corner of the west section, and at the west wall of the east part at the fourth and fifth floors. The new elevator was probably prompted by remarks made in the 1916 Valentine Report concerning a hoist in one of the stair towers: "The elevator in No. 6 Mill is too dangerous to be allowed in operation. While there are self-closing hatches at each floor the shaft is entirely open and there are no gates. The car floor measures about three feet by six. The car is unprotected on any side."[22]

As built in 1917, the enclosed elevator tower had 12" brick walls with a footprint of 15'4" (east-west axis) by 16'0" (north-south

axis). The corner at the northwest was chamfered at 45 degrees, removing 4'0" at both walls. The walls were laid up with machine-made common brick, in common bond 7:1 with flush joints, and rested on a rock-faced granite foundation at the same level as the foundation of the mill itself. There were no belt courses. The eaves extended 12" beyond the plane of the walls, with the timber roof rafters used as outriggers for a pressed metal cornice consisting of a flat fascia on a cyma-recta bedmold, with a stepped fascia on a small cavetto at the face of the wall.

Access to the elevator from the exterior was provided through an overhead door in the west wall (door is later) that slid on vertical tracks. The door was served by a concrete loading dock. Windows were placed in the west and north faces, as well as in the diagonal wall at the corner. Two windows were located in the exposed east wall of the sixth floor penthouse. The openings in the north and west walls were 5'3" wide by 8'8" high, reduced at the sixth floor to a height of only 6'0". The windows in the diagonal corner were the same height but were 3'4" wide. All sash, including that in the top floor was 12/12, wood, double hung. The lug sills and flat lintels were rock-faced granite.

g. Downspouts

The final change that occurred at the exterior of Mill #6 during this period concerned the installation of exterior downspouts to supplement the original internal roof drainage system. While no written documentation has surfaced to precisely date downspouts, photographic analysis places this at c.1927, when a downspout is shown at the right of the yet to be expanded coal pocked (Photograph 18). (Early photographs examined that do not show any downspouts include images made in 1878 (Hill), 1880 (Badger), 1893, 1889, and the 1911 Insurance survey.)

2. Interior Changes

a. Floor and Floor System

While there certainly would have been repairs made to the existing floor during this period, especially with the great amount of relocation of machinery that was occasioned in an attempt to lessen vibration caused by looms and other heavy loads, no documentary evidence has been uncovered to actually pinpoint specific areas where changes were made. However, records for general maintenance accomplished during this period, while not specific to Mill #6 are indicative of the kinds of work being carried out. In June, 1908, $365.85[23] was spent on repairing floors at the Boott

Mills, while in December of the same year the large sum of $2745.87 was recorded to "general floor improvements."[24]

b. Columns

The treasurer's report for September 1929 mentions a cost of $34.83 for "applying plates and angle irons to brace all columns where they are connected with roof beams, 6-5W" (fifth floor of the west section of Mill #6). No other documentation was found for changes, additions, or removal of the original cast iron columns between 1905-1930.

c. Roof Structure

No documented changes were made to the interior framing of the roof during this period. Stevens, writing in 1928 reported that "this framing [roof] is in very good condition, and needs no repairing at present."[25]

d. Interior Walls and Partitions

A number of alterations to the interior walls and partitions took place between 1905 and 1930, including the blocking of four pairs of windows for the 1917 freight elevator as described above. This elevator opened at each of the five mill floors, in the east end of the north wall at the first three floors in the western section, in the south end of the west wall of the east part at the fourth and fifth floors. The openings were provided with metal- clad wood doors, 5'1" x 7'10" that slid on inclined steel guides, westward at the first three floors, to the north at the upper two. The interior dimensions of the 1917 elevator shaft were 14'4" x 15'0". The original rails, drives, and motor remain in situ, with the 11'0" x 13'6" cab at rest at the bottom of the shaft on this concrete pad.

Other interior changes that took place between 1905 and 1930 include the alteration of a window in the third bay from the east end of the north wall, third floor, east section, to provide access to a footbridge built alongside the #7 connector in 1930, and a frame partition that existed between the 8th and 9th bays from the west end wall of the second floor of the west section. This partition ran from the north wall to the south but was not full height, as there are no ghosts at the ceiling. A list of machinery and equipment made in 1920 refers to a laboratory and a display room in the third floor of Mill #6. However, an insurance survey made in 1933 shows these uses at the second floor. The 1933 insurance survey, coupled with scars and worn spots on the second floor caused by unusually heavy machinery with concentrated loads, and the existence of holes in the floor for what appear to be a series of small sinks, suggests that

the laboratory was at the second floor for quite a period before the 1930s. This could be possible, since a Treasurer's Report of 1906 indicated a change in use that occurred in the two-level fireproof area at the west end of the mill: "during first six months of 1906 workers moved the Carpenter Shop, Blacksmith Shop, Paint Shop, Machine and Wood Shops."[26] Also, insurance reports filed in both 1911 and 1921 identify the use of this area: 2nd floor, recreation room abbutted Counting House, beneath it lay a repair shop.[27] This would have been in the space originally occupied by the paint shop and blacksmith shop, precluding the use of the fireproof rooms for the laboratory.

Stevens expressed concern about the condition of the masonry bearing wall that connected the east and west sections of the mill:

> *We find that the northerly arch at the east end of this mill has apparently settled, and there is a crack opened up on the north end in the 1st, 2nd, 3rd and 5th stories. The crack is less pronounced in the 5th story, where there has been installed a tie rod across the north and south arches at the spring line.*
>
> *It is our recommendation that these cracks be carefully pointed up, and periodic inspection be made. If the cracks increase tie rods should be installed in the lower stories as is already done in the 5th story.*[28]

Boott Mills went one step further in repairing the arches at the fifth floor by removing the brick pier and tie rods altogether and replacing them with "a pair of 12 inch "I" beams, supported by a 5 5/8 inch Lally column." This section opened up the fifth floor to a clearance of 10 feet, with the beams let into the haunches of the arches and the space above infilled with brick. (It appears that the so-called tie rods may have been the tension rods used in building the row-lock arches-- their removal would have caused no damage after the beams had been constructed, and the keys were in place.) The cost for this work is noted in the Treasurer's Reports on August 3, 1929: "labor and supplies replacing pier, with column on top floor of No. 6 mill 523.33", and August 31: " labor and materials, replacing pier #6 mill 14.30."

e. Coal Pocket

With the enlargement of the entrance to the coal pocket, the original interior masonry partition was relocated by Locks and Canals as mentioned in a letter from the Boott Mills to their insurance company.

We are starting work on the relocation of the sidetrack to the coal pocket of the Boott Mills. For the next few weeks we will be moving over the brick partition wall between the track and No. 6 mill. This will not affect the fire protection system in any way but it does require the erection on a temporary wooden partition.29

The interior west wall or side Coal Pocket was moved so that the passage was 14'0" side at the rear of Mill No. 6, flaring out to 21'6" at the entrance beginning at a point approximately 37' from the north end wall (Figure 21, Photographs 27A, 27B). There were no openings at the lower level initially (Photograph 28) but three fixed steel industrial style casements were installed at the second level.

f. Stair Towers

With the new freight elevator, the hoists, originally in both towers but by 1916, according to the Valentine Report, only in one, were superfluous (it is speculated that since the door remains at the fifth floor of the east tower, it was this hoist that remained in 1916). The last hoist was probably removed at this time, and all openings in the walls reduced to 5' 6" by the installation of a steel lintel and the wall bricked in, flush with the tower side, indented at the mill side 12". Ghosts of the open shaft are visible at most of the floors in both towers, but are not at the ceilings, suggesting that the ceilings were sheathed when the floors were patched to block the shaft. Other changes at the stair towers are few, apparently limited to the addition of railings above the molded wood handrails of the oval plan stairs. The Treasurer's Report of October, 1914, mentions: "Pipe rails for stairways in towers, $567.00" The same report records expenditures for brick, cement, lime, and sand that may relate to the blocking of the original door leading from the tower into the third floor of the west section of the mill.

g. Mechanical Systems

(1) Heating

Improvements to the mechanical systems were also many and varied between 1905-1930. First, the steam heating system was replaced in 1912. The following was proposed by the Middlesex Machine Company of Lowell on July 3, 1911:

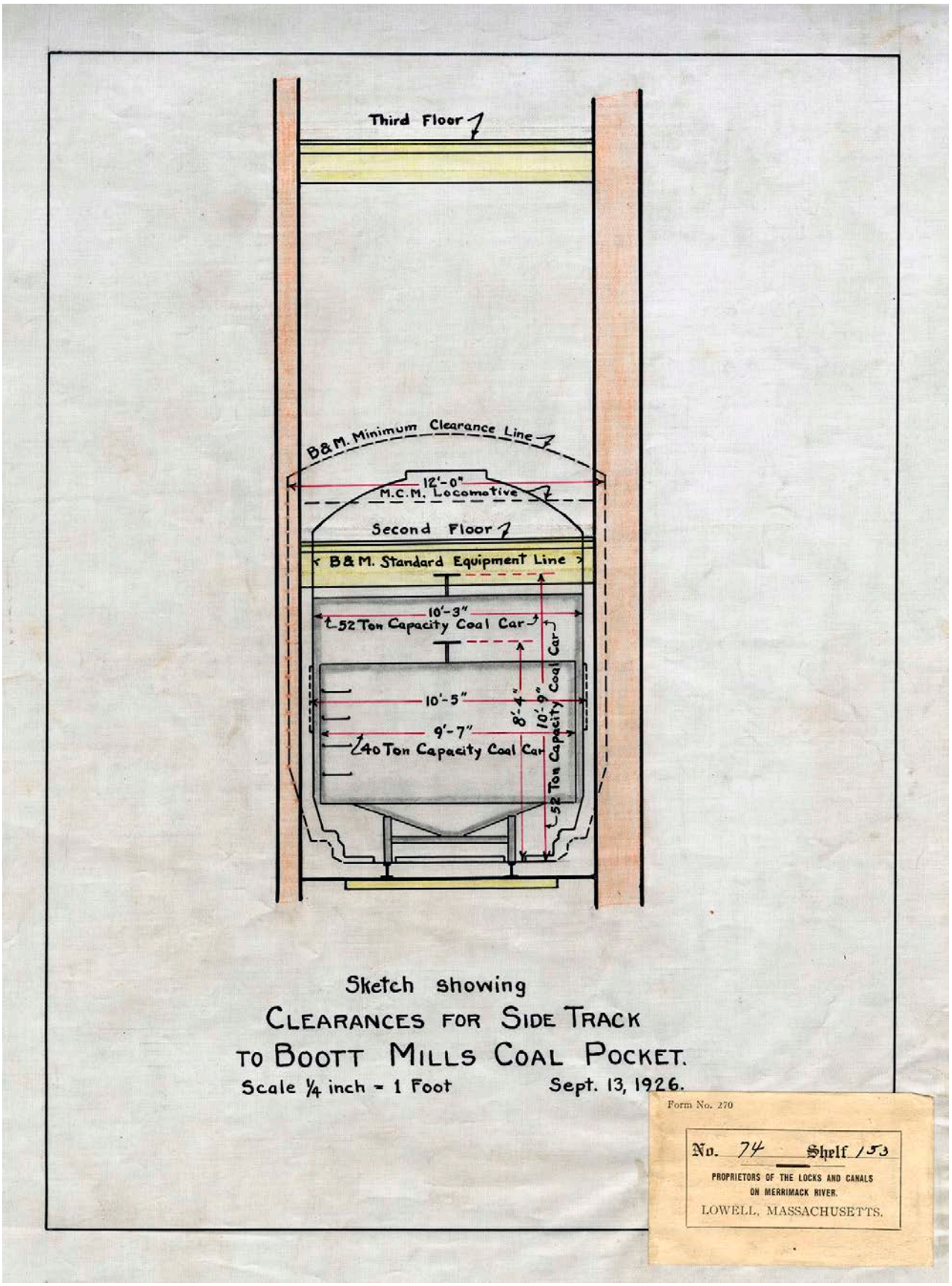


Figure 21. Clearance for Side Track to Boott Mills Coal Pocket, Sept. 1926
Source: LNHP, L&C, Plan Number 153-074



Photo 27A. "Passageway thru Mill No. 6 to Boott Mill Coal Pocket, June 1927"
Source: LNHP, Museum Collections, LOWE 8556

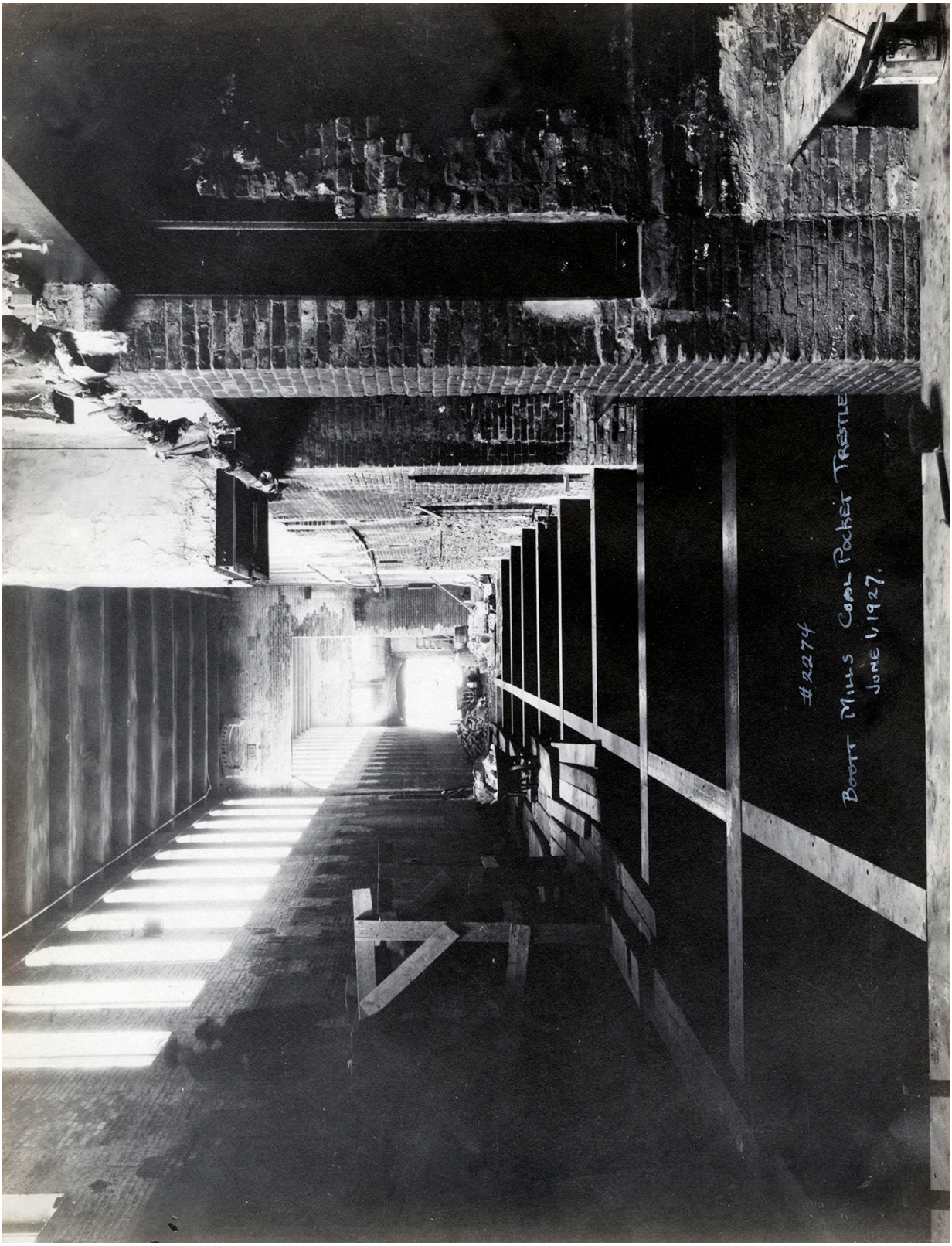


Photo 27B. "Boott Mills Coal Pocket Trestle, June 1927"
Source: LNHP, Museum Collections, LOWE 8558



Photo 28. "Coal Pocket Trestle, interior, June 1927"
Source: LNHP, Museum Collections, LOWE 8557

	Recommending Change over of Steam Heating Systems		
Mill 6	First floor,	4 coils a total of	3040', 1-1/2 pipe
	Second	5	2565
	Third	4	2190
	Fourth	5	2565
	Fifth	5	3575
and all necessary valves, pipe, fittings, vacuum pump gauges, etc.[30]			

Humidifiers were installed throughout this period, with major work completed the last part of 1907, when $2358.36 was spent at Hill No. 6, June, 1909 ($585. 00); May, 1910 ($622.44): March, 1923 ($1608. 86) and October, 1927 ($790. 82).[31]

(2) Sanitary Systems and Lockers

Sanitary facilities also were improved, perhaps prompted by inspections carried out by the Massachusetts Board of Health. The Treasurer's Reports for 1906 show $541.92 spent on sanitary improvements, with $2495.56 charged off in the first half of 1913 and $1734.43 in the second half. In October, 1917 it appears that management, perhaps for the first time, was concerned with providing amenities for the mill workers, when the Treasurer included a request in his report to the directors: "The Treasurer desires authority to carry our recommendations by Messrs. Bemis, Gregg, Agent and Employment Department for lockers, toilet rooms, wash rooms, dressing rooms, lunch room, filter, sanitation, hospital; cost $25,000.00."[32]

Hackett, in his 1911 report states: "In the spinning rooms also, the toilet rooms were small, dark and dirty… the toilet rooms were frequently very dirty and dingy, the sinks for washing were small and quite inadequate if patronized at all."[33] Valentine, writing in 1916 did not find much improvement: "long sink for washing, basins are few, no provision of warm water."[34] Also, in 1928, the following notation appeared: "State Board of Labor regulations relating to toilets are not lived up to." and "no steps taken to provide a place for operative to change their clothes required by Chapter 115, Acts of 1916".[35] It was not until 1923 that lockers were finally installed.[36]

3. Lighting

Lighting was vastly improved during this period, but not without some confusion: "buildings are old, narrow, low studded, poorly constructed, and so located with regard to each other that daylight

is reduced one-half, while in many rooms, artificial light is an hourly necessity"[37] This was despite efforts made between 1906 and 1910:

June 1906	drop wire	$910.00
October 1906	redistrib. light	$268.25
June 1907	redistrib. light	$312.44
December 1907	redistrib. light	$593.13
June 1909	redistrib. light	$598.42
November 1909	redistrib. light	$271.36
May 1910	redistrib. light	$93.74[38]

The Treasurer's Report for April 1913 mentions "wiring 6-3, 6-4 for lights," and, in the August 31, 1929, for the first time the use of mercury vapor lights "for night work" appears in the record with $1689.80 listed as the cost.[39]

Hackett comments that the "spinning room was lighted poorly" and "in one room there were lighted at a single time arc lamps, incandescent lamps and gas jets."[40]

Stevens, in a report to Frederick A. Flather filed on September 4, 1908, discussed the use of gas lighting: "1702 gas jets on property (all of the Boott Mills)... burned about 2 hours in the morning and 2 hours at night. Wiring and lamps to replace these 1702 jets, estimated costs for electric lighting $5106. 00".[41]

By August, 1911 the following light sources were in use at Mill No. 6:

6	1	Carbon	135
		Tungsten	50
		Gas	22
6	2	Tungsten	180
		Gas	102
6	3	Carbon	130
		Gas	61
6	4	Carbon	149
		Gas	48
6	5	Carbon	190
		Gas	7[42]

Evidences of the early wiring remains throughout the mill, especially in the tower at the east section, which retains the beaded, cased vertical lines, fibre wrapped wires, and ceramic insulators.

Valentine commented on "poor lighting" in 1916, and gave at least one reason: "lights are hung too high or too low and have either deep bell shaped shades, flat shades or no shades at all. Tungsten lamps predominate but there are a good many old type carbon filament bulbs."[43] Finally, on March 1, 1917, Arthur T. Safford of Locks and Canals wrote to Flather "that the Boott Mills is electrified for good."[44]

4. Fire Prevention

The vertical standpipe and sprinkler system was in place and fully operable before 1905, but it appears that new sprinklers were added and old ones replaced or repaired during the first decade of the 20th-century. New sprinklers are mentioned in the following treasurer's reports "June, 1906..... $31.44; June, 1907..... $23.97; December, 1907... $610.03" and "general fire equipment" in the June 1908 report, costing $299.39.

5. Painting

While the costs and dates for painting of the Boott Mills is not broken down by specific building in the records, Hackett mentioned in 1913: "Another favorable feature at the mills as a whole was the apparent brightness of the rooms. These seemed newly whitewashed or oil painted and this was distinctly a step in the right direction"[45] reflecting painting done in:

6/1908	Painting walls in mill	395.23			
"	Painting walls in mill	521.04	Materials		
12/1908	Painting walls in mill	800.69	Labor		
6/1909	Painting ceilings etc,	1384.83	mat	2019.59	Labor
11/1909	Painting ceilings etc,	786.68		1781.57	
5/1910	Painting ceilings etc,	7.29		467.08	"

Painting continued as a high maintenance item throughout this period, with $5122.52[46] spent between October 1927 and February, 1930.

C. Facades of Mills No. 1 and 2

With the exception of the replacement of window sash in the south facades of both mills and the connector between them, and the reinforcing of the walls, little change took place here during the period 1905-1930. The stair towers, however, were somewhat altered visually as well as at the interior as described below. Treasurer's Reports for June and December of 1908 show costs for "Re-inforcing construction of 1 and 2 mills… 371.15 materials, 130.42 labor." The December report adds $2409.95 in materials, $1398.59 for labor in "building towers in #1, 5 and 7 mills." As the towers have not changed materially, other than the improvement discussed below, since their construction in 1865, it is assumed that the work on the tower at Mill No. 1 was limited to the rearrangement of the stairs and landings, which have been altered. In addition to the "re-inforcing work," as yet unidentified as to location, $191.07 was spent between December 1906 and December 1907[47] for "basement filling, storage," an activity that probably did not have a visual impact on the facades (the cellar windows were infilled at a later date).

Based on photographic analysis, sash at the first floor of Mill No. 1 was altered after 1905 from the original 12/12 to 9/9, 6/9, and 6/6 - all of the sash at the third and fourth floors were changed to 6/6. The first and third floors of Mill No. 2 were altered to 6/6 sash, the second to 6/6 and 12/6, the 12- lite upper sash being original, which was retained at the fourth and fifth floors. The windows in the connector were also altered, from the original 12/16 to 6/6 and 12/12 at the second floor, 20/12 at the third, and 9/9 at the attic (the first floor was completely rebuilt in 1947, see next section). While no records have been found to date the replacement sash, they all appear to have been installed during this period. A 1927 (Photograph 29) shows the changes at Mill No. 1.

In April, 1929, Arthur T. Safford, Engineer of Locks and Canals toured the Boott Mills with Frederick Flather, Jr. and filed a memo that stated: "I think he will want some work done on the tower of No. 2 mill in the way of general repairs."[48] Locks and Canals forwarded an estimate and a proposal for such work to Flather on April 30, 1939:

> *We estimate that the cost of renewing the timbers that are decayed, putting in tie rods, and covering the sheet iron and painting, at about $1000. for each tower. Some $300. to $400. of this is represented by the cost of sheet iron covering. The sheet iron itself costs about $150. for each tower, and once the staging has been put up for the purpose of renewing the decayed timbers, the labor of putting on the sheet iron and the painting is not a very heavy item. In order to prevent decay in the future we would strongly recommend putting*



Photo 29. "Boott Mills Upper Yard, showing repairs to towers (of Mills No. 1 and 2) made by Locks and Canals, June 1927."
Source: LNHP, Museum Collections, LOWE 8741

on the sheet iron.

> *As I understand it, we are to proceed with #2 tower putting in the tie rods and renewing the decayed timbers. We are also to fix the staging so that the roofing under the weather vane can be repaired. As the work proceeds and we determine more definitely the conditions of the timbers, I understand that you will let us know whether you wish it covered with sheet iron, and will also determine at a later time as to what repairs are desired on 1 tower.*[49]

The sheet iron, pressed in a brick patter, was applied to both towers (Photograph 29 shows the beaded, flush horizontal siding in place, dated December 1927), and the roof of the clock tower (#2) was repaired: "copper roof, clock and weathervane, 1420.11."[50] The roof work was probably based on specifications prepared by Locks and Canals. W. A. Mack Co. responded to an offer to bid, apparently after the work had been completed, on May 11, 1929. The letter reproduced as Appendix N has a pencil notation at the bottom that states "Not accepted-low bid from M (unclear) Sheet Metal." The balustrades at both towers had been removed by this time (Photograph 23) so that only a low hipped roof that retained the bracketed cornice remained at the tower at Mill #1. Also, at some time during this period, possibly during May or June 1929 when scaffolding was in place at the towers (or in 1908 concurrent with the repairs to the towers speculated to have been limited to interior work) windows were altered at both towers. The east wall at the tower at No. 1 retained its small, narrow 1/1 windows, but the south or front facade was altered. The tripartite window at the second level was replaced with a 10/10 double-hung sash, but retained its flared sheet metal hood, and the 12/12 sash in the third through fifth floors was changed to 9/6. The west wall remained blind. The tower at No. 2 retained its blind east facade and the 12/12 sash in the fourth floor of the south wall, but the rest of the windows in this facade were altered like those at No. 1. The 1/1 sash in the west wall at the second through fourth floors was replaced with larger 12/12 units.

In July, 1930, Locks and Canals wrote to Flather:

> *With reference to the repairs to the brick wall on the fifth floor of your No. 2 mill, we found that the wall at this point on the yard side had moved out nearly two inches, moving away from the floor above and causing several cracks in the wall on the end of the mill. We are now at work tieing this in with two sets of 1 inch tie rods, securely anchored with 9 inch 20 pound channel irons. We are also securing the end wall to the first beam at the fifth and sixth floors with single 1 inch rods. After these tie rods are in, we will relay the brick work in the mill wall at the end of the bridge.*

When I discussed this matter with you last week, I thought that $100 might cover the cost if we could get along without staging. However, after going over the job more carefully, we concluded that staging would be necessary in order to do the work thoroughly with safety and, hence, have proceeded on this basis. This will increase the cost to somewhere between $150 to $200.[51]

D. The Courtyard

The courtyard changed very little during the early part of this period, retaining the oval shaped grass plot separated by macadam walks from the 1880's, the hose house, hydrant boxes and trees shown in the 1905 site plans and photographs made at the turn of the century. Archeologists have uncovered but not researched or identified a granite curb 6'6" north of the north wall of Mill No. 6. The trolley track through the yard remained in place at least until 1927 (see Photograph 29). A city building permit issued in April, 1930 includes "repairs to the tracks at Mill No. 1," indicating possible use of the tracks into the 1930s.[52] The 1927 photo mentioned above also shows, in addition to the hose house and hydrant box shed, a frame, gable roof open sided structure north of the Counting House. This building is identified as a smoking shed in a 1916 Insurance Plan, which also shows an ice house just south of the west end of Mill No. 2.[53] A 1921 Insurance Plan adds a "caustic shop" east of the tower at Mill No. 1. By 1928, a 25' x 16' concrete block "shipping shed" had been appended to the west elevation of the 1917 elevator tower, butting up against the north wall of Mill #6.[54] The one-story structure (Photograph 30) had a shallow shed roof pitched toward Building #6, with the upper section of the west and north walls consisting of steel industrial sash. The roof was surmounted by a single saw-tooth monitor on an east-west axis. The shed is also shown on the 1930 insurance map, which in addition places a small "condenser well" east of the caustic shed, 10- 2 feet south of the facade of Mill #1.

The bridge at the #7 connector in the east end of the courtyard, linking 1-4 with 6-3, was constructed in August 1930:

I am handing you herewith a blueprint showing in red the general layout for the proposed ramp between the fourth floor of No. 1 Mill and the third floor of No. 6 Mill. While some of the details will be different, in general this ramp follows the plan of the ramps on the floors directly above. However, we have made the minimum width 5 feet instead of 3 feet which is the case with the ramp on the fourth floor of No. 1 Mill, and the difference in floor levels reduces the

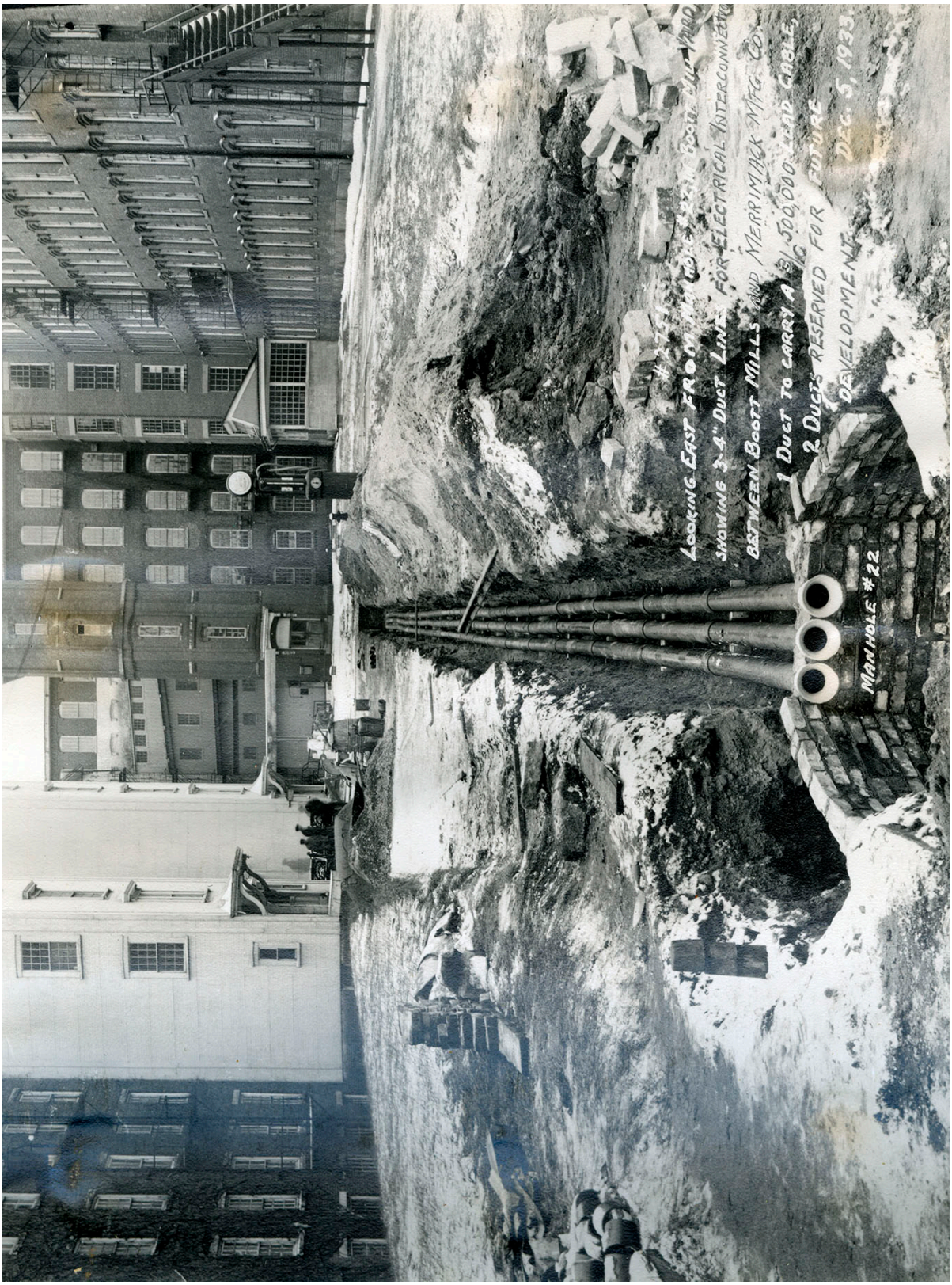


Photo 30. Mill yard between Boott Mills Number 1 and 2 and Number 6, Dec. 1933. Note fire stair at west end of Number 6, accessory structure at elevator
Source: LNHP, Museum Collections, LOWE 8986

grade to 5% instead of 6%.[55]

A drawing made on August 30, 1930 shows the corrugated metal sheathed bridge in plan and section.[56] Part payment for "building bridge connection 1-4 + 6-3"was approved on September 27, 1930.[57]

The canal bridge at the Counting House was repaired in October 1922 at a cost of $47.30 but by May 1924, it had deteriorated to a point where Boott Mills decided to explore the feasibility of replacing it.[58] A letter from H.L. Bowman at the Massachusetts Institute of Technology (Appendix 0) reviewed the Boott situation resulting in a final proposal dated May 10 (Appendix P). Boott Mills contracted with Locks and Canals on June 13, 1924 to "design, order the material, and construct the bridge at the counting room."[59] Safford estimated the costs at $1200 to repair the bridge; $3000-4000 to rebuild it.[60] The bridge was rebuilt as described on September 4, 1924 (Photograph 31):

This bridge consists of a concrete deck 7'9" wide and averaging about 8" in thickness supported by 2 – 15" 42 lb. I-beams. Each I-beam is trussed with a single 1" round rod, having a center strut about 3' long. The span is not quite 43'.

With the exception of the bottom flange, the I-beams are encased in concrete. This concrete together with the slab and the weight of the I-beam itself make a dead load of 600 lbs. per running foot for each I-beam, even when there is no one on the bridge. A live load of 100 lbs. per square foot adds very nearly 400 lbs. to each running foot, making a total of 1000 lbs. per foot. This load is fully equal to that of a 20 ton truck assuming a light floor system.[61]

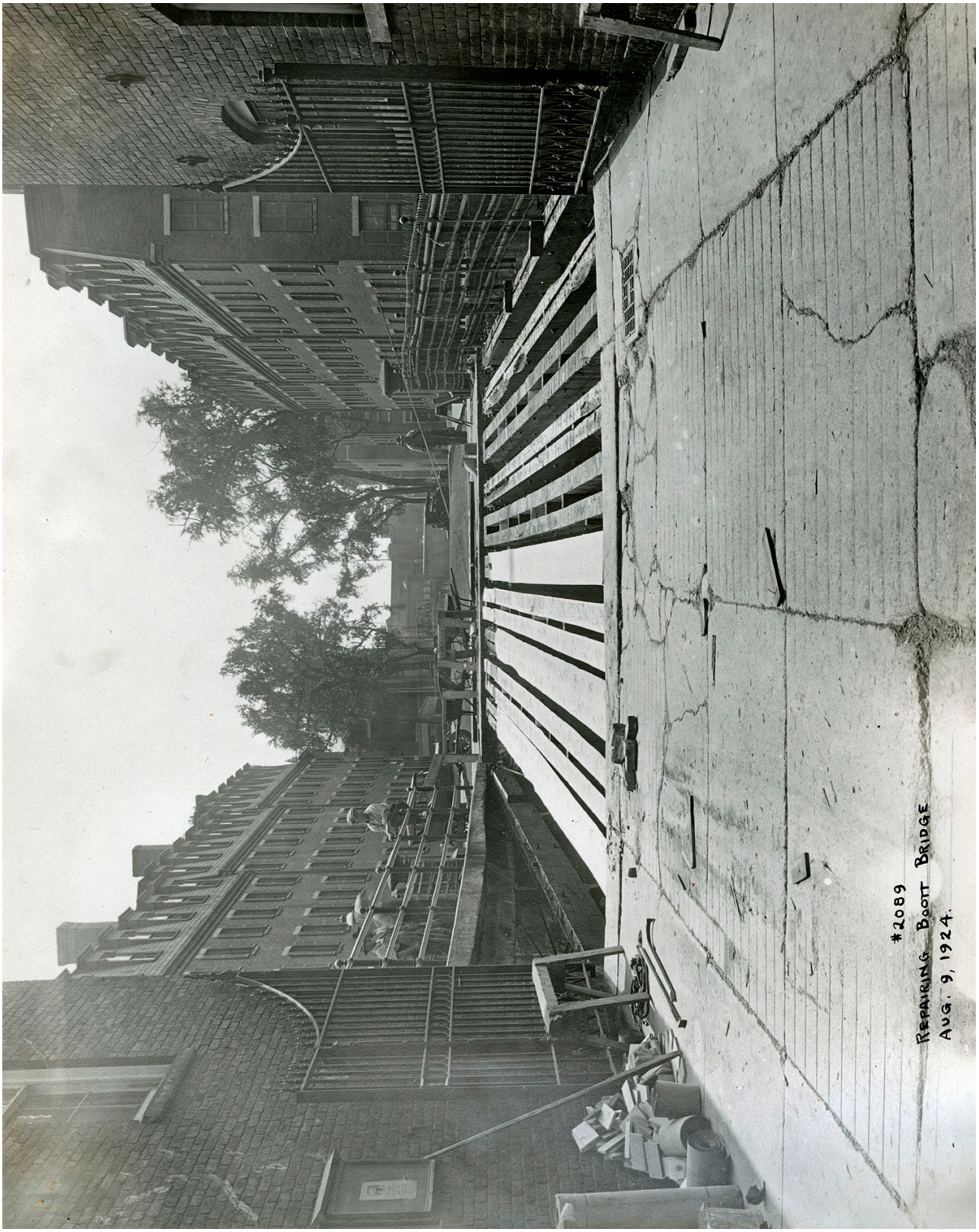


Photo 31. "Rebuilding Boott Bridge, Aug 9, 1924." Bridge spans Eastern Canal, with Counting House shown at left.
Source: LNHP, Museum Collections, LOWE 8399

ENDNOTES

1. Associated Mutual Insurance Company Survey of the Boott Mills, 1911 (F. C.).

2. "The Industrial Audit of the Boott Mills, Lowell, Massachusetts," Valentine, Tead & Gregg, Industrial Counselors, 1916, p. 37 (FC).

3. Treasurer's report to the Directors of the Boott Mills (hereafter DR), February 1927, August and September 1927 (FC).

4. Walter E. Parker, "Report on the condition of the BOOTT COTTON MILLS, 190 2, p. 35 (FC).

5. Letter, Lockwood- Gleene Co. to Boott Mills, January 29, 1907, p. 2 (FC).

6. DR, June 1914.

7. Letter, L&C to BM, August 10, 1926 (File 1009 L&C).

8. Letter, C. T. Main to BM, July 1, 1927 (FC).

9. Report, John A. Stevens, Consulting Engineer, to Frederick A. Flather, June 4, 1928, p. 8.

10. DR, August 3, 1929 (FC).

11. DR, July 21, 1917 (FC).

12. File 1009, Proprietors of the Locks and Canals, (Boott Mills Office) September 13, 1926, pp. 3-4.

13. Letter, Frederick Flather, Jr. to A. T. Stafford, Locks and Canals, December 24, 1926 (FC).

14. Letter to BM from L&C, February 23, 1927 (FC).

15. BM correspondence to L&C, May 23, 1927 (FC).

16. Letter bid proposal, Hayes Track Appliance Co. to L&C, May 25, 1927 (FC)~

17. Letter, L&C to B. W. Guppy, Boston and Maine Railroad, June 8, 1927 (FC).

18. File 1009, op cit, February 17, 1928, p. 3.

19. File 1009, July 9, 1927.

20. Letter, C. T. Main Co. to Boott Mills, November 23, 1925 (FC).

21. Stevens to F. Flather, Jr., July 1928 (FC).

22. Valentine, p. 31.

23. DR June 1908 (FC).

24. DR December 1908 (FC).

25. Stevens to F. Flather, Jr., July 1928 (FC).

26. DR, June 1906 (FC).

27. Insurance Surveys 1911, 1921 (FC).

28. Stevens to F. Flather, p. 9.

29. Letter, Boott Mill to Arkwright Mutual Fire Insurance Co., Boston, December 28, 1926.

30. Stevens to F. Flather, June 21, 1912.

31. Dr's for dates stated.

32. DR November 24, 1917 (FC).

33. L. A. Hackett "Report on the Boott Mills", December 1913 po. 7- 10 (FC).

34. Valentine, pp. 46-47 (FC).

35. Textile Development Corporation Report, 1928, np. (FC).

36. DR, March 1923.

37. Parker, p. 10.

38. DR's for dates cited (FC).

39. DR's August 31, 1929 (FC).

40. Hackett, p. 7, 10 (FC).

41. Letter, Stevens to Boott Mills, Sept. 4, 1908 (FC).

42. N. J. Neall "Report to Boott Mills", August 19, 1911, p. 45 (FC).

43. Valentine, p. 38 (FC).

44. Letter, L&C to BM, March 1, 1917.

47. Hackett, December 1913.

48. DR, October 1927, November 1927, June 1928, March 1929, August 1929, September 1929, February 1930.

49. DR's, December 1906, June 1907, December 1907 (F.C.).

50. File 1009, (Boott Mills Office).

51. Ibid.

52. Lowell Building Permit 233.

53. File 1009, July 10, 1930 (Boott Mills Office).

54. Lowell Building Permit 233, April 30, 1924. 55. Shelf 123, Parking Lot, Locks and Canals Files (Boott Cotton Mills).

56. Ibid., Envelope 25, Sheet 11.

57. File 1009, L&C to BM, August 15, 1930 (Boott Mills Office).

58. Shelf 153, drawing 104, Locks and Canals files (Boott Mills Office).

59. DR, September 27, 1930 (FC).

60. DR, October, 1922 (FC).

61. Letter, BM to L&C, June 13, 1924, file 1009 (Boott Mills Office).

62. Letter, L&C to BM, June 27, 1924, file 1009 (Boott Mills Office).

63. Ibid., September 4, 1924, file 1009 (Boott Mills Office).

X. OCCUPATION AND USE, 1931-1954

A. Introduction

This final period in the operation of the Boott witnessed wild swings of fortune for the mill, from prosperity to failure and closing. The operation held no immunity from the effects of the Depression that devastated the country's economy, but after that, the global tragedy of World War II provided steady work, as had generally been the case for the textile industry in time of war. The collapse of the national economy represented not only the most recent among many such collapses to affect the textile industry, but also the most extreme in modern times. In fact, this era in its history demonstrates the extent to which the Boott, like other mills, was subject to factors both within and without its jurisdiction. Some struck suddenly without warning, while others were the accretion of decades of action or inaction. The period was rich with drama, with evidence of perseverance, conflict, tension and, ultimately, tragedy.

The Boott Mills' operation between 1931 and 1954 saw a confluence of all the factors which could affect an operation of this sort. Changes in the mill's leadership, natural disasters, economic cataclysm, world war, police action, intensified competition from the South, combined with the continuing story of technological change and a new phase of labor-management relations to create a level of activity on all fronts which surpassed anything that had occurred before. The very fact of the many arenas in which the mill's activities were being carried on suggested the potential for difficulty with which it contended and the troubles this diffusion of attention could portend.

The setting, nationally, for the playing out of the Boott drama could hardly have been more ominous at the outset of this period. As much as a third of the country's labor force was out of work, some fifteen million men and women. Much of the famous "alphabet soup," the innumerable agencies of the New Deal era, came into being in order to deal with this problem, and the labor scene in which the Boott operated was fundamentally altered. The National Industrial Recovery Act (NIRA) sanctioned labor's right to organize and bargain collectively, leading directly to the organization for the first time of numerous industries. By the time the Supreme Court overturned that legislation, its replacement was ready, and the National Labor Relations Act (NLRA), backed by Senator Robert Wagner and often referred to as the Wagner Act, brought new rules and order to labor-management relations. Its enforcement agency, the National Labor Relations Board (NLRB) was charged with insuring that its provisions were carried out and that conflicts were settled fairly, according to the standards it set forth.

These new rules brought a new period of labor organization and bargaining to the American scene. Workers exercised their new-found rights in a big way, and management was blocked from employing many of the tactics long used to block organization or, failing that, to avoid serious negotiations. Rather than being the time of a William Wood, as the early decades of the century had been, the Thirties was the time of John L. Lewis and the United Mine Workers, Sidney Hillman of the American Clothing Workers Union, David Dubinsky of the International Ladies Garment Workers Union, and Harry Bridges of the West Coast Longshoremen. The steel, rubber, and meat industries were organized, and UMW, ACWU, ILGWU, and UAW joined the soup, along with the still more famous AFL and CIO. None of these developments made labor's lot an easy one, let alone an exception to the pervasive difficulties of the Depression, but they did permit new levels of organization and new opportunities for strength and negotiation on the part of the American worker. The opportunity was not ignored in the textile industry, and Boott workers employed all the new tools government authorized, all the opportunities it created.

While the economic storms raged across the nation, however, Frederick A. Flather (FAF) informed his Board of Directors that the Boott was not always part of that trend. When Textile Code Authority (TCA) figures showed a 22 percent decrease in textile production by comparing the first quarters of 1934 and 1935, the Boott's record showed a 66 percent increase, from 3,318,000 yards to 5,531,000 yards. Seventy-one mills had closed during this resurgence of the Depression, but Boott earnings were improving. Flather characterized the mill's relationship to the broader situation: "We take the job of getting along with the New Deal seriously, but by 'tending closely to our own knitting' we feel justified in looking forward with confidence."[1]

Despite this opportunity for optimism, hindsight shows that this period presented the acting out of a drama in ways akin to Greek tragedy, in which a family became involved in an action with a tragic conclusion preordained and inescapable, brought on in part by a flaw in the main character, but not an altogether evil, or pure, actor. Before this period began, events took place which made the outcome certain, though for a long time they were concealed from most of the players involved.

In 1926 an auditor told the mill that from an accounting standpoint, the Depreciation Reserve accumulated exceeded the book value of the plant. After that time, the reserve of $2,711,767.80 was continued but not increased. In 1932 the Treasurer explained the attitude involved:

Not adding to the Reserve for Depreciation is satisfactory from an

> *accounting and book values standpoint, but from the standpoint of prolonging the life of the plant year by year, an amount equivalent to a fair depreciation charge should be either reserved or spent on the plant annually. If each year such a sum should be expended on the plant at Lowell, it would be only where such expenditure were of special usefulness. Any large expenditure for equipment of a general nature would better be expended in the South.*[2]

At this point the die was cast: the Boott Mills could not endure in Lowell. The profit the mill and its employees had supplied the shareholders and accumulated, in part in the Depreciation Reserve, would not be used to perpetuate this operation or the jobs of those who created the reserve.

In 1937 this sentiment recurred in a discussion of tactics during a strike: "We didn't carry out one of Mr. Roberts' [a Director] favorite plans, which was ostensibly to go South. We may go yet, and not ostensibly. Whenever you are ready to give us $500,000, Frederick [Flather, Jr.] is ready to show you where we can make more money than we can by remaining here."[3] Clearly, no commitment to operation in Lowell existed, nor was there any willingness to invest money in further operation anywhere, since the $500,000 was not forthcoming. By this time, the Directors had decided to take money from the Boott Mills as long as it was forthcoming but not to attempt to continue the mill when further investment in plant or equipment was required. As Paul F. McGouldrick pointed out, "The durability of textile plant characteristic of industry technology meant that its owners could extract quasi-rents for decades rather than years."[4]

The series of quotations from FAF speaking in the inner sanctum of Board Meetings offered irrefutable evidence of the Directors' intentions and their awareness of the ultimate result of their course. No ulterior motives concealed themselves, no audience of workers or city officials provided a need for purposeful, rather than honest, speaking, as would often prove to be the case. This was the truth at the heart of the situation throughout the course of the mill's remaining years.

This decision placed the mill in a curiously fatalistic position, one in which any successes had to be temporary and could not alter the course already set. Despite the nature of the situation, Flather did not avoid deepening family involvement in the Boott, however.

In 1932 Frederick A. Flather, Treasurer and Director since the formation of the corporation in 1905, stepped down as Director to be replaced by his son, Frederick A. Flather, Jr. (FAF, Jr.), who also became Assistant Manager. John Rogers Flather (JRF), the younger son, rose to the position of Assistant Treasurer. The elder Flather remained active in the affairs of the company as Treasurer but the

changes recognized the current status of the mill's management and pointed its future course.[5] The senior Flather retained the real power while permitting his sons to take over more of the day to day operation of the mill, a conversion process which would see a continuing shift in the balance of power during the mill's final years. Given the support of the Board, which the Flathers had enjoyed on all but a couple of occasions, the position of Treasurer held great power over the running of the mill (as has been described). Within the limits of the Board's general purposes and intentions, the Flathers ran the mill as they saw fit.

> *The extent of the family's involvement in the Boott, and its attitude toward the mill, could be seen in a 1939 instance where the senior Flather called the Board's attention to a facetious, but meaningful, description:*
>
> *The following editorial by my friend Bennett of the American Wool & Cotton Reporter was not inspired by us in any way. We don't go in for notoriety, and this was a complete surprise.*
>
> *There is a gentle sarcasm in the article because I declined to furnish them the names and addresses of our overseers, from whom they desired to solicit subscriptions.*
>
> *The editorial as a whole is not correct of course, and is partly nonsense, but it is almost correct in many ways. "A little nonsense now and then, Is relished by the best of men."*
>
> *"There is one cotton mill in New England located in Massachusetts that has been remarkable for its success through recent years, and for its dividend payments even during the periods of depression and recession. Practically everyone familiar with the industry knows that the treasurer of this mill is tremendously busy all of the time in the affairs of that mill without any outside interests. He is at the mill every morning and at his treasurer's office every afternoon, and in constant touch with the selling agents all of the time. We are told that this mill has no overseers, no second hands and no superintendents that the old-time operatives with steady work and with good pay, need no overseers, and act as their own second hands. Two of the treasurer's own family are very active in the business, and are at the mill first in the morning and away from the mill last in the evening. They are all the overseers, and all the second hands, and all the superintendents. We are not sure that the above report as it was given to us is 100 percent correct, but we are definitely certain that this mill has the very lowest of non-productive expense, that every person on the pay roll actually justifies his proposition by productive ability, and that all costs are*

remarkably well controlled."[6]

While one cannot be sure what prompted Flather to read this into the Board of Directors' Minutes, speculation is irresistible. Indirect bragging, defense against ideas of nepotism, and resistance to continual consultants' reports that the mill had too many employees per spindle all suggest themselves. An attitude of proprietary feeling about the mill, and its workers, as well as management's treatment of them, comes through. In the context of his relationship with the Directors, as reflected in the Minutes of their meetings, there is a strain apparent here, something somewhat out of character. The times had been trying, his appointment of his sons could make him vulnerable, his habitual distance of manner made explanation difficult. Despite the stiffness of this technique for raising and attempting to dismiss these issues, it brought no response, perhaps indicating a degree of success for the ploy. More certainly, it reflected concerns and worries, an attempt to bypass, through levity, some of the serious considerations affecting, even threatening, the mill at this time.

Suitably for the background of the tragic action being played out, the mill's operation was buffeted by natural causes during this period. In 1936 Lowell's worst flood shut down the Boott on March 14 and 15, then again on the 19th-21st. While the water had little effect on #6, it filled the lower floor of the mills next to the river, stood 6" deep in the Courtyard, and entered the basement of the Counting House. Cloth cut from looms as the water rose escaped damage and little was lost. Refurbishing the machinery and drawing in new warps on the looms rearranged production workers for a short time but produced little lasting effect.[7] In 1938 a hurricane struck in the fall, again interrupting work with a flood, but the buildings withstood the winds and cotton in process was moved up by elevators before the power went out or the water rose.[8] Another hurricane shut down the mill in 1944 and management notified the third shift by radio that they would not be working.[9] The natural forces involved exemplified the role of age-old forces, while the radio notice indicated the new age in which the Boott found itself operating.

Other events also impinged on the history of the Boott. Starting in 1938 the mill began to convert to war production and by the time of the War Production Board's [WPB] 1942 order restricting the purposes of textile manufacture the Boott had already shifted to nearly complete concentration on military contracts. In that year the Army and Navy awarded the mill their production award recognizing the achievement of the men and women working there. In 1945, news of the dropping of the Atomic bomb on Japan interrupted union negotiations and four days later:

Sirens blowing announcing Japan had surrendered, people left the mill rather promptly. It came at a convenient time, during the lunch hour, and there was no confusion. J.R.F. visited the mill immediately and found everything in order, and the watchmen and supervisors on their toes. In accordance with the President's proclamation, the mill remained closed Wednesday and Thursday, August 15th and 16th… Notice of the mill starting up was announced by radio.[10]

In the ensuing years the Korean War also boosted production, while in its aftermath concerns were raised with preventing possible Communist infiltration of the factory.[11] Despite the anti-red programs of many unions, including the Textile Workers Union of America, such attacks were a standard part of management's diatribes against them.[12] Such was the age in which the Boott would founder.

B. Purposes, Operations and Procedures

A somewhat changed purpose governed the Boott's operation at this time. The goal now was not to run a mill for continuing profit, but to extract whatever profits remained available while the business was allowed to crumble. This change lay behind every aspect of the operation until the demise of the textile operation in 1954.

This alteration in the situation did not change the mill's cloth production in an immediate way. In the late thirties products included damask, defined, in response to one of the Director's questions, as cotton table cloth with stripes; scrim, for curtains; and toweling. Soon combed navy twill for dress uniforms became significant, occupying a good part of the mill and requiring high quality standards. Towels (other than terry, which they did not make) represented important products and were sold under the mill's name. These included part linen and linen-finish towels and encompassed a number of styles and widths. An exclusive franchise for an absorbent agent, Sorbtex, was acquired to aid performance and marketing of them. A Treasurer's Report described the mill's principal products:

Boott Toweling and Towels, for the thrifty, are nationally advertised, fit into popular price ranges and are distributed to wholesale, retail and chain stores, hospitals, hotels, institutions and laundry supply houses throughout the country. We make up towels economically in a modern, streamlined stitching room.

Boott Scrim and curtains of durable type go to and are ideal for thrifty homes, hospitals and institutions where many launderings are required. We cut and sew scrim into curtains ready to hang.

Boott Corduroy: Boott was the first to manufacture grey corduroy in the United States. Recently we changed our policy by completely finishing cloth... You may well be proud that Boot corduroy is characterized in the trade as the "Tiffany" grade. We obtain top prices for it. The corduroy business is peculiar. The old big 4 manufacturers (Boott, Crompton, New York Mills and Merrimack) will or should of course go on indefinitely, but the 10 or so new-comers are making unsatisfactory goods, which tends to weaken the market. Curtains and toweling were distributed through over a dozen of the best-known chain and mail-order stores.[13]

Producing products which the mill could both market on its own and sell on the basis of recognition of its name fulfilled long-time advice from various consultants. Both the toweling and corduroy represented materials for which they anticipated steady demand for an unchanging product. The only change in the situation was the entry into these fields of "new-comers," by which Flather meant the mills in the South which were making increasingly complex materials and thus completing even more directly with the Boott.

Later in this time period the war affected production and made it easier to reduce the number of different materials made:

In recent months we have run out of the looms a great number of former styles of goods. This involved constant adjustment of the mill balance. We were regularly making some 200 styles of cloth; now we are making about 10 styles of cloth, and will soon settle down to it. These 10 styles will run regularly without much of any change throughout the year.

Regarding the yarn numbers, we have reduced them from around 100 numbers to 15 numbers. This simplifies our operations and releases important general supervisors who will be retained to devote themselves to duties for which they are well-qualified; so, we are equipped for all functions of the business. We are not so well covered in the lower strata of skilled and semi-skilled productive personnel, but that is another story, and is being provided for by turning to training women.

Lines of Goods to be Run.

3 Towelings; one of which is for the Army.

2 finished Corduroys.

2 Scrims.

2 Ducks; one for the Army and one for the Marine Corps.

2 Drills; Navy.[14]

Wartime production (the above was written in 1942) helped achieve one goal, simplifying production, as Flather pointed out, and also rekindled the old Lowell practice of training women for increasing numbers of textile jobs as replacements for workers lost to the draft or to better wartime jobs. Employee training represented one of the primary stories of the era, in fact.

Simplified production did not guarantee profits, of course, and during a period of intense competition before the war, prices in the industry, as well as manufacturing margins, fell to new lows, particularly in 1932 and early 1933, and then again in 1939. Mills in desperate straits sold below cost in order to get business. The Boott, however, found itself in a strong financial position in 1939:

> *Due to the wise action of previous days, we were released from pressure of banks and selling house, and that is why we are in such sound condition today and able to conduct our affairs just as the Directors desire, without those handicaps at least.*
>
> *Twenty-three prominent mills last year had sales of $250,000,000 and lost $6,900,000 or 2.8 percent. The Boott on the other hand made a normal profit of $45,512 net, or 2.7%; i.e., the Boott made the same per cent as the other mills lost.*[15]

Forboding omens ringed the horizon, but the Boott stood well-prepared, unfettered in its competition against the various forces threatening the industry. It operated independently from an overpowering selling house and paid no interest to banks, unlike many operations. When management desired, things were made to sound bright.

However, when the City of Lowell proposed to raise the taxes on this profitable plant in 1944, numerous studies poured forth showing the disadvantages the mill faced on all sides. Between 1929 and 1945 the ratio of active cotton spindles, North and South, shifted from 40:60 to 20:80, and where the Boott had once run 151,000 spindles they now had 85,000 and only ran 75% of those;[16] all things are relative, and the high hopes for prosperity seen under one light vanished when viewed under another. A major contrast lay between the fiscal health of the corporation, on the one hand, and its prospects for continued manufacture in its buildings, on the other. Another lay in management's different, though self-serving, interpretations of facts for different audiences. In any case, the problems faced were real. Given the importance of the issues involved for all aspects of the last decades of the plant's operation,

the most succinct of the voluminous reports designed to plead the mill's case for a tax reduction appears:

Boott Mills Buildings Are Not Suitable For Post- War Competition In Cotton Manufacturing Nor Present Day Competition Either.

1. *When Government orders stop, Boott must return to those fabrics meeting the following tests:*

- *Fabrics which can be made on present Boott machinery.*

- *Fabrics on which Boott employees are experienced and accustomed.*

- *Fabrics which Boott has promoted and advertised extensively in the pre-war period, and on which Boott has goodwill, trade acceptance, and therefore, is surest to find a post- war market.*

2. *Competition on these items will be intense, as they are all made predominately or wholly in the South, now that the bulk of the cotton industry is in the South.*

3. *Southern mills will fight just as hard to get the small remaining portion of the Northern business they do not now have, as they fought to get the 80% which they already have.*

4. *In this fight to grab the small portion of the cotton industry which still remains in New England, Southern mills have the following advantages.*

- *Steady running, as contrasted with ups and downs in Boott production, because of Boott being located in a marginal area.*

- *Less changing from style to style, permitting lowest manufacturing cost, in contrast to Boott necessity of frequent changes to secure orders, resulting in highest manufacturing cost.*

- *Newer plants, in contrast to Boott's old plant.*

- *More efficient labor, due to less labor restrictions in the South*

than in the North.

- *Higher workloads per employee, due to less labor restrictions in the South than in the North.*

- *Northern mills are practically all organized; Southern mills only 15% organized...*

5. *Political pressure is being brought to bear on the South to build more and more cotton mills to absorb farm labor that will be stranded and without jobs, when the cotton picking machinery already proven satisfactory, is released after the war.*

6. *Restrictive labor legislation, such as Massachusetts textile laws for example, has admittedly caused the loss of many cotton mills to the South. These restrictions will further permit the resumption of the downward trend of cotton manufacturing in Massachusetts. Massachusetts, it should be noted, is the least favorable of the Northern states, from a cotton manufacturing standpoint. Cotton mill property in Massachusetts, is therefore, less valuable than if it were located in a state with few restrictions...*

7. *Most Southern mills with which Boott competes are one or two stories high. Machinery layout problems are less complicated in these relatively modern mills than in the Boott 3, 4, 5 and 6-story narrow buildings. Boott will find itself in a position of having to install new machinery in order to compete, and not being able to place such new machines efficiently to get the maximum out of them, because of its plant restrictions. Therefore, in the post-war period, even though Boott Management continues its long standing progressive policy of putting in new machinery whenever invented, Boott will be handicapped by being unable to secure the maximum benefits from new machines in its present 3, 4, 5, and 6- story narrow buildings.*

8. *Ability to Secure Competitive Work Loads: The term work load in the cotton industry refers to the number of machines an employee tends. Layout restrictions at Boott prevent assigning to Boott employees as many looms, for example, as in a mill with large areas, fewer columns, non- vibrating floors, better head room for humidity and lighting. Southern mills secure more product per employee per machine than Boott, because of Boott's building restrictions.*

9. *Inability to attract employees under the new conditions: As education and constantly higher wages raise people to higher standards of living, their desires regarding where they work also rise. We mention the following as just a few instances, to show that Boott buildings are totally unsuitable to attract this increasingly discriminatory type of employee:*

- *Boott toilets are notably unattractive and depressing, and should be built over, enlarged and refitted. To do this would require extending the toilet room into manufacturing area, because our rooms are so narrow, with resultant interference with efficient manufacturing, removing of certain machinery would be required, and a consequent small number of machines for a given employee to look after - all as result of narrow buildings and small and a further lowering of efficiency manufacturing rooms.*

- *6 flights -- A 6- flight climb every time one enters this mill to go to work, is not popular.*

10. *Officials of the War Manpower Commission and the U. S. Employment Service in Lowell have sounded a solemn warning that the newer industries that have come into this city with their modern plants, their new lighting, their beautiful toilets, and so on, are attracting the high school graduates, and if the Boott Mills wishes to attract these people they need to give thought to eliminating those unattractive and undesirable features which characterize the cotton mills, and which have been improved upon by the newer industries with newer plants...*[17]

Despite the length of the quote, it is included because of the remarkable degree to which it described the mill's plight; at the same time that, a modern reading, more informed than would have been possible for anyone at the time of its writing, reveals much about the Flather strategy for dealing with the mill's impossible situation.

The first three points said little more than that the Boott operated in a competitive economy and must make cloth it knew how to produce and with which it had been successful, a fairly attractive situation. Starting with number 4, the account began to take every aspect of the situation and attempt to turn it into a pleading for special treatment. However, the mill's location did not determine how steadily it ran, its success did. If other mills produced less variety, the Boott had ignored similar advice for decades. On the other hand, many mills, even whole areas, made careers of flexible production. Regarding the plant, advisers had recommended demolition of

the Boott throughout this century, to no effect. With regard to labor, most aspects of the relationship between the Boott and its employees were the product of its own history, its own decisions as to how to deal with the entire operation. Many of the inefficiencies of which management complained were equally troublesome to labor, interfering with efforts at competent work and limiting the earnings achievable on piecework. Even the final sections on toilets and building height simply reiterated the decades-old observations of consultants. These problems had not arrived unannounced, but were a part of the mill' s history, an avoidable part, but one which had never been treated and which certainly was not going to be treated after the 1920s decision not to reinvest.

This presentation gave a dismal picture in order to fight a tax increase, but it also reflected the thinking according to which decisions affecting the mill's future were being made at this time. While this report discussed the negative, it ignored solutions and mitigating circumstances. It presented problems of which the owners have been aware for decades and which they had chosen not to treat. It also ignored both assets of the mill, including its waterpower rights and holdings in other corporations, and its investment policy.

The mill's purposes were new, its operations little changed, and its procedures only superficially altered: while it's entrenched policy of exacting dividends without serious investment in buildings or equipment had created the situation the above account decried, the only change at this time was to intensify the past policy. This chapter of the story represents the unfolding of that development.

C. Activities

1. Counting House

Operations in the Counting House had changed little during this period. The Employment Office recommended earlier operated from these offices, and a First Aid Room also continued to share the space. In general, Accounting, Sales, and overall mill management operated here. Modernization was represented by ditto machines, and an Addressograph, payroll, adding, check-writing, and bookkeeping machines.

2. Courtyard

Several changes made the mill's interior Courtyard more an area of traffic and less an oasis of ordered plantings and comparative calm within the hustle and bustle of the city. A used dump truck and a

used stake- body truck were purchased in 1942 and presumably made regular appearances in the millyard.[18]

During this period the trolley tracks were removed from the yard. Trucks, entering over the John Street bridge, replaced the railroad and trolley as the transportation system for moving materials in and out of the mills. At the same time, new lighting and park benches were installed to enhance the usability of the space for employees.

After a history of disputes over the use of the Smoking Room (formerly the Recreation Room) and whether or not workers could repair to it while on the payroll, a new Smoking House was built in the Yard in 1950 (Photograph 34). Management was initially surprised to find that only the males were using it, then appalled to learn that they gambled in it. Watchmen were instructed to break up any gambling games on the property.[19]

C. Building #6

1. Technological Change and Its Effects

Discussion of technological change between 1931 and 1954 often turns on questions of conditions: those of the machinery, the process, and the times. Both equipment and the structure were deteriorating, and the economic situation nationally made new demands on the mills.

George Sweet Gibb emphasized this aspect of the situation with regard to new inventions for roving and spinning machinery and their relationship to the Depression:

> *The importance of this development [long-draft roving] and of the comparable introduction of long-draft spinning can scarcely be over-emphasized. Long-draft roving, which secured the necessary cohesion of fibers by the folding or condensing rather than twisting of the sliver, represented a basic change in those supposedly unalterable principles established by inventors in eighteenth-century England. The impact of long-draft roving and spinning upon the textile industry was forcible. Coming at a time when low-cost operation was essential for survival and when labor rates in the textile industry were being boosted by political action, these developments could not be ignored...*
>
> *The Saco-Lowell advertising department made certain that these developments were not ignored. The "New Deal" inspired this editorial comment in the January-February, 1934, issue of the*

> *Saco-Lowell Bulletin: "We firmly believe that the principles of the new deal having to do with wages and working conditions have practically prohibited the further use of much obsolete machinery and have made the question of mechanical efficiency one of the most important confronting mill executives at this time."*[20]

Both Gibb and Saco-Lowell, the machine-builders, referred to the federal legislation giving new rights in the areas of organizing and negotiating to labor and its impact on the workplace. Machinery offering a quantum jump forward in cotton processing technology could not help but be significant, though at this time of rising wages and demands for better, safer, working conditions its adoption held added importance. The historian's hindsight and the builder's promotional view coincided and signaled a perception of changed conditions, a perception that machine replacement had become even more important than before. While the Boott had been early to begin experimenting with long-draft spinning, as shown above, their continued innovation or lack thereof would be of crucial importance to the survival of the mill.

In light of the Boott's stand on reinvestment, it comes as little surprise that machinery changes in this period were more often relocations than purchases. An Insurance Appraisal made in 1933 described the building's contents, by floor, and provided maker and age for the equipment. It established a benchmark for evaluation of the machinery during this period.[21]

On 6-5 they ran forty ring-spinning frames made by Howard and Bullough American Machine Company [H+B] in 1902 and 1913, individually motorized in 1929. Spoolers and cone winders (package-changing machinery) from 1913 continued to be belt-driven from large electric motors. Individually controlled humidifiers attempted to cope with the moistening problems inherent in the building. To call this grouping unimpressive understates the case. Operations seriously interested in competing effectively with the South would not, and were not, utilizing this sort of antiquated machinery. Even without the pressure of new technological developments such as long-draft spinning, and the expectation of imminent labor pressures, this machinery had outlived its usefulness.

On the fourth-floor 52 Saco-Lowell ring frames from 1917 ran, along with five spoolers, with all the frames still belt-driven. One automatic regulator controlled fifty- five humidifiers. As was the case on the floor above, this equipment was seriously out of date, worn out, and of little value to a competitive mill. The southern mills of which the Falthers complained did not generally run such antiquated machines, nor did they rely on the inefficient belt-drive system found here.

The Weave Rooms on 6-3 and 6-2 held 404 Draper looms, 353 with dobbies operating 16 to 20 harnesses. The "old" looms had been made in 1901, the "new" ones in 1913. The Weave Room on 6-1 contained 164 Drapers made in 1901-1902, belt-driven, and 69 from 1911 were stored there. Humidifiers worked to control climate conditions, while two-shift pick counters measured workers' production and pay. Twenty-year-old looms were seriously worn in the best of circumstances, and no one ever suggested that machines in the Boott were running in good circumstances, regarding either the state of the building or their maintenance. Thirty-year-old looms had no place in a competitive operation. Looms which should have been replaced during or immediately after the good years of high production (and high wear) had not been, and times of depression do not produce massive reequipping.

Instead of replacement campaigns at the Boott one found continual efforts to continue maximum production (for these machines) through minimal repairs and parts additions. New shuttles and bobbins were purchased, a few looms at a time motorized, loom beams built up to hold longer warps for long runs of a given fabric.

About a dozen looms on 6-3 had Crompton and Knowles leno jumpers added in 1935. These represented a new capability, enabling the looms to produce materials in which some warp yarns were wound around others on certain picks. The jumper manipulated a portion of the threads involved while the dobby head took care of the rest. These changes continued during 1936, while at the same time long-draft spinning was slowly being added to the frames in 6-4. Both Whitin Casablancas and Saco-Lowell Long Draft attachments were installed, as were more H & B units. These went on at a pace of about six per month during the period 1936-1940, but intermittently. New roll cleaners, hank clocks, and the occasional spooler or winder accompanied these improvements. No. 6 also received temperature regulating equipment, as did the Office.[22]

These sorts of efforts did little to keep the mill apace of machinery developments; rather they offered stop-gap solutions to continuing problems. As Frederick Flather said in 1937, "Most of our new equipment is a small percentage of the whole. It is a demonstration equipment."[23]

Draper "X" looms offered an example of this behavior. A faster running loom than the "E" and "K" models used in #6, Boott Mills bought one in 1933, and by 1940 owned 78, a drop in the bucket of their 2000+ looms. They also looked at a comparable Japanese loom, but found it wasn't available here. Efforts were also made to run existing looms at higher speeds, but little seems to have come

of it, and no wonder, considering the worn-out machines on which it was attempted.[24]

Defense work at the time of World War II led to some small alterations, primarily new spindles, rings, bobbins, and such. Blackout windows, a warning horn, and a fence guard were also part of the defense work preparations.[25]

During this period of comparatively little investment in improvement to the mill and its equipment, consultants were called to the mill less often and there remain fewer outside opinions regarding conditions in the mill. However, when experts did report, they found that the equipment and program did not bode well for efficient operation. The Ralph E. Loper Company, which had studied the mill previously, returned in 1944 and found that the mill's machinery and conditions worked against effective operation, stymying production:

> *It is a fact that present operating conditions are unsatisfactory. Our comparisons have shown that your labor cost per pound is considerably higher than the average of competitors after making allowance for the difference in wage rate. Your excessive labor cost which is both the proof and the result of operating conditions being far from satisfactory, is due to the lower productivity of your employees than that of employees in competing mills. A portion of the excess cost is due to the inefficient layout of buildings and machinery necessitating employment of several persons as truckers. While this is an important item of cost, we do not believe it to be necessarily fatal to the future welfare of your company. However, we suggest consideration be given to regrouping the machinery when more positive knowledge of post war requirements is at hand.*
>
> *After eliminating the factor of machinery layout from our discussions, the remaining cause of the high labor cost is that of low machine production and low machine load per operative.*
>
> *According to our analysis there are two underlying reasons for the present situation, both of which are interrelated and have a bearing on each other. These reasons are:*
>
> 1. *The work runs so poorly that it is impossible to maintain a normal rate of machine production or to assign normal workloads in all cases. The responsibility for this condition must be born by management.*
>
> 2. *Employees lack sufficient initiative to perform to the best of*

> *their ability, in certain instances, under present operating conditions. This, of course, is labors' share of the responsibility for high costs.*

Loper began by reporting that even without a wage rate differential, the Boott's costs were higher than those of its competitors. The poor layout of the buildings and machines had been noted by consultants for many decades, without significant effect. The fact that the "work runs poorly" had to be attributed to poor machinery, poor cotton, and poor management of the process. In such a situation, the occasional modernization could have little effect.

Furthermore, the machinery was not only old, it appeared to be driven at practically random speeds:

> *The extent of machine speed variation is very excessive and is a condition which tends to keep operatives in a very unsettled state of mind. As an illustration we point to the case of weavers whose pick price is based on a loom speed of 160 P.P.M. It can be readily seen that the weaver cannot possibly earn the standard wage on looms running as slow as 137 P.P.M. Not only does the worker suffer unduly from such conditions but the mill is the chief loser because of lost production.*

> *Current working conditions, as indicated by the degree of end breakage and machine speed variation, are the result of incorrect manufacturing practices over a lengthy period and are management's direct responsibility. It is a well-known fact that the problem of maintaining peak employee efficiency is difficult even under the best of working conditions. When conditions considerably below normal are allowed to exist, employees eventually become indifferent in their attitude toward their work and toward the over-all welfare of the mill furnishing them employment. Under conditions such as are prevalent in your mill, employees adopt an antagonistic attitude toward any change in job assignments, even though they may be fully capable of taking on a great load, until operating conditions are improved.*

> *According to our diagnosis the basic responsibility for low employee productivity in Boott Mill rests with management because it has allowed conditions to exist which are detrimental to efficient operation.*

While such an indictment would have a place in a discussion of labor-management relations, it offers important commentary on the state of technology in the Boott, on the conditions of machines and process which were a part of the situation relative to the operation's

attitude toward and use of technology. It is important to note that Loper's assessment came from a consultant hired by management, not someone hostile to it.

Having established the basic situation regarding the mill's equipment and processing, Loper went on to detail the problems he found. Loper charged that the operation suffered from the lack of a plant manager expert in cotton manufacture and recommended that someone knowledgeable, established, and able to work in harmony with labor be found and added to the staff. That he would have pointed out such a lack in regard to both cotton and labor expertise said a good deal about the mill's predicament. He also noted a need for a better stock, straight cotton (without waste), in order to improve the breakage situation, particularly in toweling. The procedure of mixing in waste from processing offered false savings, an indication of the ways in which managers not expert in the field could appear to benefit the mill through frugality while actually creating production problems and discouraging employees. End breakage on spinning in combed yarns at times doubled acceptable frequency.

Slow running frames and looms frustrated workers on piece rates and indicated poor maintenance, improper settings, and incorrect parts. They also led to unrealistic piece rates and, in the case of battery-hands, an unrealistic expectation of 600 bobbins per hour to be inserted into the batteries on the looms.

Dirty and non-uniform spinning frames caused excessive broken ends and also produced inconsistent yarn. Without stricter supervision of conditions spinners could not perform normal tasks. Lack of proper humidity continued to plague the mill, as both its lab tests and excessive fly in the air indicated. Looms weaving at narrower widths than those for which they were made restricted output and demonstrated a need for either appropriate looms or fabrics consistent with the sizes of the machines.

Loper concluded by suggesting "that management would be in a very vulnerable position in case outside parties are called in to settle disputes." In other words, if a conflict between labor and management were to be arbitrated, the advantage would lie on the side of the former.[26]

In another report the Loper firm pointed out that while 69 of the frames on 6-4 and 6- 5 had been converted to long-draft, 24 conventional frames still run on 6-5. A third report, from 1945, described most of the Boott's looms as old and noncompetitive for the postwar period, probably not worth moving (within the complex) to overcome the fact that they were badly grouped.[27]

Efforts were made to group certain aspects of production at times, such as the 1947 movement to concentrate warp spinning in 6- 4.[28] But such attempts had little impact on the long-known problem of appalling transportation difficulties. As was noted in a 1948 supervisors' meeting, there persisted "too many cases of waiting for material… in carding, twisting, and weaving."[29] Such a labyrinthine pattern had afflicted the mill for decades but was only given attention by the managers when they sought tax breaks from the city.

When late in 1949 management did purchase a little new equipment, it bought:

> *96 unusually good Models E and Modified D, motor driven, Draper looms, to enlarge our capacity to produce 42 1/2" pin corduroy, at a cost of $165 each. We then scrapped 111 narrow, belt drive, fifty year old, side-cam looms, and reclaimed valuable useable parts... The looms are installed on felt pads to reduce vibration.*[30]

Such an extreme example of too little, too late, and the apparent satisfaction in it, makes one wonder. Purchasing a few secondhand looms of an outmoded type, saving "valuable" parts from 50-year-old looms, and expecting felt pads to have a significant effect on serious vibration problems does not indicate a strong focus on the sort of things the mill needed. Whether the Directors prevented more useful changes cannot be determined. Motorizing looms and mounting them on felt continued. Old "K" models were widened to produce 48" pin-cord. Minor efforts continued, little was done. Later considerations of the mill's final year (below) will contrast these measures with management's statements regarding the nature of the situation.

One technological change affecting conditions in #6 did not stem from the choices made in Lowell. Emma Belisle, Spinner in #6, complained in 1950 that the cotton was not as clean as before, left more dust on the frames and was more difficult to run. While management suggested that workers in preceding processes could cause bad work, it also noted that, "The machine-picked cotton now reaching us has more dust and dirt in it than the hand-picked cotton and it is not surprising if more dust is now occasionally seen. However, our management knows the problem and has taken steps to make corrections where and when necessary."[31] If this last were true, of course, the complaint would not have been made.

A chart prepared in 1950 indicated amounts of money spent since 1939 on equipment for the various processes in the mill. Since #6 at this time was primarily a spinning and weaving mill, only those sections, along with the Office, are reproduced:

	1939	1940	1941	1942	1943	1944	1945
Office	$ 1,259.50	827.63	995.15	1,400.46	990.25	26,410.46	1,441.10
Weaving	1,887.48		11,000.00				2,293.95
Spinning	14,035.15	168.40	1377.75	951.25		122.50	1,525.65
Laboratory-Instruments-Tools	265.58	944.28	294.15	2,019.10	239.42	376.80	948.50

	1946	1947	1948	1949	to Mar 1 1950		TOTALS
Office	1,802.80	454.84	701.97	2,296.29			38,580.45
Weaving				17,530.82	118.50		32,830.75
Spinning	1,075.00	57.65	558.68	1,292.81			21,164.84
Laboratory-Instruments-Tools	373.84			92.99			5,554.66

32

In light of the outmoded nature of the equipment in place in 1939, remarkably little was done over the next decade. To have spent nothing on the antiquated weave rooms in seven of those years, to spend nothing or in the hundreds of dollars in spinning in seven of those years, did not suggest an effort to keep the plant current in the field, to say the least.

The largest expenditures during this period went toward motorizing machinery rather than improving the mill's capabilities through technological advance. Even in the case of the long-draft adaptation of the ring frames, the value of the improvement was severely limited by the fact that the frames still ran with the small rings available at their purchase dates in the teens, thus limiting them to producing uneconomically small packages of yarn. When, in 1954 and 1955 the equipment was appraised and sold, practically everything in #6 went for scrap. Some of the frames on 6-4 sold as secondhand machines, but otherwise it was only the motors and other auxiliary items such as bobbins, shuttles, and a monorail cleaning system in spinning that had resale value. The worn-out looms (some still belt-driven) and frames had no value except for scrap. The machinery had been run until it could no longer produce profit. Twenty-six dollars a ton defined its quality and value. When the mill closed, it was no longer an effective operation but simply a building full of junk. The significance of this period lies in the human side of the story, the relationship of the scrap to the people involved.

2. Work Environment

a. Job Descriptions

(1) Introduction

This period saw the arrival of careful time-studies to the jobs in the Boott Mills. For the first time precise site-specific job descriptions became available and one can understand the operations and responsibilities of each position as never before. The extent to which practices and jobs were given definition at this time had obvious implications regarding the degree of job-definition previously.

Because of the absence of change in the mill's equipment, the earlier years of the period saw little or no change in work. The advent of wartime production first initiated alterations in standard practice (no easy thing to do). Labor turnover, unionization (which will be discussed below), the competitive squeeze and wartime opportunity to produce large quantities of goods at considerable profit all combined in efforts to rationalize production in ways which had not occurred before.

(2) Training

Labor turnover higher than the industry average had long plagued the Boott. Low wages and poor conditions, both in regard to production (and therefore earnings) and to working conditions generally, had represented a recurrent theme among both consultants and management spokesmen. Once the wartime situation emerged (and that happened well before the country's entry, in fact in 1938) war production dominated all considerations. Among other things, that meant learners were employed despite the cost disadvantages they represented. As management noted in 1944:

> *Fortunately, we had quite a back-log of experienced employees and we certainly have increased our appreciation of them.*

> *The turnover which we encountered has largely been among the newer employees. We estimate that about 75% of our people have been with us since before the war. Some of them we once would have allowed to go with our blessing, but now we want them to stay even though they are not of high efficiency. The turnover you can see has been among 25% of our employees. To maintain this 25% we have trained more than 5,000 people during the war.*

The recent record is that we had:

1 year ago	*1,403 employees*
Average last half of 1944	*1,220 employees*
Christmas low	*1,155 employees*
Present	*1,201 employees*

Our turnover has improved, in spite of the less fortunate experience locally and nationally. In fact, although 3% quit each month in 1943, we are glad to say that progressively we slightly improved in 1944 and were well under 2-1/2%.[33]

In light of other available information, and even in terms of this statement, the loss of experienced labor in this war-time period was enormous. The figure of 3% per month added up to 36% of the people working in the mill in a given year being new to the Boott, and, likely, to textile work. The concept of "our people" is better treated elsewhere.

Turnover not only required extensive training programs, but also made the mill even more susceptible to dislocations within its production system. In 1943 JRF described the necessity of laying off loom fixers, not for any reason regarding their performance, but because turnover and absenteeism in the card department created a bottleneck.[34]

Turnover required that training become increasingly effective and fast. Examining the mill's response informs about instruction and about the tasks to be learned.

Recognizing the difficulties faced, management in 1941 called on the Office of Production Management, Northern New England District, Training Within Industry, Branch of Labor Division (OPM, NKED, TWI, BLD) to assist with the mill's effort to confront the situation. (The war management effort rivaled the New Deal's alphabet soup of agencies). The report of this office described efforts to train new employees at the Boott. One method used involved assigning new people to experienced workers who would teach the skills of the department involved. This system required an enlargement of the supervisory staff and became less able to keep up with demand as production moved from one to three shifts. Another approach was to set up a loom-fixers' school in a room with 100 looms which had not run recently, had been scavenged somewhat, but which were usable machines. Trainees were put to work replacing missing or worn parts and getting these looms ready to run. Most of these trainees were males being upgraded from other jobs in the mill. Once these looms were operable, recently hired "girls" received instruction there and began to run the looms. As they learned to operate several looms at once they were inserted into the mill's

weaverooms. This system worked well but became insufficient to the Boott's needs, partly because of the amount of supervisory help it required, partly because it simply did not work quickly enough to meet the needs of the mill, and partly because the operation lacked standard machine settings and practices. Such standardization was essential to practical operation.

The production experts recognized that the mill included tasks requiring a wide range of skill levels:

> *There are a few jobs, such as bobbin-boys and bobbin-cleaners, which do not require much skill. A new employee can become effective in these jobs after a few days of experience. In the course of their duties they become somewhat familiar with other mill operations and accustomed to the noise and other peculiarities of a cotton mill. It is the policy of this mill to upgrade bobbin-cleaners to spinners and weavers, and bobbin-boys to weavers and from weavers to loom-fixers or to some of the other operations in the mill. Supervisors are selected from the outstanding weavers or loom-fixers, spinners, or carders, so that there does appear to be a reasonable chance for job progression as opportunities permit. The four department heads are men who have worked their way up in the mill.*

Success in this program would lead to increased production and therefore earnings, and, it was hoped, reduced turnover.

This study utilized meetings with the supervisors of the several departments to define some of the specific identifiable skills which the various jobs required. Efforts focused on weaving and loom-fixing as areas in which certain tasks could be specified and taught in a standardized way. The importance of uniformity of approach was emphasized, and the problem of people on different shifts implementing contrasting solutions or treatments for problems indicated.

b. Weave Room Instruction

(1) Weaving

As part of this analysis of training needs, the Office offered several "Exhibits" describing the particular tasks supervisors had brought up as both measurable and crucial. For weavers, they identified the skills that supervisors agreed were essential:

1. Tying the weaver's knot
2. Drawing in warp ends
   a) Drawing in new ends b.
   b) Repairing a broken warp thread
3. Finding the pick
4. Starting loom properly
   a) Properly placing shuttle in shuttle box
   b) Letting back warp yarn
5. Keeping correct tension on cloth and warp
6. Inspecting cloth for defects
7. Inspecting warps to prevent stoppages[35]

They then prepared a sequential approach to those operations which would lend itself to teaching. One of the values of these descriptions is their ability to describe the work involved as a series of steps and make the skills more apparent to those to whom the work is unfamiliar, whether contemporary trainees or modern readers. Furthermore, since managers, then, and scholars, since, have often referred to the "unskilled" nature of much textile work, including weaving, it could be vaulable to consider the description of "Key Points" in the performance of one aspect of the several tasks associated with a weaver's work. The OPM, NNED, TWI, BLD described drawing in a broken warp end, a common task:

2. Determine location of broken end.	2a. Move crankshaft to position between bottom and front center. This will place harnesses in "center" position and release tension on warp threads. 2b. Move stop motion feeler-finger and observe where fallen drop- wire is striking comb. On sliding bar, stop motion, observe where wire is caught between feeler-bar and holder.
3. Repair broken end.	3a. Remove broken end from position where it has fallen or become tangled, and make space for hands by sliding ends, heddles, and drop wires to either side of broken end.
4. Tie a piece of yarn on to broken end. Knot is to be so-called "weaver's" knot, closely trimmed.	
5. Relocate repaired end in its proper position.	

6. Insert weaver's hook into hole in drop wire with right hand and with left hand hold repaired thread under hook as hook is pulled out of hole in drop wire with thread in slot on hook.	
7. Locate proper heddle. This can be ascertained by checking location of thread in adjacent drop-wire.	7a. With left thumb and forefinger, hold heddle in opening made by sliding adjacent threads to right and left. Hold repaired thread between last two fingers of left hand. With right hand pass weaver's hook into eye of heddle, catch thread in opening on end of hook and pull hook and thread through eye of needle.
8. Locate proper "dent" or opening in reed. You have had explained to you how many ends should be in each dent. To locate proper dent, check location of end adjacent right and left. Insert reed hook in opening and pull through repaired end.	8a. Slightly raise the warp ends to the left of the repaired end with last or two three fingers of left hand while holding the repaired end between thumb and forefinger. This will help find correct dent or opening more easily.
9. Start up loom. Push shuttle all the way into box. Move loom by hand to position beyond bottom center. Holding repaired end with right hand, pull shipper handle to "on" position with left hand.[36]	

Before considering the job itself, one must remember the situation of the weaver. One of a number of looms he/she tended has stopped, signaling a problem. In the midst of the indescribable cacophony of the Weave Room, the weaver had to hurry to the idle machine and determine the cause of the stop. Piece work wages were halted as long as the loom was still, and the fear that another loom would need attention while this problem was treated carried the threat of a multiplying economic impact on the worker. Not only dexterity and good eyesight were required, but ability to work under pressure. Error in any of the steps described would create further difficulties. While the job might still not be seen to require brilliance, it begins to become clear that it did involve skills, and that the amount of pressure on the weaver's performance increased rapidly in proportion to the number of looms tended.

(2) Loom-Fixing

After weaving, they addressed the more complex task of loom-fixing. Again, they provided an overall description and then a breakdown of the way in which the first listed goals were accomplished. This description indicated a few of the fixer's tasks, but it must be

noted that in accomplishing these ends, the fixer confronted the particular difficulty that alteration of any one of the loom's seven motions or its settings had an effect on all the others. Each motion had to be timed in synchronization with the others, and each setting affected timings and results elsewhere in the machine. For example, adjusting the binder on the shuttle box which decelerated the shuttle after it passed through the shed affected the timing of its arrival at the picker and the amount of power which was required to return it to the other side of the loom. Given that caveat on the greater than apparent difficulty of the tasks described, the Office's program presented the fixer's duties:

1. *Adjustment and setting of picking motion*
2. *Aligning of box- plates and race-plate*
- *Aligning of box-plates and reed*
- *Centering the shuttle*
3. *Boxing and checking shuttle*
- *Adjusting of box fronts*
- *Adjustment of binder-spring*
- *Adjustment of check- straps*
4. *Setting of protection devices*
- *Adjustment of frogs, daggers, frog pieces*
5. *Proper setting of harness mechanism*
- *Adequate shed opening*
- *Timing of harness movement*
6. *Check filling-stop motion*
7. *Check feeler, transfer mechanisms, and cutters*
8. *Proper lubrication*
9. *Periodic inspection and adjustment to prevent stoppage and breakage*[37]

Such a list is far from eloquent in describing the variety and complexity of tasks facing a loom-fixer. Many of the adjustments required careful judgment, and even those which were supposed to be checked with a gauge required increasing skill as looms aged and wore. In the case of the Boott, this included all production looms.

These descriptions suggested the efforts of the training campaign and introduce one to some of the intricacies of the work at the Boott. The need to prepare the training programs indicated the informal ways in which workers had generally learned the jobs previously. Family connections were common in the industry, as were others,

such as nationality, which would enable a prospective worker to come to the factory with an educator already lined up. The demands of the war on the country's productive capacity eliminated the luxury of time which inefficient instruction demanded. The Boott's inability to compete with other employers for the available talent required it to come up with new methods to train replacements for the employees continually lost to better jobs. The necessity for careful efforts to improve training, as well as the descriptions it produced of job breakdowns, reveals a level of complexity for textile work which belies the standard accounts which dismiss it as unskilled.

c. Job Specifications

The advent of an overall union- management relationship during this period led to careful measuring of the elements in each job in the mill. Ongoing negotiations between management and the employees' authorized bargaining agent (as made possible by federal legislation establishing the workers' right to such organization), the Textile Workers Union of America (TWUA), CIO, produced efforts to create precise measurement of each job. Management hired a New York engineering firm, Albert Raimond and Associates, to define each operative's tasks. The results went to Solomon Barkin, Director of Research for the TWUA, in New York. These descriptions enable the current student to observe how time and motion study engineers applied the system formalized by Taylor's "Scientific Management" to textile production. They also show exactly what the worker described did, second by second, in performing a task, and give the standards upon which all discussion of wages, assignments, or other matters discussed between union and management were based.

Raimond developed this set of job specifications over a period of several months in 1945. At the outset, the report established certain presuppositions cited as traditionally accepted in the industry:

> *Textile mills operate in general two or three shifts per day. It is an accepted and well understood basis that all employees turn over their jobs to the operatives on the next shift in good running condition, without interruption of production.*
>
> *Contact between the two operatives on succeeding shifts is based on a mutual respect for each other, on the above understanding that each leaves the job in proper order for the other to take over.*
>
> *It is well established that all machinery is to be kept running all of each shift, except for well-defined periods of stoppages for cleaning*

and repairs.

It is well established that no smoking is permitted in a cotton mill.

It is well established and understood that supervisors; are responsible for discipline and have the authority it implies.[38]

Operating on the assumption that rules are not made against things which people do not do, one suspects that the work in the mill may well have been proceeding so poorly that these elementary conditions were not being met, or he would not have mentioned them. Careful measurement of the jobs could not erase the effects of many years of difficult operating conditions and bad feelings. Before job analysis and measurement could begin, an assumption had to be established that employees would work together and operate the machines for the requisite amount of time each shift. Having stated that assumption, Raimond could proceed to assess each position.

(1) Spinning Room

The report's treatment of the job of Spinner stands as an example of the technique employed. The work was described first as a list of the tasks which, combined, represented all the types of work included; second, the assignment was defined, the number of spindles to be tended on a certain type of yarn production; third, a schedule listed the regularity with which various functions were to be performed; finally, the elements, or parts of tasks, were considered, along with the amount of time required for each, in order to explain and justify both the work assignment and the rate of pay for it.

Raimond's description of a Spinner's job illustrated this process. He listed the tasks:

Keep machines in operation to produce yarn of uniform size and continuous length of standard quality

Start and stop machines

Observe safety rules

Piece up broken yarn and roving properly

Remove defective roving and yarn

Place waste in proper receptacles

Report machines out of order promptly

Assist in emergencies involving danger to fellow worker, plant, machinery or interruption to production

Replace nearly run out roving bobbins

Observe cleaning schedule

Remove laps from rolls

Replace travelers

Remove, clean and replace clearers

Clean roller beam by passing board

Clean spindles to properly seat bobbins

Record clock readings

Remove, clean and replace top rolls

Remove accumulation of lint

Keep record of production

This description moved from the general to the specific, breaking down the work of spinning into its constituent parts. The list did not add up to a complete account of the job; other workers, with their own assignments, contributed much of the effort needed to accomplish the spinning.

The idea of what a worker could accomplish related to the contributions of others and to the material being processed. The above tasks were assigned to a Spinner: "On basis of 1656 spindles for #16 1/2 combed warp yarn running at 140 R.P.M. and having 14 oz. roving in creel and 30 ends down per 1000 spindles hours. 6 Patrols per hr." The product was precisely defined, along with the operating speed of the machine, weight of raw material, anticipated amount of breakage (which would require repair), and the number of trips around the 1656 spindles the worker was expected to make in an hour. Production was also defined, in this case as 32.5 hanks per forty hours.

Frequency of operations was specified, as well. A cleaning schedule specified the areas of the machines to be cleaned per 40 hours, per shift, every 2-1/2 hours, every doff, and as needed. Finally, all elements were assigned what Raimond considered an appropriate amount of time: 10.5 seconds to "piece up yarn break (all)," or "Patrolling double creel per side, 35 seconds," or " Clean creel and pick lint in roving, 114 spindles--double creel--240 seconds per side." All of these functions were ultimately multiplied by the frequency of the chore to determine a total assignment and its pay.[39]

Such analyses offered the most precise description available, perhaps imaginable, for not simply the job, but the job as done in the Boott. References to "Patrolling" reflected the belief that a Spinner worked most efficiently by moving through the area of responsibility at a steady pace and direction performing tasks on the

frames as the job descriptions or the needs of the moment dictated, but not reversing direction, for example, to piece up an end which broke after the worker passed. This procedure represented a new, "scientific" approach to the job.

These job definitions represented optimal procedure. The assignments they provided did not reflect such ideal circumstances, and these workloads continued as a source of controversy until the mill closed.

Comparably complete information existed for each of the jobs in the mill. They offer an opportunity to consider the many jobs of the people working in #6. They remind one that the Spinner's assignment assumed the contribution of a Doffer, a Fixer, a Roll Picker, a Sweeper, and a Cleaner, each with duties as carefully measured and assigned as the Spinner's.

(2) Weave Room

Raimond's effort to determine standard assignments proceeded through all the mill's departments. In weaving, one found not only a Weaver, but also Fixer, Battery Hand, Filling Boy, and Loom Cleaner, suggesting once again the extent to which the division of labor, the specialization of tasks, had been carried. Each of these positions was as thoroughly measured as had been those in Spinning. The description of the Weaver's Job Specifications permitted a further understanding of the effort and skill associated with this job traditionally described as requiring little skill or training:

> *Keep a group of looms in operation to produce maximum production of highest quality cloth*
>
> *Observe safety rules*
>
> *Repair broken warp threads*
>
> *Draw threads through drop wire, heddle, reed*
>
> *Start and stop looms*
>
> *Remove incomplete picks on filling threads from cloth*
>
> *Pick up shuttles, thread same and place in proper position for starting loom*
>
> *Remove empty or bad bobbins from shuttle and replace*
>
> *Report looms out of order*
>
> *Start loom so no defect is in cloth, by "finding the pick" and "letting back"*
>
> *Inspect warp and remove bad yarn, lint*

Adjust weights

Adjust temples Inspect cloth on looms

Remove cloth from loom

Keep record of production

Mark cloth with chalk

Assist in emergencies involving danger to fellow workers, plant, machinery, or interruption to production

The concepts of "maximum production" and "highest quality" defined the two conflicting pressures under which these, and other production workers, labored. The next few tasks repeated the general descriptions of weaving found throughout accounts of this type of work. However, several points revealed the requirement of judgment and expertise generally denied this classification of workers.

After finding and repairing a mistake, the Weaver had to turn the loom backward until the harness position at which the fault had begun was found ("finding the pick"). In order to avoid a fault, the cloth on the take-up beam had to be "let back" to the point where a resumption of operation would produce cloth with neither a thick nor a thin spot. This was not done by rule or gauge, but by feel and experience. More complicated looms, and cloth, accentuated this difficulty, and the Boott's 20-harness dobbies ranked high in the level of difficulty presented. Similarly, adjusting the weights on the warp-tension mechanism had to be done with skill as the size of the warp beam changed during weaving. These and other aspects of the assignments made demands which were completely met only by well-trained and experienced weavers, despite the fact that the looms employed were denominated "automatic looms."

The Job Specifications helped describe the work which took place at the Boott. They also aimed to measure the amount of work which could be expected and to prescribe the manner in which the work should be accomplished. They were important as an indication of how management believed work should be performed, evaluated, and compensated. They were also significant as the basis from which management and the union would discuss their differences over the relationship between Raimond's idealized opinion and actual operation.

d. Work Loads

While the job descriptions portrayed tasks and suggested assignments, issues of workloads festered throughout this period.

Consultants continually indicated that loads could not be increased without improvement in conditions, as has been noted. Continual efforts at such increases were made and it cannot always be determined whether or not conditions had gotten better. One of the problems posed by the war and the accompanying loss of skilled employees to better-paying jobs was that the new help could not always work up to performance standards; in order to keep any help, the mill had to pay them a minimum wage. Experienced workers then had little incentive to work efficiently, since to do so resulted in little income difference over those whose work did not meet standards. This problem further complicated a historically troublesome disagreement.

The dispute between workers and management on the issue of increasing workloads during this period was constant. Various sources permit descriptions of the conflicts in terms of spinners, doffers, weavers, battery hands, loom-fixers and others in #6. Rather than describe each of these conflicts, a concentration on one job, spinning, permits a more thorough account which includes individual workers and represents the type of situation which was repeated throughout the mill.

A 1943 description suggested something of the nature of the work, its difficulties, and the difference in point of view between the management and the worker on piecework:

> *Results of spending 45 minutes with E. Ntapalis, a spinner, who works in 6-5 running eight sides of No. 15 combed warp... During this period she had to piece up 64 ends and put in 26 new rovings. This is equivalent to 120 operations per hour. It was noticed that whenever she put in a new roving she would attach the end of the roving to the roving of the second bobbin and break off the roving that was running out. Each time she did this there would be an average of three or four inches where 3 strands of roving were being drafted instead of 2. lt was also noticed that at times apparently the traveler would be sticking and the spinner would touch her finger to one of the bearings getting a small quantity of oil on the tip of her finger, transferring it to the traveler and then piecing up. This would give you an oily place in the yarn. The accompanying card shows the various types of piecings that this spinner made. Mr. Lemire, supervisor of this room, said this was a very good spinner. In talking with Mr. Bourgeault about it, he said that every time a piecing was made we would get a slub.*[40]

Ntapalis cared only about production and had little incentive to correct the situation regarding a sticky traveler or to piece up ends with care. Faulty supervision permitted the situation to persist. During the mid-forties a continuing dispute arose over management's effort to increase workloads in the spinner-doffer

job. Angelina (a.k.a. Emma) Belisle was first-shift union steward and a spinner on 6-4. She participated in committee meetings with various supervisors both on the floor and in the Counting House and performed, and argued about, the work under discussion. Most of the information available comes from John Rogers Flather's notebooks from the period.[41]

When management wanted to raise workloads in Spinning in 1945, it encountered difficulties from a joint advisory committee on which Belisle served (discussed below):

> *It was brought out that Mrs. Belisle's present job, 16 frames, kept her working approximately 21 minutes out of each hour, and that all we were asking her and the other doffers to do was to work approximately 35 minutes out of each hour, or 1400 minutes per week, out of 2400, leaving the doffers with 1000 minutes, or 16 hours and 40 minutes per week idle time. The trend in Mrs. Belisle's mind seemed to be that she wanted the doffers to work about one hour and then be permitted to leave the mill for an hour or more, and still be paid full time.*

While one would like another version of the meeting, the conflict was clear. Doffers were removing and replacing about 500 bobbins per hour. When the committee moved through the spinning rooms to view the work, some workers were waiting for frames to fill up and were seen eating lunches or reading newspapers. Performance was less than was specified by a 1937 Board of Conciliation and Arbitration agreement (below). However, one finds here no mention of the problems cited by consultants and workers which made workloads and earnings hard to predict: changing yarn counts, transportation delays, poor or poorly prepared stock, varying machine speeds, etc. The doffers felt they were being pushed toward doubling their performance without an increase in pay.

Complicating the situation further was a belief that some doffers in 6-4 were reporting more work than they performed. Yarn spun and bobbins doffed balanced in other rooms, but not in 6-4, where the first shift reported 50% higher production than the second.

Union officials complained of mismanagement, shortages of roving and bobbins, and a lack of expertise at the top. Flather routinely dismissed criticism of management and material.

A year later the dispute continued. In visiting 6-4, problems were seen but the engineering department described each as the fault of the Fixer, Roll Picker, or Spinner. Some workers managed to keep their frames running while others allowed several to stop

with full bobbins and did not keep up with the work. Problems, from management's viewpoint, stemmed from labor's refusal to do sufficient work and the union's refusal to enforce the mill's desires. The conflict in point of view was as old as the mill itself. Many factors had contributed to the poor relationship which made the disagreement so total at this point, and the advent of the union had given workers both strength and a voice with which to protest expectations they found unreasonable.

The end of the war in 1946 led to diminished work in 1947. All warp spinning for the Boott was concentrated on 6-4 in order to reduce the number of employees and improve efficiency. Disputes over spinning assignments continued, and management persisted in its belief that the stock was running well enough (breaking and requiring repair seldom enough) to permit an assignment of an increased number of sides (of spinning frames). John Flather noted visiting Spinning with a union representative and finding few ends down, even while Belisle left her frames to talk with the union man. He also noted that the Fixer on the floor, Joe Comtois, was found in an "empty storage room in the adjoining building,… sitting on the window sill." Not enough work going on to please the office, and an effort at arbitration was attempted, in keeping with the union contract. However, the arbitrators sent the question back to the mill for a further attempt at changing workloads, with management looking toward 900 bobbins per hour; management resumed its study. While they felt twelve sides per spinner was the right load, they decided to attempt ten sides:

> *Before the spinners change was made, a change was made eliminating one section hand and one sweeper, increasing the work assignment of the 2 fixers who remained and the 2 sweepers who remained. This had been done without comment from the union.*
>
> *Similarly, we increased the doffer assignment from 450 to about 600 bobbins per hour. This was done without any comment from the union. It goes without saying the Gionet, Hawks, Hopkinson, Dutton and the Room Supervisor, had been concentrating on the Spinning Department to be sure that the conditions were favorable to permit the change in these assignments to go smoothly.*
>
> *In 6-4 yesterday the spinners were running 8 sides on 23s combed and 23s carded. Today they were told that the assignment was to be 10 sides.*
>
> *The frames were to require 6 spinners, whereas heretofore it required 7-1/2 spinners. Each of the 6 spinners was spoken to by the supervisor, one at a time, and explained what their new assignment*

was. The spare spinners were kept in case of any difficulty, so that they could be used to step in, in case of a break. If everything went smoothly as expected, they were to be transferred somewhere else.

The first one spoken to was Jennie Slowik, who said she would take 10 sides if the rest of the room would take them, and then proceeded to run 10 sides without comment.

The second spinner was Miss Lambros. She took the 10 sides but suggested a different layout, and she proceeded to run 10 sides.

The third one was Catherine Economou. She made no comment and proceeded to run 10 sides.

The next one was Angeline Harne. She declined to take 10 sides and kept on attending 8 sides. She was told that there was no work for her if she did not carry out this assignment. She said she would not leave and proceeded to run 8 sides.

The next person was Mary Richard. She said 10 sides would make her nervous and declined to run them.

Blanche Dempsey was next, and when she was asked to run 10 sides she willingly accepted the 10 sides and proceeded to run them.

Next was Contance Economou. She declined to run 10 sides.

Bessie Karas - She willingly accepted 10 sides.

At about 6: 15 AM Richard and Harne went up to speak to Mrs. Belisle, the head steward. The conversation was not overheard by the supervisor, but when the spinners came away, after talking with her, they still refused to run 10 sides.

Hopkinson, Cheetham and Dutton then went up and spoke to Mrs. Belisle, the head steward, and requested her to explain to the spinners that they should try that assignment, and she said the union had instructed the spinners that they were not to take more sides, and that if anyone refused and was suspended or sent out, the other spinners would all sit down and not work at all. She ended by saying - "Let the head of the union come down and straighten it out".

In view of this opposition and complete lack of cooperation from the steward, we told them to go back on 8 sides pending arrival of Mr. Hodgman, head of the union.

Flather's account reflected in many ways the mill's new situation. He acknowledged the cooperation of the union in the elimination of certain positions, and tacitly admitted the problems which had at times plagued the operation in noting the efforts of the supervisors to make sure the work was running well when the changes were implemented. That the Assistant Treasurer would participate in this effort indicated the new relationship, the new degree of power on the workers' side. The degree to which the workers were personalized indicated that a new awareness of their individuality grew out of their collective strength.

Belisle's idea that the union representatives should "come down and straighten it out," a reflection of her use of the new organization, was followed. Without that presence, that assistance, Flather had seen that he could not impose the policy. Despite the effort to make the work run well on this day, Belisle feared that the conditions might well change, revert to what she had experienced as normal. The union believed that the change required fuller explanation in order to make the employees agree to try it, and after two explanations by two union representatives, it was accepted. Collective bargaining had fulfilled the fears of Lowell's investors throughout its existence: labor had a voice, an opportunity to interfere formally with production, in contrast to its informal techniques in the past.

This episode stood for a series of such efforts and confrontations throughout the period. Battles over loads with the loom-fixers went on steadily, sometimes going to arbitration, at others causing strikes. Arbitrators found fault on both sides. They criticized the mill's layout, the condition of the machines, and management policy and attitude (for example a fear of the fixers), just as had numerous consultants for decades. They also faulted the conduct of the employees as careless, uncooperative with one another, and performing less than a full day's work.

Things had run badly for so long that no one expected them to run properly. Given the condition of the building and machines at this point, probably nothing could have produced an efficient operation. In any case, no changes were made to the direction of the operation, nor to the equipment. As had traditionally been the case in Lowell, improvements were expected to come out of the workers end of the operation, not from improved machinery or direction. Unfortunately, the entire operation by this time lacked the leeway which would permit such an approach to deal adequately with the difficulties faced.

3. Wages

A number of new factors came to affect wages at this time: The National Recovery Administration [NRA], Massachusetts arbitration boards, an industrial union, and wartime federal measures. As a rule, Boott wages fluctuated as a function of the Fall River- New Bedford scale, in a relationship management worked hard to adjust to what they saw as their special situation. Newly arisen conglomerates such as the American Woolen Company and the Textron group also affected wages in New England.

During the first years of the Depression, wages fell 10 per cent on two occasions, in 1932 and 1933. Not until 1939 did they rise above 1931 levels, despite the factors assisting labor at the time. In 1933, Boott employees earned the following rates for a week of straight time (During most of the period the 40- hour week represented the standard):

Pay Schedule Adopted By Fall River & New Bedford

Textile Councils July 31, 1933

			B.M 40 Hours	
Doffers	$13.00		13.00	D
			W	F
Ring Spinners	15.00		14.70	to 16.44 P
Doffers	16.00		19.04	P
Spoolers (Cotton)	15.00		15.00	P
Winders	16.00	(from Skeins)	15.00	P Foster
Knotter Portable	23.00		24.00	P
Helpers	16.50		20.00	P
Weaving - Plain Non- Auto	16.50		--	
Weaving - Auto	18.00		18.05	P
Weaving - Fancy Non- Auto	18.50		--	
Weaving - Fancy Box & Auto	19.00	Dobby	19.32	P
Weaving - Jacquard	20.25		18.05	- Woven Name
Weaviong - Side Cam			20.25	P
Smash Piecer Room- hand	17.00		15.16	D
Loom Fixers	26.00		26.96	D
Changers	23.00		20.32	D[42]

This increase of about $4 per week led to a flurry of activity on the mill's part to determine Fall River workloads and compare them to the Boott in hopes of altering this effect.

Following reductions in 1932 and 1933, increases in 1936 and 1937, another reduction hit in 1938:

			Jan. 20/38
	40-Hour Base Rates of Pay		
			Boott
	N.B.		
Job	-12-1/2%	1937	2/7/38
Ring Spinners	16.41	20.39	17.83
Spin. Doffers	18.29	20.90	18.29
Ring Twisters	18.00	20.74	18.15
Ring Tw. Doffers	15.89	17.00	14.87
Spooler Tenders	15.89	18.40	16.10
Tie-In Girls	15.89	20.08	17.55
Warper Tenders	16.94	24.96	21.84
Slasher Tenders	23.30	26.40	23.10
Weavers Pl. Auto	19.05	21.62	18.92
Weavers Dobby Auto	20.10	23.16	20.26
Weavers S.C.		24.26	21.21
Weavers X		25.47	22.28
Smash Pr. (Rm. Hd.)	18.00	18.35	16.05
Loom Fixers	27.50	31.46	27.503[43]

Small wages, and prone to shrinkage, they followed the ups and downs of the national economy, as Lowell wages always had.

The Treasurer summarized the trends in 1940:

> *Dec. 14, 1936, Boott made a flat 10% increase to all employees in step with New Bedford and a group of Northern mills. Boott took the position with representatives of the group that it would be a mistake.*
>
> *Jan. 12, 1937, Boott made an increase of 8 1/2% to fixers only. This was awarded to the fixers by the State Board of Conciliation and Arbitration. Boott complied under protest.*
>
> *March 19, 1937, Boott made a flat increase of 10% to all, again in step with New Bedford and a group of Northern mills. Boott again expressed itself to some of the group as deploring their action.*
>
> *The three above advances made a total to fixers of 31.28%.*

May 3, 1937, a C.I.O. strike for a 20% advance for all and a written contract occurred. It lasted until June 15th, or six weeks. They all came back to work with no advance and no contract.

Feb. 7, 1938, Boott made a reduction of 12 1/2% flat to all, in step with New Bedford.

About last November, a few mills in Fall River raised wages 7%, and were followed by a majority of the mills in Massachusetts and by some in nearby states.

The Boott declined to follow.

The Boott fixers made a demand for 7% increase for themselves. No other group in the mill have made any demand.[44]

Flather, Sr.'s commentary was interesting in a number of ways. The Boott resisted, complained about, and tried to circumvent every increase, despite the fact that other mills found them acceptable. When possible, they refused to follow the regional standard and seemed to count it as an accomplishment that only their one organized group of workers, the Loom Fixers, made official demands for a raise. Despite the litany of consultants' complaints about every aspect of the mill's operation, there was a continual effort to place as much of the pressure, stemming from the Depression and from competition, on the employees, and to claim success for the operation as a whole when the effort was sustainable, despite the resulting antagonistic attitude on the part of the workers. The loom-fixers' dispute dragged on in arbitration and in the courts for two years until a judge ruled that the arbitrators had erred in failing to consider both workload and pay in its decision. The criticism of both sides in the dispute has already been noted.

During the war, the mill lost many workers to better-paying jobs. Wages rose somewhat to compete, but hiring novices, particularly women, offered the path of least resistance, or the cheapest solution, at least. After the war, other problems emerged, according to the Treasurer:

Those employees who left for "cost-plus" munition works formed bad habits regarding easy money and soldiering on the job, and are now preferring "The Nine o'clock $20 Club" tax free per week, to minimum pay of $26 per week, which less about 10% withholding tax, is $23.40. They reason that to get $3.40 per week, they would have to work 40 hours.[45]

The slight difference between unemployment compensation and Boott Mill earnings underlined the low level of the wages.

During the period 1938-1947 wages rose slowly, a few cents per hour per year for those making production quotas. In 1948, union negotiations resulted in a new contract which specified both pay and initial workloads. After a year under the contract, management boasted that despite the wage increase, increased production had actually lowered labor costs. At the end of 1949, management paid each worker a $12.50 bonus.[46] In 1950, New England owners responded to CIO pressure, in wartime conditions, with a 10 percent pay hike. In 1951 a 6 1/2 percent raise followed at the Boott. The next year, in keeping with the decision of an arbitrator in a Fall River case, the last increase was rescinded. At no time after the war did raises keep pace with increases in the cost of living.

The latest available set of hourly rates for the Boott were from 1952, before the 6 1/2 percent raise had been rescinded:

Doffer, Spinning Frame	1.41	
Spinner, Ring Frame	1.32	
Loom fixers (Plain & Dobby)	1.745	
Weavers, Dobby	1.47	Avg.
Weavers, Plain	--	
Battery Hands	1.21	
Truckers	1.165	[47]

The range, from about $1.16 to $1.75, while above the minimum wage, and above the southern wages about which management complained so constantly, offered low compensation to the employees of a faltering mill. The average, $1.38, fell slightly below that of other New England mills.

The period 1931-1954 brought little change, then, in the area of Boott wages, despite the advent of industrial unionism as fostered by New Deal legislation. Pay at this mill remained below the average for other mills in New England, and since work was sporadic, yearly income was even more adversely affected. Many of the better workers left for other jobs, and those who stayed felt underpaid and unwilling to see their work assignments extended. As had long been the case, Boott wages were low for textiles and textile wages were low for manufacturing work in the region.

4. Labor-Management Relations

a. Management View

While a number of aspects of the relationship between the two parties at the mill, management and labor, were altered by federal legislation during the 1930s and 1940s, traditional attitudes were not necessarily changed. Management's perspective revealed itself in a variety of ways. The Flathers were in turn manipulative, concerned, condescending, perplexed, and mistrustful. When wages were to be raised, they consulted with their "Senior French Canadian Supervisor" in order to make the timing most effective. They employed "women in as many operations as possible, as being easier to train and more stable."[48] When workers did not come in, someone from the office visited their residence to check up on them.[49] When a veteran returned home they complained that "his family (our employees) takes time off to help him spend his money."[50] If employees were "rewarded" it was because, "we felt like giving a bonus to everyone."[51] If employees were to be accommodated, it was by agreeing to have a meeting in the Smoking Room so the "boys" could have a smoke.[52] These were not simply the mannerisms of the time, but added up to a steady disregard for the workers as people with interests and expectations, with an existence, rights, and opinions of their own. It suggested the maintenance of the distance which permitted the decision to allow the mill to gradually deteriorate over a period of time, while the equity the employees had helped build up was used for the benefit of the owners at the expense of the workers. Inherent in all these comments and actions was a belief that labor was less than a full partner in the operation, that the decisions and interests of the managers and the investors were independent of and superior to those of the employees. Further, there was a clear assumption that the managers could better decide for labor what the best course of action was for it, unrecognizing of the separation between their points of view and actual best interests. It is axiomatic that paternalism of this sort, while expressing kindness for the recipient, at the same time reserves to itself control over the well- being of the beneficiary. Management knew better than the workers what was good for them, it believed. The degree to which it could have an insidious effect on its supposed beneficiaries could be seen in the decision to allow the operation to run itself into the ground, a decision made for the benefit of the investor s and at the expense of t hose who had created the equity involved. In making that decision, the Boott Directors were typical of, rather than an exception to, the pattern of the industry.

b. Labor View

Records of individual responses from workers are rare, but a recent interview by Judith K. Dunning with Harry Dickenson, loom- fixer and union officer in #6, offers a bit of a reply. His commentary about entering the mill offers an interesting counterpoint to

the nineteenth- century resentment of Agent Cumnock and his associates regarding the Commonwealth's attitude toward the existence of a permanent class of mill-workers:

> *No. He didn't have to teach you, you were suppose to be in the mill. What was good for your mother and sisters, you were suppose to be. That's the worst part of it, I think that is the worst part of any family, you don't give the kids a chance to get interested in anything else. You have to be a mill rat. That's what they used to call them, mill rats. My brother was awful strong on that, he was all mill.*[53]

Dickenson indicates the extent to which going into the mill could represent thwarted ambition, the loss of an opportunity to choose, caused in part by the family's need for the income of every member to survive. Low wages meant an early end to school and little opportunity to learn a trade, a process which might not pay, and help support the family, at first. Dickenson's account, given twenty-five years after the mills closed, also reflects labor's concern with the operation of the mill, its knowledge and frustration, as well as the somewhat rose- colored memory which casts the best light possible on the work that had been his life:

> *Some mills you know are run better than others on account of management. The Boott, we used to go to work there and I'd rather go to work there than go to the show. Everyone was pleasant. The head of the mill, he started putting his sons in there... Before, they used to hire a man to run the mill that knew the business. Now, when they started putting the sons in there that had come out college it was a different story altogether…*

> *What he [Frederick Jr.) did was breaking down the standards of foremanship. He'd take a man off a junk pile and put him in the mill as a foreman. He really ruined the mill. But John he was older than Frederick, you could talk to him, he had more reason. Frederick seemed to take charge and you couldn't do anything about it. When I was foreman, you know in the mill you have got to have heat, warm, and then you've got to have humidity and you can't have no drafts. The drafts in the weaveroom causes static electricity and it dries everything up... So, I had trouble there and kept asking for more heat but all they did was just laugh at me. Some of the weavers were having a hard time and there was a place there, next to where the weaveroom was there was an empty room and it was wide open. Every so often there was a window there, it was open. So the weavers couldn't do nothing. You know what I mean, work hard for nothing. So I spoke to another guy, I was fixing looms then. I said "Give me the right to close those windows…*

He [FAF, Jr.] came through and saw it. Ordered them all down, all the windows open again. So, you couldn't do nothing. It's unbelieveable, any millman, and I can prove it if they want to prove it, that went to work, them weavers had gone to work in the morning and worked with their sweaters on and coats and rubbers on. The people was willing to do their work and produce if the management will give them the necessary things to do with.[54]

Dickenson's commentary reads like a summary of the many hired consultants. His evident satisfaction in his work when it went well, and his obvious frustration with poor operating conditions, parallels the advice received for decades. Heat and humidity problems had long been noted, as had the unpleasant working conditions related to them. Poor management of the mill had appeared more and more often in the reports from this period, the time after the days when mill men, cotton experts, oversaw the cotton process. Dickenson's words give life to the abstraction of "Labor" of whom the consultants wrote and with whom management dealt as it made the determinations which would lead to the mill's closing.

c. Unionization

During the 1930s and 1940s management had to learn to deal with labor in new ways which conflicted with its paternalistic attitude. In the past, dealings generally took place in confrontations between the office and a small, skilled, loosely organized group. As late as 1935 the Treasurer described such a relationship:

R. What are the labor unions doing?

F. They will do what they can to reduce our profit. We have them out on a limb.

A. What is that -- "out on a limb"?.

F. Daigle, politician and real estate dealer and farmer and assessor for the Town of Dracut -- these fellows picked him up to be their leader. He started an organization called the Loomfixers Club, and he made trouble for us about two years ago. We sent a couple of smart young fellows there to see the people at their houses when he didn't know it, and he got tired of this and resigned. Then we had the man Alliades, a Greek lawyer. We got our loomfixers pretty well tamed. Jerry Sullivan came down. We got rid of him pretty well. I used to buy shoes of his Father. I showed him one mill. He said, "The trouble with these loomfixers is they are not doing work enough." He dropped out and then we had Alliades,

the Greek lawyer. They hired him in the Textile Workers Protective Association in Lowell, and pretty nearly everything in Lowell was in this. A young lady rang up Rogers [JRF], and said they wanted to send down a committee. Rogers said he couldn't do that until he know who it was. Every little while the girl rang up and asked, "What about that appointment" Rogers said, "We haven't got your committee yet." Some of them got disaffected. They said they were turned off and that we discriminated. They went up to headquarters, and were told that they would compel us to do so and so. We found that one fellow was laid off legitimately.

A. Was he a loomfixer

JRF. No, a weaver.

F. The policy of the Boott Mills now is to get the labor leaders out on a limb.[55]

This description applied to a situation of intimidation and control. Personalities were seen as the significant factors and paternalism prevailed.

The combination of unemployment and poverty, plus federal legislation, which marked the Depression era, led to the most active resistance to such attitudes Lowell had ever seen. Strikes hit the Boott often after 1930. One occurred in 1933 and another in 1934. In the second, the Loomfixers' Club, the Textile Workers' Protective Association, and the United Textile Workers represented different constituencies and conflicting points of view. The importance of the loomfixers to the operation enabled them to halt production despite the desire of some to return to work, thus delaying an end to the conflict. By October, however, the strike, which began in September, had ended and the mill stated it hired back more workers than it felt were needed in order to avoid charges of discrimination and bad feelings.[56]

In May of 1937 workers again struck the mill. Management refused their demand to recognize the CIO or to raise wages. It claimed that the Greeks employed violence to intimidate the French and sought an injunction. The State Board of Conciliation and Arbitration [SBCA] recommended that the strike be ended without discrimination against any employee, a Grievance Committee be established, and the Textile Workers Organization Committee [TWOC] be recognized as bargaining agent. This settlement held until October, when the doffers went out for two days. The Board got them to return on the basis that they would receive the work

load and wages to be agreed upon in the Fall River-New Bedford dispute.[57]

By the early 1940's a new figure entered the picture; he was seen in terms similar to those previously applied to union organizers at the Boott:

> *A neighboring cotton mill fell victim to an ambitious independent local Greek organizer, Louis Vergados. He first usurped the throne of the old Loomfixers' Club, fired its old-time officials, flattered the French making Valencourt President of the Loomfixers' Club, but eclipsed that Club by a greater new organization, patterned after the tricky shoe shop organizations (which found fertile ground in the fly-by-night shoe shops), and is call the "Lowell Textile Independent Union," Louis Vergados, Organizer.*

Flattery and trickery were seen as the keys to labor's moves. Only the people in charge, it seemed, were capable of interest in the mill's success, and labor was open to manipulation by the likes of Vergados, against the kind concern for it on the part of management.

Yet, despite the benevolence of the operators of the mill, Vergados' role grew. In fact, efforts on the part of management and the local paper to minimize his impact failed to deter the organization. The union distributed this appeal in 1941:

> *Attention! Workers of the Boott Mills; Over 65% of the workers of the Boott Mills have already joined The Lowell Textile Independent Union:*
>
> *1. The United States Government gives you the right to organize and become members of a UNION.*
>
> *2. The United States Government gives you the right to choose who you want to represent you.*
>
> *3. If you want higher rates; better conditions; one week vacation with pay; elimination of the stretch out or overload; and to stop discrimination by the supervisors, then join now.*
>
> *4. So why not join now with the LOWELL TEXTILE INDEPENDENT UNION and derive the benefits of a UNION contract that are being received by the workers on the Merrimack Mills; where the LOWELL TEXTILE INDEPENDENT UNION has a Union contract, representing all the workers of that mill.*

5. Our offices are located at 373 Moody St. and are open from 9:00 A.M. to 5:00 P.M.

JOIN NOW AND FULFILL YOUR AMERICAN RIGHT; Fraternally Yours, Louis Vergados, Organizer; LOWELL TEXTILE INDEPENDENT UNION.[58]

In 1940 the loom-fixers had struck again. This group, French with just four exceptions, went out despite lacking, in management's opinion, the support of the French community. The mill did not close and kept the looms running with the help of supervisors and weavers.[59] This dispute stemmed from a 1939 demand for a seven percent pay increase, spent many months in arbitration, and was only settled when in April, 1942, the state courts struck down the arbitration board's decision in the case. It was typical of the situation in that it revealed management's continuing belief that factors outside the mill (such as arbitration) could play a decisive role, and its willingness to spend large amounts of time and money in an effort to block organization. No interference with its operation of the mill would be tolerated.

After a series of rearrangements among labor representatives in order to avoid internecine conflict, the Textile Workers Union of America (TWUA), CIO, achieved recognition as representatives of the production and maintenance workers at the Boott Mills, despite the original insistence by management on avoiding recognition that a national agency had the support of the workers. By the end of the decade, after an eight month strike (Photograph 32), the union had achieved a closed shop, with all employees required to join the union. Excluded were executive officers, foremen, supervisors, office employees, watchmen, and guards.[60] A new status quo created new relationships, new dealings between the two contesting sides.

Many aspects of the long-standing relationship were affected. Supervisors had to be instructed to maintain neutrality with regard to all matters regarding the existence of the union, to guard against any indication, verbal or facial, of a desire to keep people out of the union. The rules had been changed by the union agreement. Within the mill, relationships between workers were also affected. Winder operators in 6-4, along with the spinners there, stopped work on March 20, 1945, rather than work with a non-union employee on the floor.[61] Similar eruptions took place consistently during the late forties.

Management, as always, sought expert opinion and help in confronting the union activities. Two New York consultants gave advice, one of whom warned that "this is not a simple Union matter but a social and political revolution." While wages rose during the

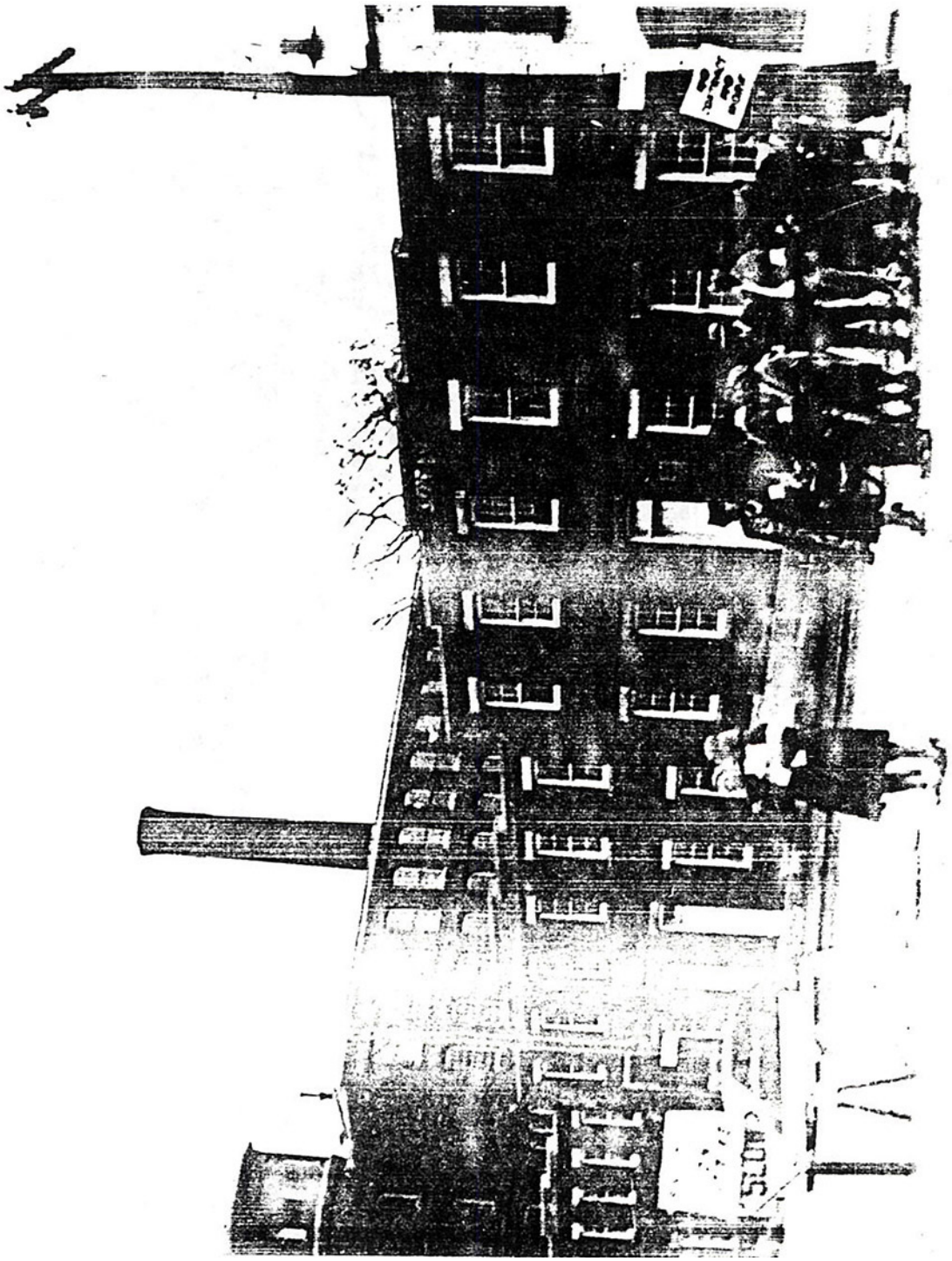


Photo 32. Striking workers picketing the Boott, c.1942.
Source: American Textile History Museum

period, management noted that increased production per worker continued to lower labor's share of production costs.[62] In other words, new efficiencies more than outweighed the cost of raises.

Management continued to see its relationship with the employees as a personal one, a paternalistic situation in which it could best determine and define the workers' needs and best interests. They failed to learn the lesson of the industrial relations people they had consulted since the teens, that workers had interests which had to be considered and that mechanisms existed to facilitate the exchange, and that the exchanges were not personal, as they were felt to be by the management, or even revolutionary, but simply an effort to redress the imbalance of power that had been part of the Lowell situation for over one hundred years.

At the end of the 1949- 50 strike, an effort was made to unseat the management. Arguing loyalty, responsibility for successes, and low management salaries, as well as comparatively high investment in the firm, the Flathers held on.[63]

d. Conclusion

Speaking to the stockholders at the Annual Meeting in February, 1951, the Treasurer announced that the mill had done twice as well as the year before, with income after taxes and depreciation of $167,870.52. He defended the paying of an extra, fifth, dividend in 1950.[64] All these numbers are suspect, as indicated in letters from the younger Flathers to the employees in 1953 which stated that the mill lost money in 1951 and 1952. Another document pointed out that the mill also owned one-half of the Lowell Industrial Development Company, consisting of the Massachusetts Mills, the Bigelow- Hartford Carpet Company power plant, and the mill-powers water rights associated with each, along with 622 share of Locks and Canals and proportionate mill powers, none of which appeared on their balance sheet.[65] These aspects of the mill's situation, which reflected part of the success achieved by the plant as a whole, particularly the workers, did not appear during the negotiations of 1952-54 in which the Office unsuccessfully sought greatly increased workloads without pay increases. In retrospect it seems clear that these negotiations were doomed from the start, based as they were on the union's desire to protect the workers and management's intent to extract significantly more production from the mill despite its refusal to invest in the equipment needed to generate maximum production from minimum labor.

The result:

Mr. John Smith

45 Smith Street

Lowell, Mass.

Dear Mr. Smith:

We regret to inform you that your department has been permanently discontinued with the result that your job here is no longer available. We enclose, accordingly, a Suspension-Discharge Notice to this effect.

We are sorry that it has not proven possible to save your job, but as there is no longer any hope of doing so, we feel that it is only fair to so inform you, in order that you may secure other employment. We hope you will be successful in doing so.

Very truly yours,

BOOTT MILLS.

Personnel Department[66]

Thus, not with a bang but a whimper, ended the story of the Boott Cotton Mills-Boott Mills as producers of textiles.

It is important to note that not only were wage increases outweighed by increased efficiency, but also that the decision to terminate reinvestment was made in the twenties and reasserted in the early thirties. Both factors argued against the common belief that unionization led to the flight of textile industry from New England to the South. One notes the continuing pattern of paternalistic relations, the resentment on the part of management of any labor voice, the lack of upgraded machinery or plant, and the generally poor operation of the mill, and one realizes that these factors played an obvious role in its demise.

Throughout the period 1931- 1954, the mill lurched along, heavily impacted by outside forces. Floods, hurricanes, wars, and

government legislation alike impacted the operation, and in no case did the mill come up with innovative or original responses. Operating conditions remained poor, became worse in every aspect: machinery, plant, working conditions, process management. Both labor and management resented the other and the difficulties it presented to their idea of how the mill should have been run. Since the decision to close had, in effect, been made years earlier, all the action of the time was an exercise in futility, a self-fulfilling prophecy of doom. An era that began in the poverty of the Depression had no hope of rising to escape the chains of its own past, the decision not to reinvest, the history of plant deterioration, acrimonious labor-management relations, or poor cotton processing. Crushed beneath such a series of burdens, the Boott Mills foundered, strewing blame in its wake, accusing unionization, reds, and government officials, but never recognizing the true culprit, its own historic course.

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2. DR, 1929.

3. DR, 4/1937.

4. Paul F. McGouldrick, New England Textiles in the Nineteenth Century, p. 210.

5. DR, 5/1932.

6. DR for 3/1939.

7. DR for 2 and 3/1936.

8. DR for 8/1938.

9. JRF, 9/14/1944, p. 147.

10. DR for 3/1942, 8/1942; JRF, pp. 210- 211.

11. National Industrial Conference Board, "Previews," 1174 (4/1 2/1952).

12. Richard 0. Boyer and Herbert M. Morais, Labor's Untold Story, (New York: United Electrical, Radio, and Machine Wor ker s of America), pp. 366-367.

13. DR, 8/1939; 9/1939; 2/1940; 7/1940; 1/1949; 7/ 1949.

14. DR, 1/1942.

15. DR, 4/ 1939.

16. "Boott Mills vs. City of Lowell," 3/ 3/ 1945, FC, p. 1.

17. "Boott Mills' Buildings Are Not Suitable for Post-War Competition in Cotton Manufacturing Nor Present Day Competition Either," FC, 12/15/1944.

18. DR for 1942.

19. John Rogers Flather's Notes, 1943-1 950, esp. 10/13/1950.

20. George Sweet Gibb, The Saco-Lowell Shops: Textile Machinery Building in New England, 1813-1949 (Cambridge: Harvard University Press, 1950), pp. 565, 803N.

21. F. A. Estes and B.F. Pierson, Insurance Appraisal of the Boott Mills, Lowell, Massachusetts, FC (5/27/1933), pp. 24- 27.

22. DR, 1936- 1940.

23. DR, 11/1937.

24. DR, 1940.

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26. Ralph E. Loper Co., Report to Boott Mills, FC (11/1944), pp. 1- 7.

27. Ibid., 12/14/1944, p. lA; 1/17/1945, p. 1.

28. JRF, 7/10/1947, p. 494.

29. DR, Supplemental Meeting, 7/16/1948, p. 2.

30. DR for 11/1949.

31. JRF, 8/22/1950, p. 941.

32. Machinery and Equipment Purchased since January 1, 1939, DR, March, 1950, FC.; 29. BM, Machinery List, 12/1954, FC.

33. DR for 12/1944.

34. JRF, 5/ 18/1943, p. 52.

35. Survey and Recommendations on Employee Training in the Plant of the BM, Lowell, Mass., 8/1/1945, pp. 1- 3, 8.

36. Ibid., pp. 9- 10.

37. Ibid., pp. 11-13.

38. Albert Raimond and Associates, Inc., Job Specifications, 4/17/1945, FC.

39. Raimond, Spinner Job Specifications; all the job specifications which follow are based on this report.

40. Account from 3/27/1943, FC.

41. Wherever not otherwise noted data for this discussion comes from JRF, 12/1945-3/1950.

42. Pay Schedule Adopted by Fall River and New Bedford Textile Councils, 7/31/1933, FC.

43. 40-Hour Base Rates of Pay, 1/ 20/1938.

44. DR for 5/1940.

45. DR for 3/1946.

46. DR, Supplement, 12/1949.

47. Straight Time Hourly Earnings for Selected Occupations, 3/1952, FC.

48. DR for 8/1941.

49. e.g., JRF, 10/19,21/1943.

50. DR for 11/1945.

51. JRF, 12/28/1949.

52. Ibid., 1/24/1947.

53. Harry Dickenson, interviewed by Judith K. Dunning, 9/17/1980, p.8, Lowell National Historic Park.

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56. DR for 9- 11/1934.

57. DR for 5/1937: DR for 6/1937; DR, 11/2/1937.

58. DR, 10/1941.

59. DR for 11/1940.

60. DR for 9/1942; 3/1/1950.

61. JRF, 7/18/1944; 3/20/1945.

62. DR for 9/1945; DR, e.g. for 10/1948.

63. Untitled, 3/1/1950.

64. DR, 2/13/1951.

65. Increasing Income and Decreasing Expenditures for the Purpose of Reducing Losses Can Hardly Be a Quick Job, FC.

66. BM to John Smith, 4/16/1954.

XI. PHYSICAL HISTORY 1931- 1955

A. The Counting House

The interior of the Counting House was replanned in 1936.[1] The plans (Figure 22) show the first floor as having an entry in the northwest corner, with stairs leading off it to the second floor along the west end wall. A door was let into the north bay of the west wall, the rest of the wall at this level was blind. The first floor entrance served a large "employment office," three bays wide by almost two-thirds of the depth of the building. To the canal side of this office was a payroll office and a hall giving access to men's toilets in the extreme southwest corner and a large closet under the stairs. A first-aid room was planned east of the payroll office, along the canal wall, with another first-aid room directly east of the first. This east room had a toilet room appended to it at the canal wall. The east end of the employment office was occupied by an earlier "safe" or fireproof vault (in the center) and a hall leading to a large coat room. Two stock rooms followed to the east, the first four bays wide, the second narrower at two bays--both ran the full depth of the Counting House, from the canal wall to the yard. A third stock room was located in what was the original blacksmith shop of Mill #6, with a wide ramp leading to it from the Counting House side.

The upper floor as shown in the 1936 drawing was entered from the foot bridge, with a curved stair leading up to a landing that paralleled the stair to the lower floor. Three waiting rooms were arranged along the canal (south) wall, fronted by a three bay long hall that opened to the landing. This narrow passage opened at the east end to another hall that ran alongside "Mr. Flather Sr.'s " office, which extended two bays along the canal wall and had a mens' toilet at the east end. A second large office was located east of the toilet. The rest of the first floor was a large open-plan office that ran along the entire yard (north) wall. The second floor area at the west end of Mill #6, the original Paint Room, was used as an "Office-Stockroom" and was reached by an "L"-shaped stair and landing tucked into the northeast corner of the Counting House, with a door cut into the center of this wall.

No record of costs for the 1936 proposal has been found, and since a second plan (Figure 23) for virtually the same work was prepared in 1937 it is likely that the 1936 plan was not undertaken.[2] The 1937 plan relates favorably with existing conditions at the Counting House, and cost accounts are available. The 1937 Plan, prepared in July of that year, has the same entrance at the lower level as shown in the 1936 version, but the pre-1936 door at the north bay of the west end wall was now a window, and a second window was added south of it.

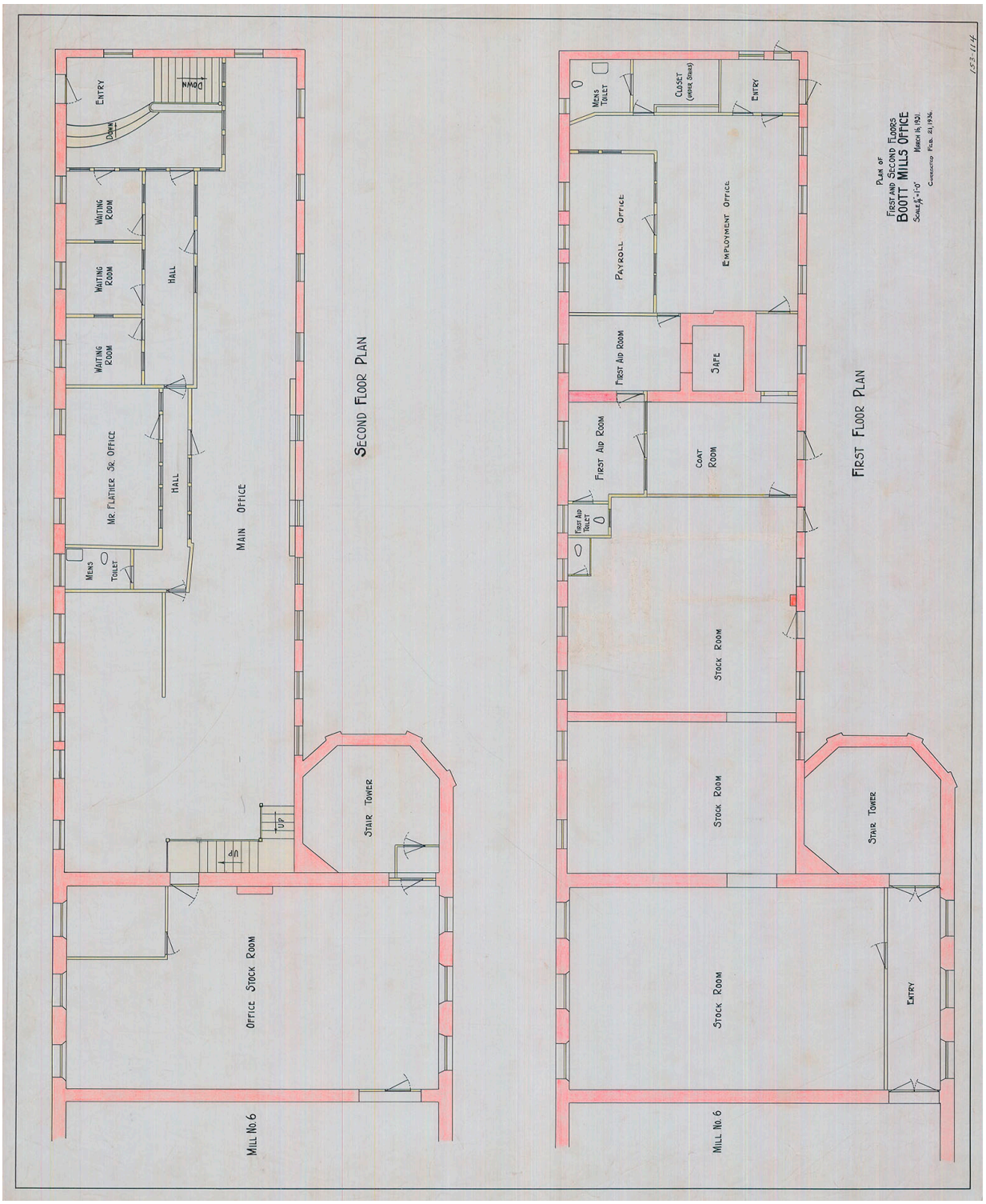


Figure 22. Plan of First and Second Floors, Boott Mills Office, March 1931, corrected 1936.
Source: LNHP, L&C, Plan Number 153-114

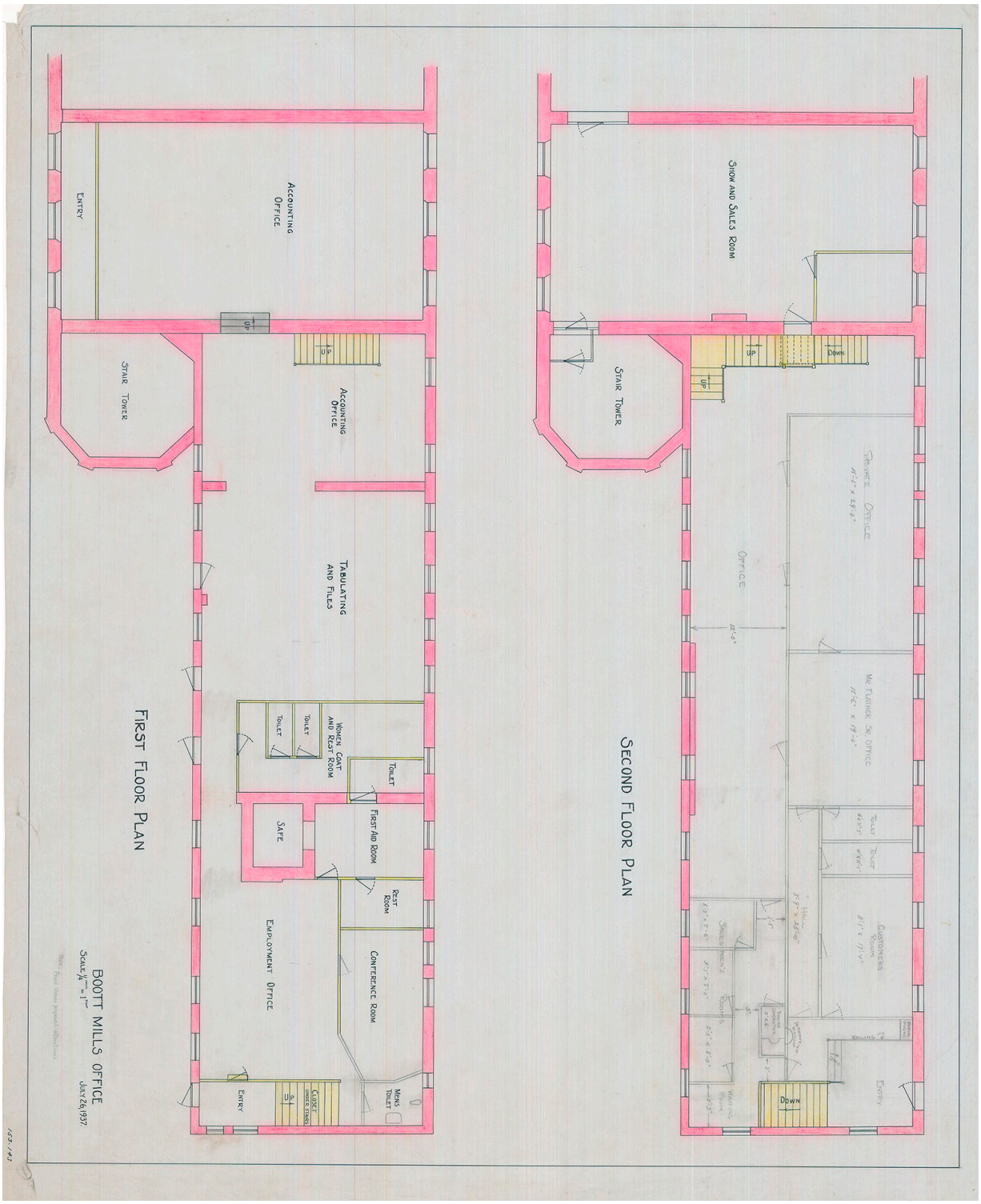


Figure 23. Plan of First and Second Floors, Boott Mills Office, July 26, 1937.
Source: LNHP, L&C, Plan Number 153-143

The 1937 plan is virtually the same as that proposed in 1936 for the area west of the first-aid room and the vault. However, the payroll office at the canal wall was now a conference room with a large rest room in the east part. The space identified in 1936 as a coat room and a second first-aid room was now given over to a large coat, rest, and toilet room for women. The two stock rooms shown within the Counting House in 1936 were now "tabulating, files and accounting offices." The stock room in the east part of the first floor, served by the same ramp, was another "accounting office."

The second floor of the 1937 proposal retained the 1936 entrance plan except that the curved stair to the landing was replaced with a stair perpendicular to the end wall. The three waiting rooms along the west part of the canal wall were "customer rooms" and two toilets, with the narrow hall remaining. The extension of the hall at the east, however, was removed, creating a larger office, designed as "Mr. Flather Jr."[s] office, with a second "private" office five bays long cut out of the large area at the east part at the canal wall. The large, open-plan office that occupied the entire yard side of the building in the 1936 plan was subdivided, with "three salesman's offices" in the west part and an "L"-shaped long office in the remaining space.

The stair (Figure 24) to the office in the second floor of Mill #6 was double loaded, with a second stair at the end wall; the same door opened into a stock room as shown in the 1936 plan. With the exception of the windor/door changes in the west end wall, there were no alterations suggested for the exterior in either the 1936 or the 1937 plans. Costs for the 1937 improvements were $2076.65.[3]

The only obvious changes to the exterior of the Counting House are unfortunately undated. The fourth bay at the first floor from the east at the yard side is shown as a window in the 1936 plan and elevation (it was a door before this time) and the fifth bay, shown as a door in 1936 and 1937 is now a window. Conversely, the fourth bay from the west end, now a door, was a window in 1936-37. Also, the third window from the east end at the second floor, and the third window in the first floor from the west end of the canal wall were inserted sometime between 1890 (Photo 20) and 1936. Sash has also been altered, most of which appears to predate an elevation drawn in 1936 (Figure 25).[4] 1/1 sash was installed in the first three windows from the east end, second floor, yard side, and 2/2 in the next window. A small window in the fifth bay from the east end of the first floor, canal side, had been changed from 6/6 in 1936 to 1/1, probably in the mid-1940s. Also, all of the sash in the second floor of the canal elevation was 1/1, again probably from the mid-1940 period (based on the condition of the woodwork).

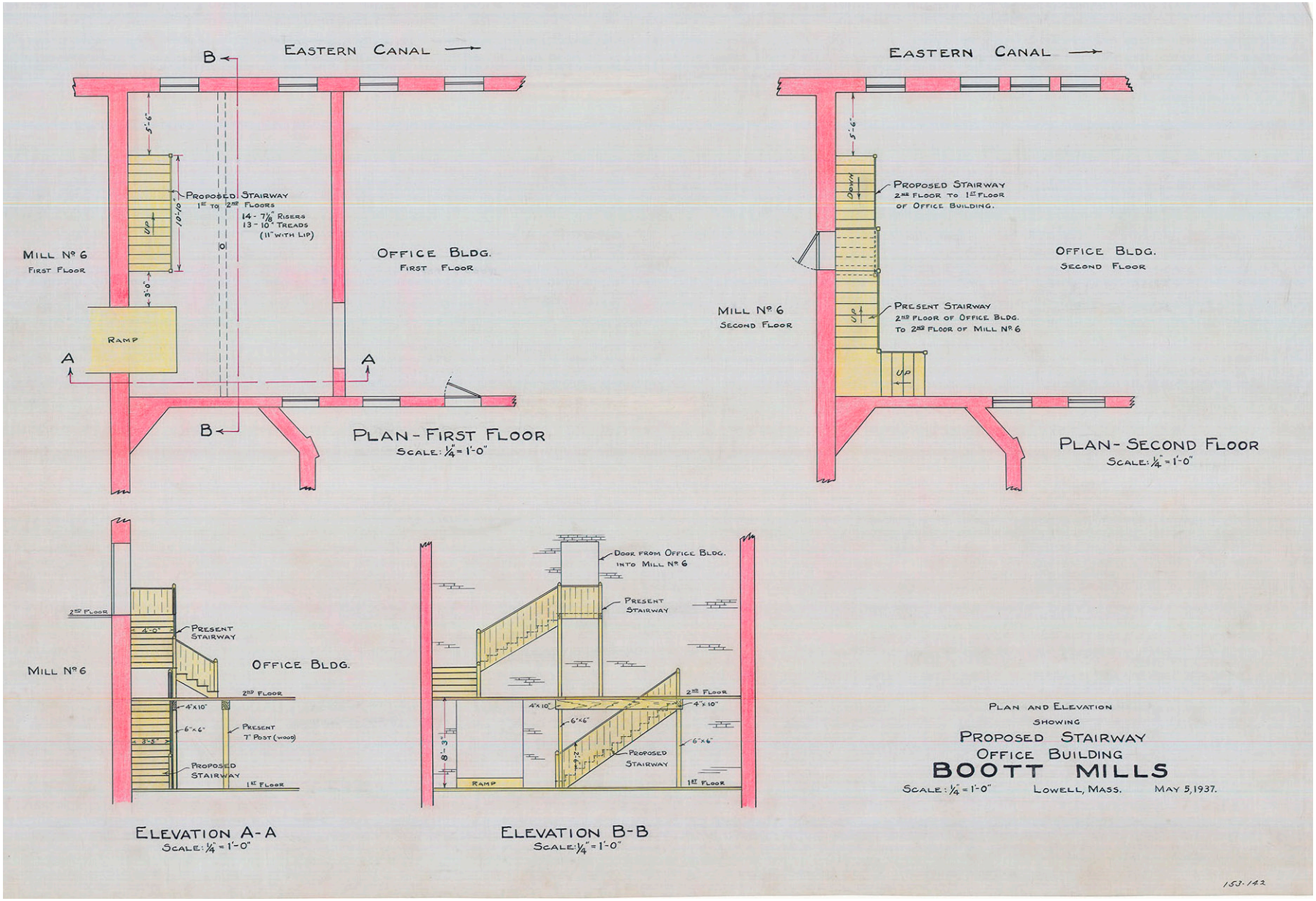


Figure 24. Proposed Stairway, Office Building, Boott Mills, May 1937.
Source: LNHP, L&C, Plan Number 153-142

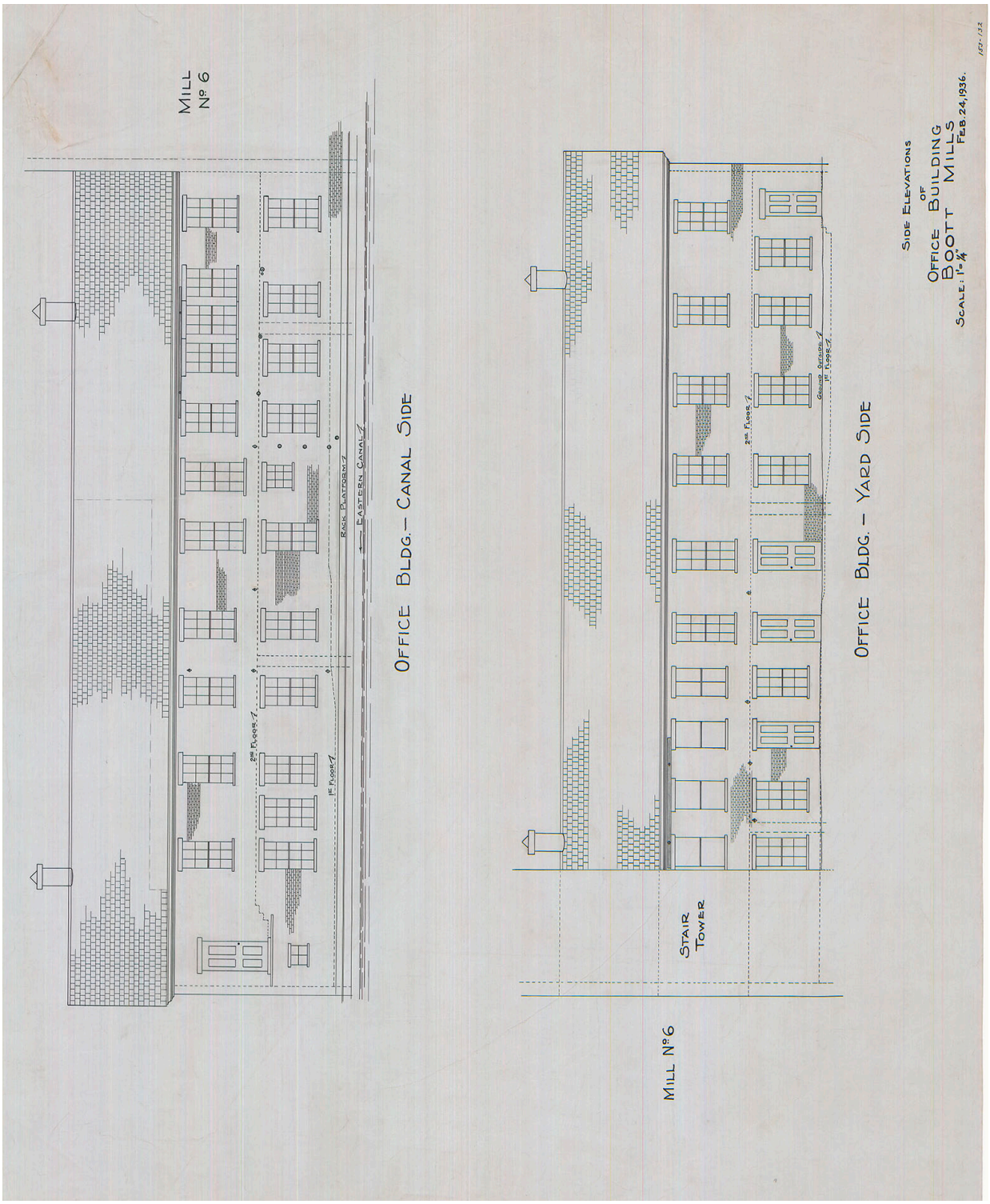


Figure 25. Side Elevations of Office Building, Boott Mills, Feb. 1936.
Source: LNHP, L&C, Plan Number 153-132

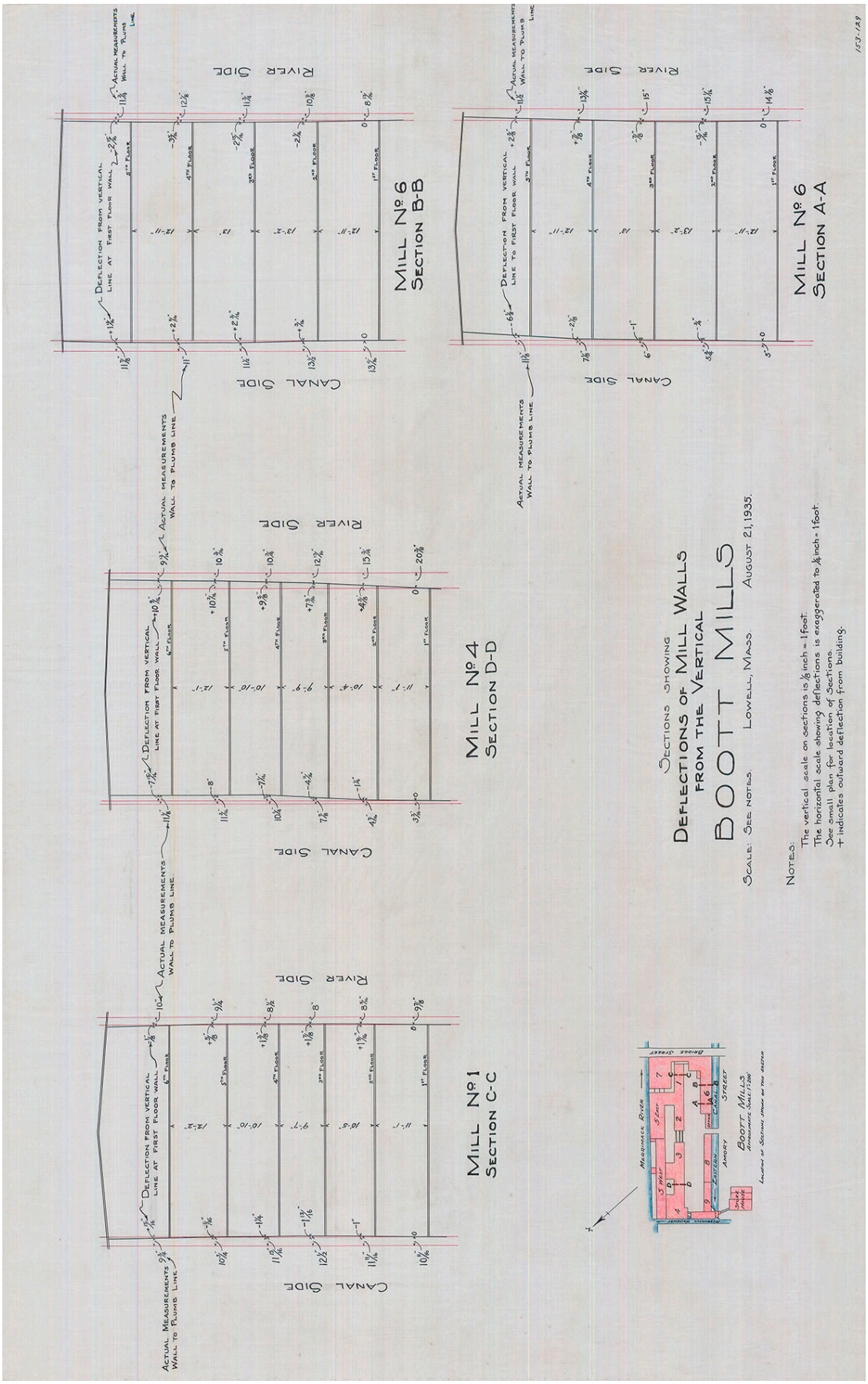


Figure 26. Deflection in walls of Mill Number 6, drawing dated August 21, 1935.
Source: LNHP, L&C, Plan Number 153-129

As mentioned in the previous chapter, four skylights had been installed at the eaves of the south roof, near Mill No. 6. These were removed in 1942 at a cost of $38.24.[5] Also, walls and floors were reinforced (especially at the canal wall, where tie rods were added) in 1944.[6] Other changes that probably occurred during the 193 1-1955 period include the addition of simple wood hoods at the four doors along the yard side, and the insertion of steel lintels at the same wall (those in the canal wall predate 1936).

B. Mill #6

1. Exterior

a. General Conditions

The appearance of Mill #6 was not materially changed during the period 1931-1955, the last year of operation by Boott Mills. However, an important study of the structural soundness of the exterior walls was conducted at Mills 1 and 6 by Charles T. Main in 1935 (Appendix Q). The report was concerned with vibration, especially at the second floor and recommended that they monitor the "bulges in the #6 mill wall on the canal side." This was done and a drawing (Figure 26) was prepared to show the results of the study.[7] Dated August 21, 1935 and titled "Deflections of Mill Walls from the Vertical" it shows Mill No. 6 out-of-line towards the south by 6 1/8" at the north facade, fifth floor. With the possible exception of the tightening of tie rods and the relocation of some machinery (replacement looms put in in 1949 had felt pads at the floor) little attempt was apparently made to correct the problems caused by the vibration.[8] However, in 1950, in reporting what was perhaps a hasty move, the treasurer announced the removal of the sixth floors of the towers at the mill: " No. 6 Mill Tower's parapet removed one story above the roof to prevent vibration and sway."9

This act had been recommended as early as 1930 by Locks and Canals in a letter to Frederick Flather, Jr.:

> *With regard to the upper story of the tower of No. 6 mill, we believe that this can be made safe and the vibration reduced by either one of two ways. The most economical way would be to leave the tower as it is by securely tieing it in to the corner of the mill with tie rods, and also nut in either three or four tie rods from one side to the other of the tower at the point where the floor was taken out. We estimate the cost of doing this at about $200.*
>
> *The other method would be to take down the upper story of the tower, with a new roof put on a little above the height of the roof of*

> *the mill. Even with the top story taken off we still ought to tie the upper part of the tower into the mill as some cracks have developed. It is rather difficult to closely estimate the cost of taking off the top story putting in the tie rods, but think it would be about $500.*[10]

At that time the towers were retained and tie rods installed and the towers stood for another 30 years.* A photo in the collection of the Lowell Museum made in October, 1942 (Photograph 33) shows the towers as built.

The 1945 Plant Condition Report also reiterated earlier recommendations that the mill structures in their entirety be demolished:

> *Due to the narrow buildings, small spans and bays, differences in floor levels, small rooms and other features, there is considerable waste space in the machinery arrangement compared to what might be done in a modern mill. Little can be done in the way of saving this waste space in that portion of the existing buildings which will continue in use, as it is not going to be feasible to remove side walls or existing columns to any material extent until the existing buildings are torn down and replaced.*[11]

b. Foundation

Prompted by structural damage that occurred to the first floor and foundation as a result of a hurricane in 1938, Flather prepared an in-house memo on September 22 of that year detailing the need to "re-examine the underpinning of our foundation walls inside and out, under floors and around the base of columns... and point up wherever any cracks show, and close all apertures."[12]

A number of short steel I-beams were inserted as columns and braces under the first floor. Based on visual inspection they are likely a result of this memo, but there is no documentation or cost records to substantiate the date of installation.

c. Roof and Exterior Walls

The 1945 Plant Condition Report previously cited mentioned that cornices were repaired, painted, and new flashings installed because of hurricane damage, claiming that they had rotted because of moisture over many years. The same report stated "Tie rods

* A report prepared for the Appellate Court in February 1950, mentioned that the flag pole had been removed from No. 6 tower, a further indication that the sixth floors of the stair towers were in existence at that time. (Appellate Tax Court Record, 1950 [F.C.]).



Photo 33. West stair tower at Boott Mill Number 6, October 1942. Note top floor in place, and skylights and vents in roof of Counting House in the foreground
Source: LNHP, Museum Collections, Lowe 15655

installed on Engineers recommendation in office, #3 mill, #4 mill, #5 mill, #6 mill, #1 mill, most towers."[13]

2. Interior

a. Floors

The June 1935 memo written by James R. Flather mentions "a new section of flooring" in the second floor, indicative of assumedly continuous repairs to the original plank flooring. The most important of these repairs and alterations were caused by the construction of a conveyor system in 1948. On June 21st of that year James R. Flather wrote to Mr. Hawks of Locks and Canals concerning the employment of A.W.G. (not further identified), "the bulk of his time is being spent on the conveyor, to get it functioning."[14]

No exact location has been determined for the conveyor, but architectural analysis suggests that it was located at the north end of the east section of the mill. Alterations to the floor, floor beams, and ceiling at the fourth bay south of the north wall, (second floor) indicate the possibility of such a conveyor in a location convenient to the three bridges that connect mill #6 to #7 at the #7 connector. 6" x 8" timbers were installed with steel angle hangers at this location, with the bottom edge of the northern beam chamfered 9" at the horizontal, 6" at the vertical, and the top edge of the southern beam cut 3" at the top. This would suggest a four foot wide conveyor running at an angle through the second floor to the first, where the ceiling is repaired in this location, and up to the floors above. The third floor is patched at the same area, as has the ceiling at the fourth, but the floor here has been altered at a later date eliminating the potential for discovering seams in that floor. Two other beams, both one bay long, have been inserted at the north wall, from the wall to the first timber beam supporting the floor. 12" x 15" in section, they are supported by cast iron clips at the floor beam. There are patches in the second floor and ceiling and in the third floor at this area. This was probably, based on its size, a trap door serving the same purpose as the conveyor until that apparatus was installed.

b. Columns

The Flather memo concerning the damages experienced during the 1938 hurricane also called for a plan to anchor all roofs at Boott Mills. Again, there is no documentary evidence to date accurately the work, but considerable bracing was applied at sometime during this period at the roof beams and columns in both the east and west sections of the fifth floor. The repairs are especially noticeable at the first eight column/beam connections in the west part, where

additional flitch plates and shims have been added. The Plant Condition Report of 1945 mentions that beams had been plated, floors stiffened, indicating that the work may have been completed c. 1938-40.

c. Walls and Interior Doors

Plans drawn in 1936 and 1937 for alterations to the Counting House (see above), indicated that the original blacksmith shop at the first floor of the west section of Mill #6, and the paint shop, at the second floor, were used as offices. To facilitate communication between these areas and the Counting House, a ramped entrance was built at the lower level of #6 and a full door opening cut into the end wall of the mill at the second floor, served by a stair at the Counting House side. The 1937 plan also showed a vestibule arrangement at the interior entrance to the first floor at the west tower; the only reference to this configuration found. It is not known if the vestibule had been in existence previous to when the plans for the Counting House were drafted in 1937, or if it was ever constructed and if it was, when it was removed.

The Treasurer's Report for September 1935 recorded "widening doorway, fourth floor. $88.17" with an additional $53.86 spent in June, 1936. [15] This refers to the widening of an opening at the two doors that had been previously cut into the north wall of the east section, from the original windows, to communicate with the bridges at the #7 connector. A single door replaced the two and was in use until 1955. Also, a safety gate was added to the 1917 elevator in 1936.

d. Coal Pocket

The Plant Condition Report for January 5, 1945 noted a change at the entrance to the coal pocket. The trestle and track was filled in to facilitate oil truck deliveries. This would date the installation of the steel diamond plate in the track area at the 1944-45 period. (At the time the 1927 rolling door was probably replaced, as the existing door is certainly not fifty- seven years old.)

e. Interior of the Stair Towers

A supplement to the Treasurer's Report for November 1949 reported "we are reinforcing with channel irons (the spiral stairs in the towers) due to sagging. This is a safety and maintenance measure to extend use fullness indefinitely."[16] According to the 1950 Plant Condition Report other minor work had been accomplished in the stair towers, including "cement floors laid under all stairs."[17]

f. Painting

While the Plant Condition Report of 1945 states "most of the mills painted inside and out in past ten years," a report prepared by the Boott in reference to an Appellate Court Tax case in February of that year says "painting done in 1943 already dull."[18] There is no evidence that the interior was painted after 1943 until after Mill #6 was sold in 1955.

g. Mechanical Systems

(1) Heating

Based on documentary evidence, it appears that only minor improvements were made to the heating system in this period. Three Beacon Unit Heaters were installed in 1953.[19] Temperature regulators were added in 1938 at a cost of $420.13.[20]

(2) Sanitary Facilities

Sanitary facilities were not improved either during this period, as evidenced in a report made in 1944, "Boott toilets are notably unattractive and depressing, and should be rebuilt over, enlarged and refitted. To do this would require extending the toilet rooms into the manufacturing area, because all rooms are so narrow."[21] Despite this recommendation, the 1955 Plant Conditions Report recorded only six female toilets (two at the fourth floor in the east section, one at each of the other floors), and six male toilets (two at the third floor of the west section, one at the other floors).[22]

(3) Lighting

Lighting remained an issue throughout this period but gradual improvements did occur as witnessed by the 1945 Plant Condition Report, "some rooms changed to Cooper-Hewitt, some rooms changed to flourescent," followed by comments in the 1949 Treasurer's Report, "Boott Mills continued to install them (florescent lights) regularly, monthly." The 1949 report explained the rationale for the change-over, "flourescents have two advantages--they give us better light with less current, which is a quality measure, and they are not stolen as are incandescent bulbs."[23] While the 1950 Treasurer's Report stated that they had installed "about 1000 new flourescent lights and fixtures, thus saving current, improving lighting. Cost[ing] about $15,000," Boott Mill Mill #6 still labored under a mixture of light sources as late as 1955, when the Plant Condition Report for that year mentioned "1st floor, mercury and flourescent; 2nd through 4th, flourescent; 5th, drop lights.''

Boott Mills was sold on December 10, 1954, with the result that a number of alterations were made to Mill No. 6 throughout the first half of 1955 to satisfy conditions of that and subsequent sales. These changes are more appropriately discussed in chapter XII, dealing with the period after the Boott ceased its operations as a cotton mill.

3. Facades of Mills #1 and 2

Major changes to the first floors of Mills No. 1 and 2 and the Connector occurred in the 1940s, many of them related to the paving of the yard (Photograph 34). Prior to 1944 the courtyard was still primarily a pedestrian space. In that year the: "Main entrance [was] resurfaced, Entire upper yard resurfaced, Road to Storehouse: resurfaced Too narrow for highway trucks. Too steep. Studded with hydrants & gate valves."[24]

A supplement to the November 1949 Treasurer's Report clarified the reason for the repaving:

> *Whereas formerly goods went out in the grey in bales by railroad from our storehouses, they now go entirely as finished goods in corrugated containers from the mill yard. Many huge trucks use our main entrance bridge daily. We have resurfaced the bridge with Koppers Co. lumber impregnated with preservatives and laid a new asphalt roadway.*[25]

While no records for the actual work have been located, it is assumed that the truck docks and loading doors, except for one at the east of the tower of No. 1 mill (1955) were put in between 1945 and 1950--they were all in place by 1969.[26] Alterations to the first and part of the second floor of the connector between these two mills, however, can be documented. Three 33" Leffels turbines were installed here in 1947, causing the removal of the entire center section of the south facade (the turbines were inserted into the building from the courtyard). All original windows were replaced with the present steel casement industrial sash.

By 1949 most of the changes to the facades of Mills #1 and 2 that took place during this period were completed.

> *Our yards are in good shape, kept clean and provide an attractive appearance. We are gradually filling a banking, cementing the lower floor windows, thus improving the room inside, and the yard outside... We removed the unsightly size room penthouse above the sixth floor of Buildings Nos. 1 and 2 connection... this summer we removed old tar and gravel roof covering of No. 2 Mill and connection, and applied latest type Johns-Manville bonded asphalt covering.*[27]



Photo 34. "Courtyard at Mills No. 1 and 2", 1957. Note "Recreation and Employee's Room" or "Personnel House" at right, constructed in 1950
Source: UML, CLH, LHS, LM Flather Collection

4. The Courtyard

Changes to the courtyard area during 1931-1955, other than the repaving mentioned above, included roofing over the bridges that connected Mills No. 1 and 7 with No. 6, "primarily done to strengthen structures,"[28] planting "six trees and grass plot,"[29] and the addition of new lighting: "Outside Lighting-we have installed ten flood lights-a safety measure-helpful to employees at change of shift in Winter weather."[30]

Also, the hydrants were removed, a "dozen metal park benches for the convenience of emloyes (sic) during lunch and change of shifts"[31] were installed, and a "Recreation and Employees Room"[32] was constructed just north of the Counting House (Photograph 34). This "room" was described in the Extracts from the Plant Physical Condition Report for 1950:[33] "PERSONNEL HOUSE in the Yard-One-room Hodgson Portable House, concrete asbestos board, automatic sprinklers, unit heaters, fluorescent lights, settees. It is used for waiting between shifts, for lunch recreation and smoking. Cost about $7,000."[34]

The building permit describes the building further as: "24x42x15', gable roof, frame on concrete, rear of Office Building, $3400."[35]

ENDNOTES

1. Shelf 153, drawing 114, Locks and Canals file (Boott Mills Office).

2. Shelf 153, drawing 131.

3. Treasurer' s Report to the Directors of Boott Mills (hereafter DR), September 1937.

4. Shelf 153, drawing 132.

5. DR 1942 (FC).

6. Plant Condit ion Report, January 5, 1945 (FC).

7. Shelf 153, drawing 129.

8. Memo, James R. Flather, August 22, 1950, found in File 1009, Locks and Canals (Boott Mills Office).

9. DR, October 1950 (FC).

10. Letter, Locks and Canals to Boott Mills, File 1009 (Boott Mills Office).

11. Plant Condition Report, January 5, 1945 (FC).

12. Memo, Flood and Wind, Frederick Flather, Jr., September 22, 1938 (FC).

13. Plant Condition Report, January 5, 1945 (FC).

14. Letter, JRF to "Mr. Hawks", June 21, 1948 (FC).

15. DR, June 1937 (FC).

16. DR, Supplement to November 1949 (FC).

17. Plant Condition Report, 1950 (FC).

18. Appellate Tax Court Records, February 17, 1945 (FC).

19. DR, 1953 (FC).

20. DR, March 1938 (FC).

21. Memo, ''Boott Mills Buildings are not Suitable for Post War Competition in Cotton Manufacturing", December 15, 1944 (FC).

22. Plant Condition Report, 1955.

23. Ibid.

24. Plant Condition Report, January 5, 1945 (FC).

25. DR, Supplement to November 1949 (FC).

26. Interview with Melvin Lezberg, Proprietors of the Locks and Canals, Russell Wright, February 17, 1984.

27. DR, supplement to November 1949.

28. Ibid.

29. Ibid.

30. Ibid.

31. Ibid.

32. City of Lowell building permit 34, February 9, 1950.

33. Flather Collection.

34. Plant Condition Report for 1950, p. 1 (FC).

35. Cit y of Lowell building permit 34, February 9, 1950.

XII. PHYSICAL HISTORY 1956 TO DATE

Boott Mills was sold on December 10, 1954 to the Overseas Discount Corporation, (ODC) New York. ODC sold the complex to the Massachusetts Mohair Plush Company on June 15, 1955. An article in the April 6, 1955 Lowell Sun quotes Richard N. Stone, Vice President of the Mohair Company: "A group closely associated with the ownership of Massachusetts Mohair have arranged to purchase the entire stock of Boott."

This group, incorporated under the name Northern Textiles of Lowell, sold Mill #6 to the Lowell Realty Corporation for $65,630. The transfer of ownership occurred on July 22, 1955. This sale prompted a number of alterations and changes to Mill #6, the south facade of #l, and 2, the interior of the Counting House, and the courtyard. In 1972 the Capehart Corporation purchased the property, which was then, in 1979 sold to the Wang Corporation.

A. The Counting House

The interior of the Counting House was considerably altered starting in May, 1960 when a permit was issued for "new partitions for office and a door"[1] at a cost of $5000. This corresponds to the time that the Counting House was first occupied as offices by Locks and Canals. The entire second (main) floor was rearranged, especially at the east end where a series of offices, rest rooms and a conference room are now located. The stair to the second floor of Mill No. 6 remained in place but the door was blocked off. The first floor has seen the removal of the employment office and rooms along the canal wall to be partially replaced by a concrete block fireproof vault. However, no changes were made to the exterior of the Counting House at this time.

B. Mill #6

1. General Repairs

A memo prepared by James R. Flather outlines work to be accomplished in preparation of turning Mill #6 over to its new owners. 0f particular interest was work items 6 though 10, reproduced below:

6. Close conveyor holes in No. 6 floors.
   - 2nd floor - 2 holes
   - 3rd floor - 2 holes
   - 4th floor - 1 hole
   - 5th floor - 1 hole

7. Remove all machinery.

1st floor completed	
2nd floor completed	
3rd floor completed	
4th floor completed	Close to July 15
5th floor completed	

8. Remove humidifier heads and piping.
9. Remove overhead spinning cleaners.
10. Close doorways between No. 6 Mill and adjoining Boott buildings.[2]

Item 6, "close conveyor holes in No. 6 floors" was completed July 14, as noted on a marked-up copy of the June 29th memo that records Flather's conversations with Stone (who by this time has been named President of Northern Textiles). All machinery (item 7) had been removed by July 15. Items 8 and 9, the removal of the humidifiers and the overhead spinning cleaners was completed on July 14. Closing of the doorways between #6 and "adjoining Boott Buildings" was put off, "postponement agreed to", but was accomplished by August or September of 1955.

Previous to this work, the conveyor system, humidity lines and electric motors had been removed during the week of April 13, 1955.[3] Windows at the first floor of the north wall of the east section were bricked in on June 13, 1955 in anticipation of three new transformers that were to have been installed in the yard between Mills No. 1 and 6 (see Courtyard, below).[4] While undocumented, it is assumed that the door in the north wall of the east tower, originally a window, was also blocked below the sill line at this time. (Returned to a window, it has a pre-cast concrete still typical of other work carried out during this period.) The final item, (No. 4), "steam line entrance to No. 6 mill" is noted as "completed portion inside mill No. 6 July 12."[5] The installation of the transformers caused minor additions to the interior of Mill No. 6; a vertical electrical conduit was located in the east stair tower opposite the bricked-in hoist opening. The conduit runs through the first floor ceiling to the second floor, where it is connected to a large breaker panel. Also, two 5" diameter steel conduits were installed at the 2nd and 3rd floors between the third and fourth bays at the north wall, directly above the transformers.

2. Supervisor's Office

One other substantiative alteration to the interior, other than considerable floor patching, was the construction of a "supervisor's office" at the center of the north wall of the west section, 13' 6" x 16' in plan. As described in March 1984, "this office was frame with large windows, set into the floor, heated by steam pirated from the Locks and Canals line that heated the office (Counting House). It was put there by Capehart/Wakefield in the late 1950's, was there when we came to work here in 1970. We took it down around 1982."[6]

3. Doors

As called for in Flather's memo of June 29, 1955, all doorways connecting Mill #6 with other Boott buildings were closed off in the summer of that year. This included the doors (originally windows) at the second floor, "1 ordinary doorway" at the fourth, and "1 ordinary door" at the fifth floor.[7] A door in the west end wall of the west section at the second floor, and presumably, the ramped opening at the first floor below it serving offices in the mill that were a part of the Counting House, were also closed off at this time.

4. Boiler Installation

Two major improvements were made to Mill #6 in 1973, the installation of a boiler in the original blacksmith shop at the first floor, west end of the west section, and the addition of a freight elevator to replace the outmoded 1917 elevator. The three bay wide fireproof section of the first floor of the west section of the mill was divided into two spaces: "install 8" masonry wall between two rooms-see plans attached-paint room, to be approved by Fire Prevention Bureau (paint room notation is wrong, as it was located at the second floor)."[8]

The "plans attached" (Figure 37)* showed an 8" block wall just to the west of the west jamb of the second window in the south wall of this part of the mill, extending to the existing masonry corridor wall along the north side. A "present metal door" was retained in the right part (where the boiler was installed) and a "new door" installed at the left. The work was completed by the Fairway Construction Company of Fitchburg, Massachusetts at the request of Wakefield Industries. Numerous holes were cut into the new north-south partition and the original east end wall of the fireproof area for steam lines, which were also extended into the Counting

* This reference to Figure 37 in the 1984 HSR could not be located. There is no Figure 37 in the 1984 HSR, hence no Figure 37 is included in this digitized 2016 version.

House. Prior to this work, in May 1960, a new door had been let into the first floor of the shop area, replacing the ramped opening that had been blocked in 1955 leading to the Counting house.[9] The 1960 door was blocked as part of a 1973 contract.

The building permit issued for the work at the boiler room also called for an "Overhead Door… replace two windows with overhead door." The door and framing was shown on a plan that accompanied the permit application as a 10' wide opening in the brick wall just west of the 1917 elevator, framed at the head with two 8' I-beams. The overhead door was set on tracks to be flush with the interior wall when closed. While the permit was issued in May, 1973, it appears that the door was not installed until 1974, when a second permit was taken out: "first floor area-remove structural column and install 15WF beam to open span-solid masonry in walls to receive one end of beam- install 10'x9' overhead door with 3-12" lintel over."[10]

Fairway Construction did this work as well. The door as built is similar to the one shown in the May 1973 plan, but the opening has four 12" channels as a lintel, conforming closely to the 1974 permit description. There is a narrow concrete loading dock at the opening with the slab resting on the granite foundation wall. Building permit 349, issued on October 1, 1974 calls for Fairway Construction to complete the work in this area by adding a fire-rated pedestrian door west of the overhead freight door, replacing a third window. It also includes a second overhead door, most likely the overhead door that replaced an original steel casement window in the west wall of the coal pocket entrance area, all for the cost of $1500.[11]

5. Elevator

Construction on a new elevator (Photograph 35) started in May 1973 with a "pad and footing for elevator shaft" to be installed at a cost of $2500, again by Fairway Construction.[12] The interior dimensions of the tower were 10'0" x 13'1". The elevator is an "oildraulic 1000 lb" freight elevator manufactured by the Beckwith Elevator Corporation and installed under contract no. H-5162-73 by Southeastern Elevator Company of Atlanta. ("Bryan 1973" is chalked on the wall at the interior of the fourth floor door opening, consistent with the date of the permit.) The new elevator caused the bricking in of the 3rd and 4th bays of the west wall of the east section of the mill, north of the 1917 elevator. The 1973 elevator opens at the east into all five levels, with bi-fold metal clad doors in steel casings. The full opening, including the wall area between the two original windows was spanned by steel I-beams that were faced with brick for fire protection.

The elevator tower measured 12′ x 13′ in plan and extended 6″ above the roof line. It was built of a combination of concrete block (CMU) and brick, with the first 16 courses block, then 9 courses of brick, 16 CHU, 9 brick, 16 CMU, 9 brick and terminating with 8 courses CMU. A one-story machine room was appended to the north side of the elevator tower, 8′ 9″ side, with a flat roof, concrete block walls and a modern flush door. It blocked one window at the second bay south of the east stair tower at the first floor only.

6. Other Changes

Other changes to Mill #6 that, while undocumented as to exact date, almost surely took place during the period 1956-1984 included the replacement of the interior doors at the first floor of the east stair tower with an overhead door and the cutting of 12 joists and three 4′ diameter holes into the roof of the west sec tion, 12″ from the south wall at the second, fifth and tenth bays. There is a similar hole in the brick area above the altered party wall between the two parts of the mill. All of these intrusions have been attributed to the installation of roof fans as a stop-gap ventilation system. (Plant Condition Reports up to 1955 repeatedly stress that there is no artificial ventilation in the mill, an indication that this work was at least post-1955.)

A frame partition was installed at the fourth floor, west part, between the first and second bays from the west end wall. Only the south part remains, paneled with plywood at both faces, with the remains of a telephone switchboard at the west side. Also at the fourth floor, west part, a later pipe column has been inserted south of the original cast iron column that supported the floor beam at the third bay. This beam has been cut out 24′′ in width, full depth, effectively splitting it in two. The reason for the removal of part of the beam is as yet unknown, but a rectangular patch in the ceiling perpendicular to the cut may indicate a possible second, later conveyor and/or trap door.

There have been other structural modifications made to this floor, apparently in the same time frame, including the addition of paired steel cribbing at the 5th, 6th and 15th bays from the west end wall, supporting the fifth floor at both sides of the row of columns, and at the center section of the 15th bay. Other steel bridging of this period is found at the 16th, 19th and 23rd columns where a beam extends from the centered column to the north wall, at the west side of the floor beams only. New timbers had been inserted at the fourth floor of the west section, in the 6th and 7th bays west of the party wall between the two parts of the mill, hung on steel joists hangers.

The structural system at the first floor, east section was also modified, where a 12″ steel I-beam marked “Eastern Steel” was placed at the

ceiling in the third bay from the coal pocket entrance wall. The first column in the west row of columns was also removed and a lally-column installed next to the second column. The window opposite the beam was infilled with concrete block and faced with plywood at the outside.

A photograph (Photograph 34) made in 1957 and in the collection of the Lowell Museum showed a sheet metal construction at the first bay south of the east stair tower. Of unknown use (possible a conveyor for the extraction of sawdust) it was removed in 1980. A small section of a steel channel used to anchor it to the stair tower remains. A vertical sheet metal shaft located in the fifth bay of the south facade (Photograph 36), running from the third floor to the roof was in place in 1979 but was also removed in 1980.[13] Undated but considered to be of this period are changes to a number of the interior doors at the stair towers, where many have been replaced with modern fire-rated metal clad doors.

7. 1980 Changes Made by the Wang Corporation

a. Window Sash

Wang Corporation carried out extensive repairs at Mill #6, including the replacement of 400 sash and the repair of window frames and sills. The window openings were weatherstripped and the jambs rabbeted for storm windows that were not installed. Most noticeable, the window in the first floor, north wall, west tower received a new jamb and stool, and a window immediately south of the east tower, second floor had the jamb rebuilt from below the stool to the meeting rail, both repairs of poor visual quality.

b. Boiler and Other Interior Changes

Wang also replaced the 1973 boiler with a Cleaver and Brooks boiler in 1980, removing steam lines and refitting the heating system. The new boiler is vented with a large diameter stack that runs up to the fifth floor where it turns at an angle to exit through a brick chimney constructed in 1981. To install the new boiler the north wall of the 1973 boiler room was removed. Rebuilt when the boiler was in place, it is inset 18" from the line of the original wall, which remains in the eastern part of the fireproof room. Wang also removed a number of air ducts and a compressor that were located in the upper part of the east masonry wall.[14] However, a square sheet metal conveyor that runs from the first floor, eighth bay from the west end wall to the fence at the south side of the canal remains in place. To provide a more secure storage area at the first floor, a chain link fence and probably much of the existing steel diamond plate replacement flooring was installed by Wang at the party wall



Photo 35. East stairtower, Mill Number 6, June 1985. Note later elevator shaft at right, and altered door at stair tower.
Source: HAER, NPS MA-16, 1985

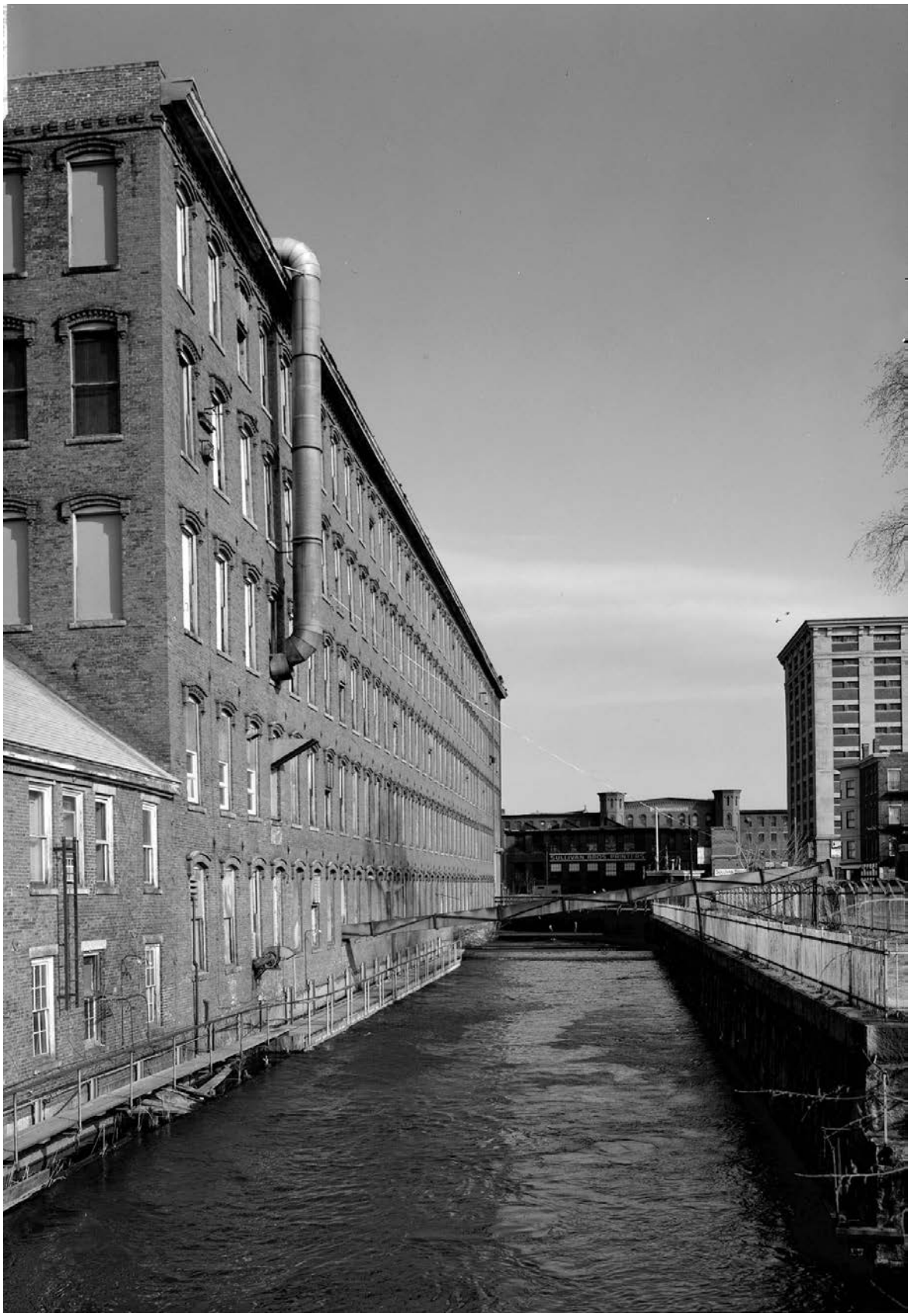


Photo 36. Eastern Canal elevation of Boott Mill Number 6, July 1979. Note curious sheet metal shaft at fourth bay, third floor to roof.
Source: HAER, NPS MA-7 #4, 1976

between the two sections of the mill, the fence removed in March, 1984.[15]

c. New Roof

The most important of all the work carried out by Wang in 1980 was the resurfacing of the entire roof. An elastometric roof system was applied over the existing built-up roof, with all flashing replaced, 2-3/4" rigid insulation installed between the old and new roofing, ballast applied to the membrane, gravel strips added, and the cornice either repaired or rebuilt as required. As an unfortunate consequence of this work, the original entrance at the east stair tower was altered by the roofing contractor who used the tower as his office. A concrete loading dock at the entrance, predating the 1980 alterations, was altered by adding concrete pads to the jambs of the entrance.

d. Facades of Mills #1 and 2

The tower at Mill #2 was altered at the ground floor level (Photograph 37) in the 1970s (photographic evidence). The wall surface was covered with wood shingles and a modern fire-rated door installed. The first floor of the tower at Mill #1 was also altered. The bracketed hood was removed and a new loading dock constructed, and a flat hood was installed in the northwest corner to protect a later door in the east bay of the connector. A letter to Richard N. Stone of Northern Textiles, from Paul Murray of Boott Mills dated April 19, 1955 (previously mentioned), outlines other changes at Mill #1:

> *Work will begin this week on the construction of a loading platform at #1 mill tower. This platform is required in order to remove machinery from the general area of #1 and #2 mills and connecting buildings. Heavy timbers and planking for platforms are available at the Boott Mill, labor will constitute the main expense. Work to be done by Boott millwrights.*[16]

The loading platform is located just east of the Mill No. 1 tower and has a large service door.

e. Courtyard

The courtyard was also altered during this transitional period, much of the work related to that completed by Boott Mills prior to the occupation by Northern Textiles. Flather's memo of June 29, 1955 outlined the following projects, with comments on the dates of completion in handwriting as mentioned above:



Photo 37. Stair towers at Mills Number 1 and 2, 1975
Source: HAER, NPS MA-7, 1975

Black Top Yard

Move 2 hydrants (will post instead of moving)

Water and Sewer pipe to cafeteria (July 15)

Destroy Ice House (July 18)

Move tool house (July 18)

Lower one shut-off valy' (July 19)

Build Transformer base[17]

The transformers were delayed, but the section of the Treasurer's Report for July 19, 1955 dealing with future expenditures at Mill #6 cites:

3 transformers 4126.50 payment due August

Cable-Primary 500 v

Secondary 110 & 120v 1373 August

Mis Power Equipt 1000 August[18]

The three "HT Quite Transformers," presumably installed in August or September, 1955 rested on concrete piers set on a concrete pad and surrounded by a 24" high cast concrete wall. The pad was depressed 12" below the wall, the wall used as a base for a pipe-frame construction that created a pent-roof form, with chain link fencing at the roof and upper walls for security. The transformers were located at the northwest corner of the mill, opposite Mill #1. The yard in this area also has a series of concrete piers parallel to the #7 connector that might be the location of the tool and ice house mentioned in the 1955 memo noted above. Two of the piers measure 56" x 56" x 18" high with steel diamond plates in the top face.

ENDNOTES

1. City of Lowell building permit 298, May 9, 1950.

2. Memo JRF to Richard N. Stone, June 29, 1955 (F.C.)

3. Letter, Paul W. Murray to Richard N. St one, April 19, 1955 (F.C.

4. Pencil notations by JRF on memo dated June 29, 1955, op cit (F.C.

5. Ibid.

6. Interview with Dunn brothers, warehousemen for Wang Corporation, Russell Wright, February 17, 1984.

7. Shelf 153, sheet 169. Locks and Canals (Boott Mills Office).

8. City of Lowell building permit 144, April 24, 1973.

9. Building permit 298, May 9, 1960.

10. Building permit 20, January 31, 1974.

11. Building permit 349, October 1, 1974.

12. Building permit 209A, May 17, 1973.

13. "Photo of Eastern Canal Side of Boott Mills No. 6, July 1979", in Preliminary HSR, (undated) NPS np.

14. Interview with Dunn Brothers by R. Wright.

15. Field inspection by Russell Wright, February 17, 1984.

16. Letter, Murray to Stone, op cit.

17. JRF memo June 29, 1955 op cit.

18. DR July 9, 1955.

XIII. SUMMARY

A. Occupation and Use

The Boott Cotton Mill's origins differed little from those of any of the major Lowell companies. Mercantile investors created a joint-stock company characterized by large holdings, built a set of buildings like all the others, and produced a narrow range of coarse cloth for which they anticipated a steady market. The production process was rationalized and fully integrated, all functions taking place at the mill complex. Tasks were reduced to the simplest level in order to make the necessary labor as cheap as possible. Highly skilled operations were avoided and an inexperienced workforce attracted and taught the work. Drawing workers in part, though to an unknown degree, from existing mills must have simplified the process. However, for positions of skill and oversight, the reserve of English talent served until well into the twentieth-century. Because of the extent of textile-related operations in Lowell by the 1870s, the Boott managers had a comparatively easy task when they decided to expand after the Civil War. The Lowell Machine Shop, part of the interlocking and overlapping set of companies controlled by the Boston Associates, stood ready to provide most of the machinery needed. It could also provide an engineer, Channing Whittaker, to provide the layout of the individual machines on the factory floor. The fact that the mill needed an outsider to perform this rather simple task, and the fact that it was done after the building had been built to a set of standard dimensions, rather than looking toward the accommodation of a particular set of equipment, might have raised a tremor of concern in an interested observer.

However, the mill had employed two agents of note in the years leading up to the building of Number 6: William A. Burke and A. G. Cumnock. Each introduced practices noted by the New England Cotton Manufacturers Association, and Cumnock correctly analyzed the emerging ring-spinning technology of the day and equipped the mill with the new light-weight spindles after careful tests.

Even with hindsight, one hesitates to evaluate some of the decisions made at the time. For example, management began replacing looms shortly after the opening of #6, but descriptions of their initial purchase are incomplete, making it impossible to determine whether or not they took advantage of the availability of state-of-the-art equipment when starting up. Perhaps more important than a somewhat limited expertise in cotton manufacture displayed at times, the first decade of the mills' operation coincided with a serious depression in the national economy, leading to a series of wage-cuts. When money was spent during this period, it was on

equipment, with workers absorbing the brunt of the effects of the economy's problems, a pattern which would continue. A reluctance to invest in the plant's future, in terms of either people or machines, plagued the mill from the start and never left it.

Still, the operation began with a good set of machinery and an astute Agent. It had the capacity to make money during good times in the industry and suffered from the same boom and bust cycle as the rest of the mills.

In certain areas, the Boott moved quickly to take advantage of technological advances, as in its purchase of Draper automatic looms beginning in 1901. But in others, they persisted in running obsolete machinery such as the fixed - flat cards in #6 which stayed for decades after the end of their useful life. Even in the realm of looms, the Boott simultaneously purchased some state-of -the-art Drapers and then ran old, belt-driven Lowell looms for years after they were outmoded, despite knowledge of the advantages of the Drapers.

The mentality which would operate machinery despite awareness of the advantageousness of available replacements also permitted the mill itself to become archaic before its time. Never an appealing place to work, #6 went downhill quickly as the building grew older and ameliorative measures were not taken. Drawing employees to these rooms represented a continuing problem. Wages were not used to overcome this disadvantage, either, for the Boott's stayed low throughout its history. Workers went to the Boott because they could not find a job that would pay them more; only by taking the whole family to the mill could labor acquire a living wage. By letting the mill and equipment deteriorate, profits, from the beginning, were made at the expense of the workers, whose labor generated the income but did not retain it, either as wages or as re-investment which would sustain their jobs. This pattern, traditional to Lowell, would intensify and spread with time.

Yet the managers of the mill objected, from the start and continuously, to any claims that were anything but concerned with the workers' well-being that they employed a degraded class of citizens, or that they failed to do their part in working toward the mill's continuing success. Their protestations did not reflect reality, but they may well have indicated their feelings, their desire to be providing valuable employment and, certainly, to run a successful factory. The managers' bias, however, affects many of the available sources of information. It has an interest of its own, part of which lies in the distance it discloses between the two classes of employees (management and labor) in the minds of the management.

Management domination of the situation, in terms of power, made the early decades fairly quiet, with little active or organized resistance on the part of labor to the many pay-cuts (at least little that can be detected now). Still, the situations which would lead to resentment and disagreement were being established.

When one management had taken all it could from the mill, it passed along what remained to new owners and the era of Flather Treasurership began. New ownership meant new consultants, and one report after another analyzed the building, the equipment, the workers, and, at times, the management. None emerged unscathed. Many of the difficulties identified had been inherited. The lay-out of machinery and processes, the machinery itself, as well as much of the workforce, came with the mill. While consultants pointed out deficiencies, the people involved, such as the Agents, described things in a way to cast a favorable and optimistic light on the fruits of their careers, and the new Treasurer knew more about managing machine-shops than cotton mills. Yet Frederick Flather played a major role in the mill's operation, particularly during the ill-health of E.W. Thomas in the second decade of this century. The use of the mill by the selling agents and chief stockholders, Wellington, Sears, accentuated its difficulties, taking profit from the mill not only without concern for its future, but with little concern for its present. Their success came from selling the cloth, and they seem to have cared little for the condition of one mill, among many, that made cloth for them to sell. Their misuse of the mill only increased effects of the damaging practices of the past.

One of the impressions that emerges from study of the mill's workings is that of a seat-of-the-pants operation. Accounting and supervision were not precise or well- developed, but when the Agent had sufficient knowledge and skill, as with Burke and particularly Cumnock, the factory succeeded. Under the turn-of-the-century agents it floundered and struggled. It is to Flather's credit that when he finally wrested control from Wellington, Sears he was able to extract some last decades of occasional success from the plant.

Reinvestment in machinery during this period followed the usual mixed pattern. The value of knotters and warp-tiers was recognized, as was long-draft spinning, but while the former were adopted wholesale, because of their small number and expense, the latter entered the mill piecemeal, increasing the disparities between machines which produce in tandem. Furthermore, conditions in the mill did not permit efficient operation of the new equipment (nor of the old, for that matter). No willingness existed to make major changes, to either buy new groups of machinery or to rhabiliate the structure. Gradual replacement improved spinning and weaving, which came to fill #6, but never caught up with the problem. Dividing the responsibility for what did not happen

seems impossible: the Directors did not appear eager to improve the plant, but suggestions for improvements in the record are too slight to absolve Flather.

Throughout this period the mill, except when great runs of one product for defense work were available, made a multitude of materials. This program brought innumerable problems. Mills, particularly in other areas, succeeded with such practices, and at times they worked for the Boott. The insurmountable problem was not simply the mixed production, but the inappropriateness of the plant for it, and that issue the owners never addressed adequately.

Given these difficult conditions regarding plant, equipment, and flow, it comes as no surprise that consultants found labor discouraged about its ability to produce successfully, or to make a good income on piece rates there.

Poor practices flowed through the mill much like the archaic line shafting which continued to power it. An operation which succeeded only fitfully did not hold the best workers or encourage the best efforts from those who remained, just as poor temperature and humidity control and worn-out machines did not lead to efficient production or machine repair. The consultants' reports of dirty, unsanitary, unpleasant conditions must be kept in mind by the modern observer, for they were a constant part of the existence of those who worked in the mill. The failure to take care of even the simplest of these problems underlined an unwillingness to improve production or to admit the importance of the workers as people.

Wages continued to go up and down according to the market, a factor greatly accentuated by the fact that hours of work, while gradually declining per day, rose and fell dramatically overall, according to demand. It is important to note that management reported that every wage increase was more than made up for through increased productivity from the workers. Still, wages remained low and worker turnover high, a factor which led to the introduction of large numbers of new immigrants to the mill. The tradition of hiring the cheapest available workers and then teaching them the work was a consistent one in Lowell. Losing many workers, and presumably losing even more among the most skilled (and able to get work elsewhere), placed an enormous burden on the managers at all levels.

Despite the beginnings of labor organization, the period up to the Depression was dominated by the old ways, the era harking back, consciously, to the "Lowell mill girls," and absolute owner control, or at least a belief in that management.

The final decades of operation took place under a cloud formed by the stated belief on the part of management that significant investment in the Boott would be misplaced. Given the frugality of previous times, such a situation could only bode ill for continuing operation. Some companies bought southern mills as adjuncts, while others invested money there. The Boott investigated such mills but did not buy. Some of the owners were involved with mills elsewhere, but their finances have not been traced as part of this study. In any case, they did not invest heavily in Lowell at this time.

The pattern followed by the Boott fit that of many textile companies at the time and many others since. The Amoskeag, in Manchester, New Hampshire was one of the best known to make a clear-cut decision to cease to reinvest, to take all the capital which had been built up by years of operation but not paid out in dividends and separate it from the company. The plant and machinery then ran as long as they could produce a profit and were then abandoned. (In fact, the Dumaine family which presided over the pillaging of Amoskeag proceeded to repeat the process at the venerable Waltham Watch Co.).

Workers, being less mobile than capital, suffered when the operation and capital they had helped create were removed geographically, depriving them of a livelihood in which they had had a stake.

Consultants continued to tell Boott management the same things in the last decades that they had for years. The plant was inefficient and unattractive; machinery was old, workers uninspired (as well they might be, given their situation). Certain steps were taken, though at little expense. Finishing operations, including stitching of curtains and towels, began and a conveyor system was installed to improve transportation between departments, but these had little impact in comparison to the decision not to reinvest.

Management came to speak with two voices, one which described the plant's shortcomings to Lowell tax assessors, another which claimed fine conditions in negotiations with labor.

Modernization continued in a small and piecemeal way with occasional new machines, often secondhand, and some electrification of individual machines. Wartime again brought big government contracts and renewed production.

A great deal of effort went into labor-management relations, with effort on both sides. The disagreements were fundamental: management trying to maintain control in as complete a way as possible, labor attempting to improve wages and power. The union gave the worker a voice, both collectively, in bargaining, and individually, through a grievance procedure and various

committees and stewards. The accommodation of the two sides to one another was often awkward, handicapped by decades of freedom on one side and new found ability to debate on the other. At times differences continued in arbitration for more than a year. Many disputes continued unresolved, or resolved unsatisfactorily to one side or the other, for many years. In numerous cases the comparative merit of the two positions has been obscured by time, but the energy spent disputing is still clear.

The fact of the constant disputes and their attendant cost, in terms of time and resulting ill-will, remains apparent. It had been a long time since workers had felt as though they and management were in the enterprise together, but the final period made it clear how far apant they were. All the time management argued for accommodation, for concessions on the part of labor, it knew that the mill was doomed, although it said otherwise. The workers battled to maintain the position they had attained in recent years while management worked to undermine it on the pretext of continuing employment. Although we do not have all of labor's side of the disputes, it may well be that it recognized the handwriting on the wall and rejected the idea of endless concessions in what would be a hopeless cause and an endangerment of the union position elsewhere.

All sides expended effort on the task of solving the mill's problems. From the present vantage point, it appears that the only side which could have put those efforts on a potentially successf ul basis had long since determined not to do so. Slowly the Boott Mills sank beneath the weight of antiquated machinery and plant.

B. Structural Development

The physical development and architectural evolution of the Boott Mills, and especially that of Mill #6, may be considered to be tot ally derivative in nature. Similar to the problems experienced by management as a result of their cavalier treatment of the workers and a reluctance to keep pace with technological improvements regarding new machinery, the owners relied on tried and true lessons of the past in the construct ion of their physical plant. Either through ignorance (unlikely, at least after 1904 as the Flather collection contains a wealth of material concerned with avant garde textile engineering, processes and mill construction) or misplaced determination, the owners were reluctant to experiment with innovative design and structural techniques that might have improved the productivity and longevity of the mills under their control. This pattern was not unique to the Boott Mills--it was pervasive throughout Lowell. It is here that the value of the Counting House, the Courtyard with the facades of Mills #1 and 2, and especially Mill #6 as an interpretive museum lies.

The complex incorporates virtually all of the architectural and construction devices, good and bad, in use in Lowell during the mid-to-late 19th- century. It is the perfect stage to present the activities, disputes and processes that took place within the mill and effected the lives of the workers as described above.

The Counting House is one of two (Suffolk Mills is the other) survivors of a building type in continuous use that existed at each of the textile manufacturers in Lowell. It has survived a century and a half of such use remarkably intact, suffering only minor alteration to the exterior and the partitioning of the office space. Importantly, all of the changes made to the Counting House reflect a simplistic but effective accommodation to an expanded need.

Mill #6 offers the rare opportunity of interpreting a structure itself as an artifact. It displays many of the design and structural features of the original construction as well as introducing the positive changes that occurred over time that reflect the technological evolution of such a facility and use.

The design and construction of Mill #6 may have lacked innovation, yet the building has experienced only minor structural damage to the foundations, (repaired in 1926) the rotting of flooring at the first level (because of a lack of ventilation) and a distress line in the north wall of the west section. These changes to the structural integrity of the mill resulted primarily from the lack of maintenance, continuing the pattern of neglect we have seen in other areas of management, and were not the result of inherent design flaws. Importantly, however, gross errors of omission occurred regarding design and construction that must be laid at the feet of the owners and builders. The most important error was the failure to take full advantage of the opportunity afforded by the new shafting and by the availability of turbines for power to increase the width of the mills. This should have provided the designers of Mill No. 6 with enough freedom in planning to tailor the plan to the exact layout requirements of the new machinery and processes to be used here. Instead, the west section of the mill retains the traditional 48' width. While the third through fifth floors of the east section are expanded to 78', this width is most likely a result of the decision to locate the entrance to the coal pocket at the eastern end of the structure, enclosed from the weather. Initially, occupying only the first floor, later enlarged and raised to two floors in height, the coal pocket forced the widening of the entire east section if the remainder of the first floor were to be used for manufacturing.

The narrow width of the mill, together with the five-story height required to make the structure economically efficient, was the main reason cited by Lockwood-Greene & Company in their 1907 report recommending that the Boott Mills be torn down and started anew:

"Mills 45' and 50' in width and six stories high cannot be considered good buildings for any department of a modern cotton mill. "[1]

The width problems were restated in a 1944 report that compared the Boott Mills to new mills under construction in the South. "Competitor mills in the south are 1 and 2 stories high, as wide as 150'..," citing that such a width offered complete freedom in the arrangement and re-arrangement of machinery and describing the height of Boott Mills in an understated comment: "A 6-flight climb every time one enters the mill to go to work, is not popular."[2]

The size of Mill #6, like most of those at the Boott and elsewhere in Lowell, was of course partially dictated by site conditions--the contiguous Eastern Canal and the pre-existing mills--yet the width and walk-up problems certainly were major factors in the inefficiency in operation and discontent among the workers that plagued the Boott during most of the 20th century. Other factors that are related to design and construction that have had a negative effect on Mill #6 include the lack of sufficient lateral supports in the structural system that contributed to the deflection of the mill (6-1/2" at one point) and increased the effects of vibration inherent with textile machinery. Both could have been alleviated to a large degree if the designers had utilized pilastered walls, a device in common use at the time of construction. The pilastered walls would also have improved both natural light and ventilation, as the wall area between the brick piers is usually filled with operable windows. Instead, the building was put up with the "traditional" bearing walls, reduced in thickness as they rose to the eaves, and extremely susceptible to high winds loads because of the unbroken flat wall surfaces of such length. Minor structural details that fortunately have not been tested at the Boott Mills include the archaic use of tie rods with anchor plates at the exterior wall to fasten the floor beams (the beams fall inward if the ends are burned, bringing the wall with it since it is tied to the rods), the use of cast iron columns despite the known threat of collapse during a fire, especially in sprinklered spaces where cold water will split cast iron on contact, and the lack of any masonry fire walls to retard the spread of fire horizontally throughout the mill; the party wall at the juncture of the east and west sections would have been an ideal location for such a device.

The above features can all be related to the traditional approach to design and construction taken by both Boott Mills, the owner, and by Locks and Canals, the designers and builders; such traditionalism certainly contributing to the other problems faced by management. The same approach also led to the removal of the sixth floors and cresting at both stair towers at Mill #6, the most destructive action taken by management with regard to the visual appearance of the mill. The towers and balustrades were the dominant feature of the entire Boott complex, punctuating the skyline in all photos of the

manufacturing section of Lowell made after the 1870s. Fortunately, the same photos offer the necessary documentation to permit their reconstruction, an action that would return the mills to their appearance during their most productive period of operation. Removal in 1950 to "reduce vibration" thus was a wanton, uncalled for destructive act.

While there are numerous negative implications of some of the original design concepts and of later actions at the heavy hand of management, they are at the least equaled by the numerous positive features of Mill #6 that exemplify the state-of-the-art of mill construction during the mid-19th-century and later. However, it must be stated once again that most of these positive features were already well known to millwrights in and out of Lowell when the mill was started in 1872. The use of octagonal plan towers with stairs and hoists had been incorporated into the mills rebuilt after a fire at the Merrimack Manufacturing Company in 1855, and the same company placed the stair towers at the corners of the mill, rather than in the center of the main facade when they built a new dressing mill in 1863. The almost flat roof had replaced both the dormer and clerestory lit roofs of earlier mills in Lowell by the mid-1850s. Steam heat along the walls, gas lighting, sprinklers at all floors with vertical stand pipes, composite beams (rather than a single large timber), slow-burn floor construction, brick rather than stone lintels at the windows for strength in case of fire, corbelled solid brick cornices that eliminated the flue-like effect of hollow metal or wood cornices, and even the cast iron treads at the stairs to reduce wear had all been in use in Lowell and at the Boott Mills before #6 was built. Yet, importantly, they all occur here, ready to be interpreted.

Despite the lament of some writers at the close of the 19th century:

> *The cotton factories themselves are not so agreeable nor so healthful to work in as they used to be. Once they were light, well ventilated, and moderately heated: each factory-building stood detached, with pleasant sunlit windows, cheerful views and fresh air from all points of the compass*[3]

and a statement in the 1945 Plant Condition Report regarding non-compliance to state building codes of the time:

> *Certain features could not be used in present day construction but buildings grounds & waterways restrict betterments. If present buildings were removed they would not be rebuilt*[4]

Boott Mill No. 6 reflects the technological development of textile mills from the 1870s on. It has stood the test of time, with over

100 years of continuous occupancy, most of which was less than friendly to the structural system, without serious compromise to its integrity as a building. Obviously,:

> *In general, Mill #6 can be considered an engineered structure. The beams, columns, walls, and foundations are all matched for the same superimposed loading. Except for the first floor, durable materials were appropriately used. Further evidence of this is the overall fine condition of the mill after 113 years of varied uses.*[5]

The facades of Mills #1 and 2, with their connector, are in themselves documents to the evolution of many of the mills at Lowell. They represent the first phase of development as a pair of free-standing four-story structures of "typical size" as well as the second phase, when the open space between them was infilled as prearranged to provide additional manufacturing floor area. These so called "connectors were usually designed to be visually sympathetic with the original mills, and often incorporated new stair towers at more functional locations into their planning. The connector between Mills #1 and #2 at Boott Mills, with the towers at the ends of the new construction, is an exemplary example of this device. The facades of these structures also reflect the final development phase of many of the mills at Lowell, when a full fifth floor replaced the dormered (or as at other mills in the city, the clerestory) gable roof. All three phases of development are present here, offering documentary evidence of the architectural changes that took place at many of the mills throughout Lowell before the Civil War. Despite the negative visual impact, even the post-1955 alterations to the facades and connector are of importance, as they tell the story of the rise and fall of the mills as profitable textile concerns.

The Courtyard, its present use as a truck entrance, service yard, and parking lot notwithstanding, reflects the importance of open space in the original organizational pattern of the Boott Mills. The arrangement of the early mills in long rows, separated by continuous open spaces to provide natural light and ventilation was predicated on the Waltham system of a canal built parallel to the river, with perpendicular raceways. This planning device was followed throughout the initial stages of the Boott Mills, and was carefully modified to satisfy the development pressures of the mid-19th century. Since the mill yard was restricted in area from the start, later structures were placed at right angles to the rows, and enclosed both of the original parallel courtyards of the Boott. This limited access to the formal, easily controlled central entrance at John Street. The courtyard between the Counting House and Mill #6 at the south, and Mills#1 and #2 at the north represents the southern spine of the original site plan. It is of special importance as this area became the dominant open space during the mid-

19th century when most of the north yard was infilled by new construction.

The extant buildings, library and archaeological materials and artifacts, represent an outstanding, perhaps unparalleled, opportunity for interpretation of all aspects of large-scale cotton textile production in New England. The roles of owners, managers, and workers, the interplay of capital, water and steam power, and textile technology, the effects of market fluctuations, government intervention, and national unionization trends all interacted within and around Boott Mill #6. It stands as an ideal opportunity for discussion and interpretation of all these factors.

ENDNOTES

1. Letter, Lockwood-Greene & Co. to FRF, Jr., January 29, 1907 (FC).

2. Memo to BM, "Boott Mills Buildings Competition in Cotton Manufacturing, Nor December 15, 1944 (FC). are Not Suitable for Post War Present Day Competition Either,"

3. Harriet Robinson, Loom and Spindle, New York, 1898, pp. 208-209.

4. Plant Condition Report, January 5, 1955, p. 4 (FC).

5. Structural Report of Mill 6 Boott Mill in Lowell, Brown, Rona, Inc., Boston, 1984, p. 53.

XIV. FUTURE RESEARCH

While much has been accomplished in terms of research concerning the operation, planning, and construction of the Boott Cotton Mills and Boot Mills, substantial areas remain to be studied. The quality of the Flather Collection insures that research will continue for many years. In fact, a first priority would be a review of that material from a broader perspective than that permitted by the Historic Structures Report's focus on specific structures. Further beneficial expansion would include examination of the structures and records of other major Lowell corporations in order that a valid comparative analysis can be created.

Specific topics that should be explored:

1. Design and construction sources: what handbooks or other published material influenced the design and planning of the mills at Lowell, with site specific reference to Mill #6 and others at the Boott?

2. Who was responsible for the actual design of the mills, in Lowell and at the Boott in particular? Did Locks and Canals prepare the plans and specifications or did they subcontract to professionals? If Locks and Canals actually did the design and structural work in-house, who was responsible; was there a separate staff for this work, or did the millwrights and engineers double as architects?

3. What influence did management have on the design of the mill structures? How was work coordinated between Locks and Canals and the owners-financiers, etc?

4. How did Locks and Canals actually build the mill structures; was there a permanent construction team moving from mill to mill, or did they sub-contract out some of the construction? Who were the men responsible for overseeing the work, where were the laborers drawn from?

5. Who supplied the building materials and components for the mills at Lowell as well as the Boott. Where did the brick and stone come from, how was it transported?

6. HABS and HAER quality drawings and records should be made for all the standing mills in Lowell so that comparative analysis can be made of such features as floor sizes (by time period); floor to ceiling heights (by time period); the use of cast iron versus timber for columns; when was slow-burn construction introduced, where, by whom and how did they learn about it; were pilastered walls ever used at Lowell, if so where and when; fenestration patterns

(percentage of openings to solid walls as related to the width of the mills) and the kind of artificial lighting available; how did the mills satisfy sanitary needs; coatrooms, recreation rooms, etc.; where were the heating pipes attached (at the walls as at Mill #6 or at the ceiling); what were the differences in floor dimensions over time, keyed to advances in machinery and lighting?

7. What were the costs of the mills, on a comparative basis, per loom or square foot, over time?

8. It is assumed that other avenues of research will be uncovered during the next phases of work related to the Boott Mills and Lowell, but it is recommended that the completion of the HABS and HAER drawings take precedence, as much of the comparative analysis suggested above can be drawn from the visual record. Also, while this project has afforded the opportunity to thoroughly explore the records of the Flather Collection and the files of the proprietors of Locks and Canals, both at their Boott Mills office and at the Lowell University Library Special Collections†, as well as other collections, little documentary evidence regarding architects and engineers, or contractors and laborers, suppliers and craftsmen has been found. Oral history may help in this area, as some of the workers on the later mills must still reside in the area. Other sources for this kind of material normally include union records, extant contracting and building firms and suppliers records, local and other architectural and engineering firms and consultants records such as those contracted by Locks and Canals during the reconstruction of the John Street bridge and the relocation of the railroad tracks at the coal pocket.

9. Oral histories with former workers, managers, or builders would illuminate the written record. Library research can lay the groundwork for a sophisticated use of this avenue. Detailed knowledge of the mill's history would permit insightful use of the memories of those connected with its history. Park Service efforts in this area deserve strong support.

10. Economic analysis of the business records of the mill and of its investors. Determination of actual profits, other investments by these people, and the precise amounts of money spent in various ways would reveal much about the plant's performance and its Directors' relations to this and other mills, including those in the South with which the Boott competed.

† This reference is reproduced verbatim from the 1984 HSR. It should be noted that as of 2016, these records are housed at the Lowell National Park's Locks and Canal Collection and at the University of Massachusetts Lowell, Special Collections.

11. The relationship between Boott production and competition in the South. This relationship represented a factor of growing importance during the final half-century of the mill's operation. It effected decisions on products and investment and influenced all aspects of the mill's situation. It was both the source of real concern and powerful propaganda.

12. A detailed examination of surviving Lowell newspapers for textile industry news and other relevant material. Such a study would not only help flesh out the mills' histories, despite the close relationship between the corporations and the papers in most instances, but also enhance one's understanding of the local milieu within which the activity took place.

13. Comparison of the Boott's equipment with that of other mills. Operations in various parts of the country with which the Boott competed employed machinery which accomplished the same ends as the Boott; the relative merits of the various complements of machinery would increase understanding of labor's situation regarding skills and loads and further understanding of the management's competence.

14. Union-management relations and labor-management relations. While both these were studied for the HSR, more could be done to untangle these complex relationships.

15. Immigration and textile labor. The origins and motivations of the mill's changing workforce deserve further attention than that provided by the available contemporary lists of nationalites. Motivations, recruitment, intentions, travel routes, and experiences all offer fruitful ground.

16. Sources of innovation in textile technology. The relative contributions of machine-builders and shop floor or workshop inventors would cast light on the state of the American machine building industry over time.

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Research for this report drew primarily on the collections of Lowell University, the Museum of American Textile History‡, Baker Library at the Harvard University Business School, and the Library of Congress. The Society for the Preservation of New England Antiquities, the Archives of the Commonwealth of Massachusetts, and the American Antiquarian Society collections also contributed information.

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COLLECTIONS§

Lowell University Library¶. Flather Collection. A rare and complete group of business records, primarily for the Boott Mills, 1905-1954, including all consultants' reports cited, and also related material; see Catalog by R. Nicholas Oldsberg.

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‡ This reference is reproduced verbatim from the 1984 HSR. It should be noted that as of 2016, these locations are referred to as the University of Massachusetts Lowell, Special Collections; and American Textile History Museum.
§ As of 2016, part of the collections exist at Lowell National Historical Park, Museum Collections. Proprietors of Locks and Canal Collection.
¶ As of 2016, this location is referred to as the University of Massachusetts Lowell, Special Collections.
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APPENDIX A

Description of crawl space under Mill No . 6

"The height of the crawl space varies from 1' ± at the north foundation wall to 6'± at the south foundation wall in the area of the penstocks. The floor is mostly dirt and littered with rotted , broken beams and planks.

The penstocks are open in some areas, covered by granite slabs in other and by wood beams and planks in still others... It is apparent that at one time the penstocks were covered with wood beams and planks but this covered area has now collapsed.

In the northwest area there is a masonry and granite pit extending 8' below the grade of the crawl space, approximately 11' below the first floor. Two 14"x14" wood beams span the top of the pit, with supports for the first floor beams. Two other 14"x14" beams span the pit approximately half way down. The notches and markings on these lower beams indicate some equipment used to bear on them. In the north wall of the pit there is an opening into a tunnel heading north. The top of the opening is framed by large granite blocks.

Most of the remaining crawl space in the east section is not accessible… The east wall is cast in place concrete, with the framework still in place in some areas."

(The last sentence refers to the foundations put in when the coal pocket was enlarged in 1927.)

Source: Structural Report of Mill 6, Boott Mill in Lowell, Brown, Rona, Inc., Boston, 1984, p. 3-4 .

APPENDIX B

Roofing specifications, published c.1905

"Place upon the roof plank three layers of roofing felt parallel with the eaves; continue by lapping each additional layer two-thirds of its width upon the preceding one; so continue until the whole surface of the roof is covered. This being properly secured, coat the same with the melted composition, and over this place two additional layers of felt… The felt being thus properly secured, spread upon the surface a good body of the melted composition and gravel in sufficient quantity to thoroughly incorporate the same with the composition."

Source: Boston Manufacturers Mutual Fire Insurance Company Special Report, "Outside Coverings for Flat Roofs," undated (c.1905).

APPENDIX C

Design of composite beams, including the use of an open space between the individual members

> *"A preference may also be expressed for timbers in two parts rather than solid beams , for the reasons:*
>
> *1st . The space between the two parts will adequately serve for ventilation, even if the outer part of the beam is indiscreetly painted when the wood is green.*
>
> *2nd. Sounder timber may be expected if 6 or 7x14 inch rather than 12x14 is ordered."*

Source: Boston Manufacturers Mutual Insurance Company Special Report #10, Boston, April 7, 1882, p. 9

> *"…instead of attempting the use of one piece of timber, it is preferable to use two pieces of the same depth and half the breadth. These should be bolted together, with a space of an inch or so left between them left by placing small, vertical pieces of wood between the timbers when they are bolted together. In this manner one is more sure of sound timber, and in the process of seasoning there is less liability or dry rot in the interior, or of injurious checking, warping or twisting"*

Source: Scientific American, June 2, 1888, p. 10346

APPENDIX D

"Raising thresholds at doors to contain water for the prevention of the floors igniting"

> *"All floors should be arranged for flooding. This is accomplished by raising all sills and other openings through which water may escape. A floor arranged for flooding, when otherwise well laid, is one of the best means for restricking a fire from extending from one room to another, for, a soon as the fire appliances, such as sprinklers, hose, etc., are turned on, there is, in a very short time, a pond of an inch or an inch and a half deep formed on the floor, which prevents the floor from igniting, at the same time, a rise in temperature vaporizes the water on the floor , causing the formation of steam, which aids in extinguishing the fire."*

Source: C. John Hexamer, "Mill Architecture", article appearing in the Journal of the Franklin Institute, Vol. CXX, July 1885, p. 4

APPENDIX E

Cast iron versus timber columns for mill construction

> *"The best column to stand in case of fire is a good hard wood column, without taper, bored near the top and bottom so as to prevent dry rot, lined with sheet iron or any other metal, or covered with a good protecting substance. Of all columns, those of exposed cast iron are the poorest."*

Source : Hexamer, op cit

By 1888,

> *"Iron columns for mills have been entirely displaced by those of timber, as it was found that the latter were more reliable in resistance to fire, were freer from defects in construction and possessed less tendency to vibration."*

Source: Scientific American, (Supplement No . 648) May 26, 1888, p . 10345

APPENDIX F

Improvements to the interior of the Counting House, 1906-1909

"June 30, 1906

Office basement	*$*	*61.09*
Supply room		*30.72*
Office improvements		*35.16*
Office Equpt, & improv		*132.99*

December, 1906

Supply room	*$*	*71.25*
Office improvements		*12.54*
Alteration cotton sample room		*50.71*

June, 1907

Supply room	*$*	*22.01*
Office basement improv		*5.50*
Office in cloth room		*142.73*

December 1907

Supply room	*$*	*7.50*
Office in cloth room		*10.96*

June 1909

Office equpt & improv	*$*	*54.13*
November 1909		
Office improv	*$*	*16.39"*

Source: Treasurer's Reports to the Directors of Boott Mills (FC)

APPENDIX G

Letter re: fire proof vault in Counting House, Sept. 20, 1930

Frederick Flather, Jr.
Boott Mills,
Lowell, Massachusetts.

Dear Sir:

I am enclosing a sketch showing the relations between your fire proof vault and the adjoining part of the office. By taking out the fire proof vault you can add an area of about 7' ft. by 9 ft. which could be added either to the office or to the stock room. We estimate the cost of taking out the vault at about $100.

Yours very truly ,

Assistant Engineer.

SSK:H
Encl.

Source: File 1009, Locks and Canals (to Boott Mills)

APPENDIX H

Letter re: Safford to Flather, 1926 Conditions Report

June 8, 1926.

File #1009

Boott Mills

Lowell, Mass.

Attention Frederick Flather, Jr.

Gentlemen:

The enclosed statement covers as nearly as we can obtain them the conditions at your No. 6 mill.

I personally looked over the underground structures with the water out last Sunday, and could see nothing to indicate that they were any different from what I had noticed the many times I have been under this mill . I noticed one granite flag stone which was cracked, and there was some slight opening of the brick in one of the groined arches, but not at a place which was carrying an extreme weight.

Mr. Kent, the assistant engineer, not only looked over the underground conditions with me Sunday but has observed the vibration at each one of the floors of No. 6 mill. (See attached statement also copy of a statement giving Mr. Francis' computations for the columns of this mill under date of March 25, 1872.)

While I am pretty confident that the vibration of this mill is not unusual with cotton mills having looms in the upper stories, there is no question that it is something which should not continue if it is possible to change the set-up of the machinery and get rid of this vibration.

Yours truly,

ATS

Engineer

ATS/R

Encls.

Source: File 1009, Locks and Canals

APPENDIX I

Charles T. Main 1926 Conditions Report

Chas. T. Main
Engineer
Massachusetts Trust Building
200 Devonshire Street
Boston, Mass.

C O P Y

June 11, 1926.

SUBJECT: Foundations of No. 6 Mill

Boott Mills

Lowell, Mass.

- Attention of Mr. Frederick A. Flather, Treasurer -

Gentlemen:

In accordance with the request of Mr. Flather, Jr., we have made an examination of the foundations of this mill which are built in connection with or in the canal.

Our representative's visit was made on June 6, 1926 at a time when the water was drawn down and Mr. Stafford of the Locks and Canals Company was there to assist.

The following items were noticed:

It may be well to state at first that nothing of an alarming nature was found, although there were several places where the brick work needs pointing very badly, and one stone lintel or sill was found to be cracked, and two stone slabs were also badly cracked. These things are noted on the accompanying sketch.

No signs of settlements of the foundations were visible from the level of the canal floor and the stone footings were found · to extend out wider than the columns.

The bottom of the canal just behind the screens is covered with planking, so that the full extent of the footings could not be found. Where there were cracks or openings in the planking the footings showed that they were stone or mass concrete with large stones embedded. A number of the piers are out of plumb as shown on the accompanying sketch.

2 Boott Mills June 11, 1928

The underpinning course of granite with the wall which it carries is from 2" to 3" out beyond the base course of stone lintels at the section where the brick wall has the greatest motion from the action of the looms, and where the top of the wall sets back about 5", as shown by sketch of plumb readings of the wall taken in November 1925.

At other sections of the wall the underpinning is either flush with the face of the stone lintels or from 3" to 6" back of it. This is shown on the sketch.

It would seem from this that there has been a movement toward the canal of the lower portion of the canal wall followed up to some extent by the yard wall. This movement appears to have taken place a number of years ago, but is has produced in the wall a rather unstable condition. The wall does not appear to be broken up, so that if a portion of the looms are changed as suggested in our previous report, it probably will be very favorable to the construction of this mill, and make it good for many more years. If the changing of the looms does not stop the movement of the walls as described, it will be necessary to reinforce the building in a positive manner in the near future.

The brick walls especially have of later years withstood the swaying motion in a remarkable manner and have demonstrated that the brick walls having window openings such as are in this building have a large amount of elasticity and a large safety factor. It is, however, necessary to stop the swaying of the walls previous to the time when the mortar is over-stressed, or breaks up through fatigue. We trust that this will now be accomplished.

We recommend that close watch be kept of the tendency to lean by these walls and also the tendency of the underpinning and lintels over the openings to the canal to move. It would seem that this could be done probably through an examination occurring at not more than six month periods.

Mr. Stafford of the Locks & Canals stated that they had no information relative to the sizes of the footings under the columns which were covered, but he felt sure that they were on good solid foundations. He stated that the building was erected in the early 70's , and in his opinion it was nicely built and in first-class manner. He did not anticipate any failure or weakness of the foundations themselves.

Very truly yours,
CHAS. T. MAIN
By
H. E. Sawtell

HES D

Source: File 1009, Locks and Canals

APPENDIX J

"Conclusions Regarding R.R. Track to Boott Coal Pocket, Sept. 13, 1926"

Conclusions Regarding B. B. Track to Boott Coal Pocket.

1. The present bridge is not strong enough for the smallest coal cars coming to Lowell.

2. The passageway (after substituting I-beams for the arch at the entrance) is large enough for the small to medium coal cars (40000 lbs to 80000 lbs capacity) but is too low for the large size cars (100,000 to 110,000 lbs) or for a locomotive.

3. In order to take the largest coal cars and a locomotive, the passageway will have to be extended up through the second floor.

4. A windlass and cable, or perhaps a special gasoline driven locomotive could probably be used to haul the smallest sized cars into the coal pocket in case the 2nd floor cannot be encroached upon. Windlass and cable operation might not be very satisfactory.

5. The beams supporting the track in the coal pocket itself are too light for even the small sized cars, and would have to be replaced by heavier cross beams with stringers.

6. The cost of Scheme No. 1 (passageway raised to include 2nd floor and admit use of locomotives) is estimated at from $12000 to $16000. Cost of moving machinery not included.

7. The cost of Scheme No. 2 (track lowered 1 foot, 2nd floor not affected, passageway high enough for small sized cars but not for locomotives) is estimated at from $9000 to $12000. Cost of windlass and cable, or special locomotive not included.

Source: File 1009 Locks and Canals

APPENDIX K

"Track to Boott Coal Pocket

September 13, 1926

The track to the Boott coal pocket branches off from the southerly track on Amory Street crosses the canal on a curve of 80 ft. radius, passes through the first floor of the Bridge Street end of No. 6 mill, thence through the first floor of No. 6 and 7 connection, and thence to the coal pocket in the basement of No. 7 mill. In considering ways and means of using this track for taking cars down to the coal pocket there are three features that have to be considered.

(1) The short radius curve and the bridge across the canal.

(2) The clearance in the passage way from the canal wall to the coal pocket.

(3) The support of the track in the coal pocket itself.

Source: File 1009, Locks and Canals

APPENDIX L

Letter from Boott Mills to R. Burroughs, Division Engineer, Boston & Maine Railroad, December 17, 1926

> *"Curvature of the track will be approximately forty-eight degrees. Our standard curvature is ten degrees for sidetrack operation. Wherever this requirement is exceeded, it is necessary for the licensee, the shipper or the owner of the track to agree if after the track is built, it becomes necessary for the Boston & Maine Railroad to increase size of power which is operating tracks, thereby necessitating a decrease in the amount of curvature in the track, that the shipper stand the expence of realigning the track or do their own shifting upon it."*

Source: File 1009, Locks and Canals

APPENDIX M

Estimates of cost for constructing the new track for the Coal Pocket at the Boott Mills

> *"Agreeable with your conversation with my assistant, Mr. Chase, a few days ago in Lowell, I have developed an estimate covering cost of labor and material to put in track for Boott Mills about which we have had considerable correspondence , estimate covering from point of new switch to portal of building and including rearrangement of crossover. I believe the work can be done for approximately thirty seven hundred dollars, ($3700.00) the big item of which is special crossing frogs which as near as I am able to discover from one or two bills which I have received, will be about twelve hundred dollars, ($1200.00). The labor item will come to about eight hundred dollars ($800.00), the switch item to about three hundred dollars ($300.00), the tie item to about four hundred dollars ($400.00) and the remainder of the charges to make up the total I mentioned are for rail and other small material and includes engineering and supervision."*

Source: File 1009, Locks and Canals (filed under Boott Mills correspondence, May 23, 1927)

APPENDIX N

W. A. MACK CO.

25 Shattuck Street

Lowell, Mass.

May 11, 1929.

Locks & Canals Co.,

Lowell, Mass.

Gentlemen:-

We are pleased to quote you the following prices to cover the roof of the bell deck at the Boott Mills, as follows: -

The entire roof and curved face drip, with M.F. tin, for the sum of one hundred and eighty-three dollars ($183.00).

The same roof and drip, with copper, for the sum of four hundred and three dollars ($403.00).

The above roof originally was covered with Belgium zinc, what there is left of the roof has become very brittle and has been patched at various times with American zinc.

We should recommend M.F. tin or copper for this roof, tin would have to be painted, but the copper would need no attention.

Thanking you for the inquiry, and hoping we may receive your order, we remain,

Yours very truly,

W. A. Mack Co.

Source: File 1009, Locks and Canals

APPENDIX O

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Civil and Sanitary Engineering

Cambridge 39, Mass.
May 1, 1924

Professor E. B. Millard, Asst. Director
Division of Industrial Cooperation and Research
Massachusetts Institute of Technology

Dear Professor Millard:

The plans and correspondence submitted to you by the Boott Mills, of Lowell, show that it is proposed to replace their main entrance bridge by a structure composed of 24" - 79.9 lb. I-beams spaced 3.39 ft. center to center with a deck of 4" planking. The distance center to center of supports for the I-Beams is approximately 44 ft.

Certain questions which have been raised concerning this proposed bridge together with the answers to the same are as follows:

1. Will the proposed design sustain a load of 20 tons on 4 wheels?

The proposed design will not be safe for 20 ton trucks. Provided heavier planking is used in the floor (as will be noted below) the I-beams proposed will safely carry 15 ton trucks. To make the bridge safe for 20 ton trucks it would be necessary to substitute 24", 105 lb. per foot I-beams in place of those now proposed, or it would be possible to use the 24", 79.9 lb. I's provided 9 beams, spaced about 2 ft. 6-1/2" c. to c. were used.

2. Should provision be made for heavier loads than 20 ton trucks?

The use of 20 ton trucks is in line with the best modern practice in highway bridge design.

3. Is the proposed flooring adequate for the proposed load?

The 4" planking proposed is unsafe for either a 15 ton or a 20 ton truck. The planking should be composed of 6 x 12's , (actual size 5-1/2 x 11-1/2) . These should be laid with 1/2", clear between planks to allow the floor to dry out after a rain.

4 . What would be the safe life of the proposed structure?

Prof . E. B. Millard - 2- May 1, 1924

If the design is modified as above indicated, the planking should last for 10 to 15 years. If the planks are creosoted the life might well be twice the above figure. The life of the steel beams will depend entirely on the care and frequency with which they were painted. If well taken care of the B-Beams would outlast the flooring.

5. If the proposed structure is inadequate in any way, what should be done to make it thoroughly safe?

The design should be modified as above indicated. In addition, care must be taken in bolting the spiking pieces to the beams and in spiking the flooring to these, as the safety of the bridge will depend in a large measure on the tops of the I-Beams being well supported by the flooring against transverse deflection. A further precaution should be taken along this same line by placing a line of diaphragms between the I-Beams at approximately one-third the span from each end of the beams. These diaphrams might be made of 12" I-Beams with standard connection angles at the ends and should be placed as near the tops of the 24" I's as may be done without cutting the flanges.

Yours truly,

(Signed) H. L. Bowman

COPY

Source: File 1009, Locks and Canals, (copy)

APPENDIX P

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Cambridge 39, Massachusetts

May 10, 1924

Dr. E. B. Millard
M. I. T.

Dear Sir:

Certain additional questions have been raised by the Boott Mills in connection with the entrance bridge which they propose to build at their mills. The answers to these questions are as follows:

A 6 x 8 nailing strip would be entirely satisfactory. The I-beams should be punched 2 ft. center to center, the holes being first in one side of the flange and then in the other. Due to the closer spacing of the main beams it will be possible to use 4 x 12 planking. Two 9 inch spikes at each crossing of the nailing strip would securely fasten the planking.

Your attention is called to the fact that the use of nine beams means 8 spaces between beams so that the spacing center to center of the beams is about 2 ft. 6 inches instead of 2 feet 3 inches, as stated in Mr. Flather's letter.

I do not recall that any mention has been made of wall bearing plates, and would further direct your attention to the fact that it is customary under the ends of 24 inch I-beams to use a plate 16 x 16 x 1" to distribute the load to the masonry, and I am assuming that it is the intention of the Boott Mill to use such plates in their bridge.

Your very truly,

(Signed) H. L. Bowman

COPY

Source: File 1009, Locks and Canals, (copy)

APPENDIX Q

Request by Boott Mills for a study of conditions to be completed by the C.T. Main Company

About ten days ago suggested to Treasurer and F. F. Jr. that Chas. T. Main make a report of the safety of our mills from a structural point of view.

I had noticed in the back office that the vibration from #6 Mill seemed a little more than a short time ago. This prompted my remark, although the idea of the safety of our mill is almost constantly in my mind.

Chas . T. Main was written to, and their Mr. Robinson who has inspected our mills before, was assigned to the work. Today having completed his preliminary study, and upon leaving to make his report, I showed him the place in the back office which I noticed the vibration. I then took him to 6-2, where there was a new section of flooring which vibrates considerably, and asked him if this did not cause excessive strain to the walls. He said he did not think so, in fact he though our mills were in excellent condition.

He noticed some danger points, but nothing serious compared with our mills. I said we were not content to be compared with other mills, but we wanted to be sure that they were absolutely safe and that no tragedy would take place. He said there was no danger of that.

He said he though it might be advisable to measure the bulges in the #6 mill wall on the canal side, sometime. I said I certainly think he ought to do that and anything else, so that he could definitely take entire responsibility for the safety of our structures. He said he would do this, and might come back again after writing his report.

Source: Memo, James R. Flather, June 14, 1935, File 1009, Locks and Canals

CHAPTER 1.3

Historical Background and Context

1.3 Historical Background and Context

I. Birth of Lowell National Historical Park

The Counting House and Mill 6 are significant surviving examples of America's industrial past. They tell the important story of how a group of ingenious investors, engineers and mill-workers transformed Lowell from the quiet village of Chelmsford to a bustling city in the 19th century. The numerous mills of Lowell propelled it to prosperity in the 19th and early-20th century. However, by the middle of the 20th century, the days of prosperity were long gone, as one mill after another started shutting its doors. Boott Mills was no different- after terminating production in 1955, the buildings sat vacant or under-utilised for a number of decades. The Boott complex, and particularly Mill 6 and the Counting House received a new lease on life in the 1980's by their redevelopment as the flagship buildings within the newly formed Lowell National Historic Park.

Therefore, as one begins to understand the historical development of Mill 6 and the Counting House during the period 1984- 2016, it is important to place the physical changes at the buildings within a larger context. The following section is aimed to give the readers a brief summary of the creation and early years of operation of LNHP and how that set the stage for the comprehensive renovation and reuse of Mill 6 and the Counting House.

The book 'Mill Power: The Origin and Impact of Lowell National Historical Park' presents a comprehensive account of the various people, processes and agencies that played a crucial role during the Park's creation. The book should be consulted for more detailed information. In the following paragraphs is a brief summary of the key decisions surrounding Mill 6 and the Counting House.

Interest in the revival of Lowell's industrial past began in the mid 1960's when Lowell received aid via the Federal Model Cities program for urban redevelopment. The aim of this 5-year program was to improve the quality of life in Lowell's poorest neighborhood, the Acre, organize community groups and get them thinking about how the city could be revamped. At the same time, Lowell schoolteacher Dr. Patrick J. Mogan emerged as a key figure in the city's revival. He routinely campaigned for using the city as a learning laboratory and celebrating its industrial past. Mogan and his collaborators formed a non-profit organization, the Human Services Corporation (HSC) in 1971. With the help of some regional grants and the involvement of outside consultants, HSC

began exploring the idea of a an urban cultural park in more detail. They drafted the first legislation calling for a Park in Lowell. The National Park Service was initially not very excited about the idea of a national park in Lowell owing to the loss of a number of mill buildings by the 1970's, however Mogan and his crew kept pushing on. The continued local and regional traction led to the creation of the city's first historic district - the Locks and Canals District in 1973. In the summers of 1974 and 1975 successive teams of architects and historians from the Historic American Engineering Record (HAER) of the National Park Service recorded through measured drawings and historical documentation the canal system, which remained intact and was the most significant site of hydro-power technology development of the early and mid-19the century. In 1975, the US Congress created a federal commission to study Lowell's prospect for inclusion in the national park system. The commission's report came to be known as the 'Brown Book' for the color of the cover, and prominently featured a mill worker on its cover page. It was clear that the once forgotten, derelict mill buildings and historic canal system of Lowell were going to play an important role in its revitalization.

The final push to establish the Park happened in 1977 when Congressman Paul Tsongas put forward a bill to establish Lowell National Historical Park and it was finally signed into Law on June 5, 1978. The creation of Lowell National Park was unique in that it also mandated the creation of a sister agency the Lowell Historic Preservation Commission (LHPC) that would help jump-start the Park creation for the next 10 years. One of the roles of the LHPC was to encourage private property owners to renovate their buildings in and around the historic district to give the area a cohesive feel.

Neither Mill 6 nor the Counting House were on the list of the first few properties that were purchased by the newly formed Park. Mill 6 was owned by the Capehart Corporation at the time and was actually in really poor condition during the late 1970's. It had suffered a gas explosion in the mid-70's which had led to the loss of a majority of its historic wood windows. The building was lying unused and its owners were on the brink of declaring bankruptcy.

It was in this socio-economic climate that the LHPC did exactly what it was designed to do-it worked with the City to convince An Wang, an emerging technology entrepreneur who was setting base in Lowell to purchase this building for a future use. From 1979-1981 Wang Corporation would receive federal funds to undertake historically sensitive repairs at the building, including replacement of all the wood sash and the roof. However, by 1983, Wang had not determined a use for Mill 6 had was interested in another location elsewhere in the city for building a new training center.

Since its creation in 1978, the Park had its eyes set on the Wannalancit Mills for development into the Park Visitor Center and Museum. However, that deal did not materialize and the Park turned its eyes instead to the Boott Mills. The Park had expressed interest in the Boot Mill Complex as early as 1979 and declared that they would develop a portion of the Mills for a high-profile use to be identified later. The proximity of Boott Mills to downtown was a key factor in the Park's eventual decision to shift its base to Boott Mills and purchase Mill 6 from the Wang Corporation in 1983. The Counting House was purchased in 1983 from the then owners of the remainder of the Boott Mills complex. Thus by 1983, the Park service was all set to begin planning a new Museum and an educational industrial history center at Mill 6 and the Counting House.

Over the next ten years, this plan was realized via a phased project, that completed core-and-shell improvements to Mill 6 in Phase I, including substantial structural repairs. Phase II included the interior fit-out of Mill 6 and both core-and -shell and interior improvements at the Counting House.



Photo 49. President Jimmy Carter signs the legislation establishing the Lowell National Historical Park, June 5, 1978.
Source: Marion, *Mill Power*, 2014, p. 51

II. Creating a Mixed-Use Center for Education, Interpretation and NPS functions

As outlined in the previous section, through the tenacious and innovative efforts of various local Lowell residents, educators, state legislators and administrators, The Lowell National Historical Park (LNHP) was established in 1978 with Mill 6 and the Counting House poised to become its signature buildings. This section will describe the functions and programs that filled these two buildings creating a vibrant mixed-use center for education, interpretation, and NPS operations.

The first two floors of Mill 6 were designed as a museum exhibit of the textile era in Lowell. The idea was to recreate an entire working weave room on the first floor of Mill 6 with more general interpretive exhibits on the second floor. The Museum was designed to entered through the set of double doors at the first floor of the west stair tower - much like how it would have been entered historically. The spiral staircase with cast iron plates embossed with 'Boott Cotton Mills' on each tread, was important to setting the stage and preparing visitors to enter the Weave Room. Filled with eighty-eight looms that were of the Draper automatic type once prolific in Lowell that had once been in a southern textile mill, the loud noise of the banging shuttles creates a one-of a kind experience of being inside a working 19th century mill. On the second floor, the exhibits use various period artifacts, images, 3D models, dioramas and audio-visual presentations to illustrate various aspects of the textile industry in Lowell. The Counting House was designed to serve as an extension of the Museum, connected to it on both floors 1 and 2 to house the entrance lobby and the bookstore. The bookstore relocated to the first floor of Mill 6 in 2007.

The third and part of the fourth floor of the building were envisioned to house an educational component. This was a novel idea and one that was implemented for the first time at any national Park in the country. Probably owing to the involvement of key educators like Pat Mogan in the creation of the Park, and the desire from its early origins to combine education with interpretation, the Park conceptualized to create a one-of-a-kind educational program that was to be housed at Mill 6. Formalized in 1991, the Tsongas Industrial History Center (TIHC) became the culmination of these ideas aiming to create educational programs inspired by the industrial history of Lowell. It is a collaboration between the LNHP, UMass-Lowell and the Lowell School Department Now renamed the Tsongas Industrial History and Science Center, the educational program has grown and evolved in the last 23 years-not just in size but in terms of its reach, its content and its ability to

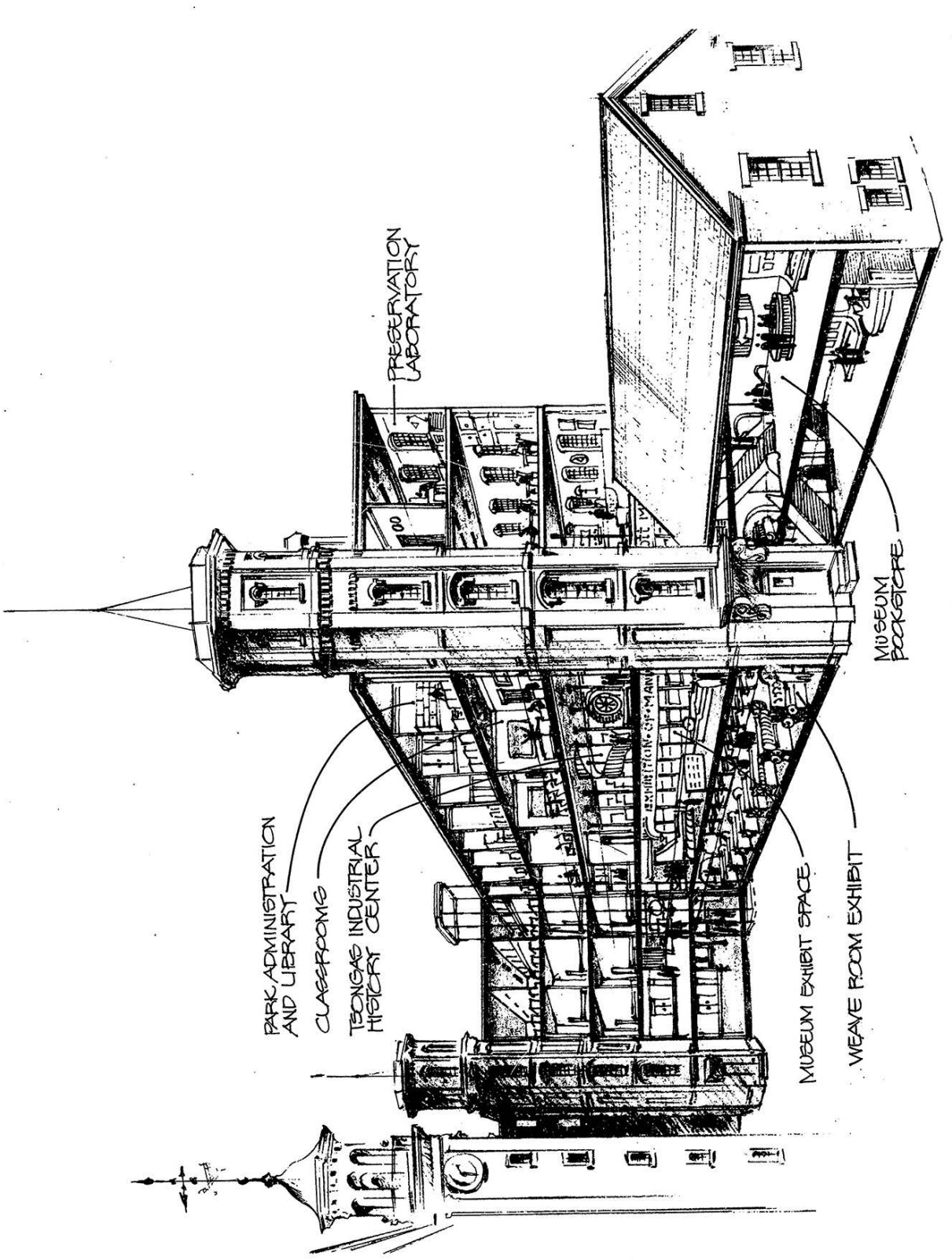


Figure 39. Cut-away perspective sketch showing museum, admin and TIHC program layout at various floors, c. 1986
Source: DSC Archives, LOWE_475_41012_[id1440017]

to have various classrooms or workshops that combined hands-on learning for students in elementary, middle and high school. These classrooms were originally located on the third floor of Mill 6 with a lunch room on the fourth floor. Post 1993 five additional workshops/ classrooms have been created on the fifth floor.

The upper floors of Mill 6 - third, fourth and fifth were also designed to house staff for the LNHP and the NPS Northeast Regional Office (NERO). Curatorial storage space was created on the third floor while library and office space was created on the fourth and fifth floors with material conservation laboratories occupying the west end of the fifth floor. The new service core created in 1993 in the east wing provided elevator communication between the floors, along with an enclosed egress stairway. In the long west wing, an enclosed egress stairway reaches only the third floor, although two communicating stairs were provided.

As described in Chapter 1.4 Chronology of Development, the functions as designed originally and their location within the building have changed somewhat since 1993, but remain largely the same.

CHAPTER 1.4

Chronology of Development

1.4 Chronology of Development

I. History of Use and Physical Changes

The HSR completed in 1984 (and transcribed in Chapter 1.2) provides a comprehensive account of the original use patterns and physical appearance of Mill 6 and the Counting House, and the subsequent changes right up to 1984. Owing to available archival material, the period from 1871-1955 is most detailed in its account -the period from 1956-1984 is less detailed. In order to build upon the chronology of development outlined in the previous HSR and document the period from 1984 to the current time (2016), it is important to first begin with a summary of changes that had already taken place in each building's life up to that point. This will allow us to distinguish original features from later ones, and inform the identification of character-defining features in subsequent chapters.

Therefore, this current chapter is organized into two parts– **Counting House** and **Mill 6.** In each part, we will begin with a brief summary of the chronological development of the building, from 1839-1984 in the case of the Counting House, and 1871-1984 in the case of Mill 6. Please note the descriptions included here are summaries of the information included in Chapter 1.2, which should be referred to for more detailed information.

The narrative is supplemented by photographs and new color-coded illustrations that highlight important physical changes in every time period. These graphic illustrations are based on photographs and other archival information contained in the 1984 HSR and other data collected as part of research for this HSR update. The period 1956-1984 is expanded upon from what was included in the 1984 HSR. This is important not only to document that period better, but also since its end serves as the physical baseline for the time period of this HSR update (1984-2016).

COUNTING HOUSE

1839-1936

This period begins with the presumed construction date of the Counting House 1836-1839, and ends right before a comprehensive interior renovation was carried out in 1937 (which provides the earliest drawings of this building). It roughly covers the first two time periods of the previous HSR. Although this time spans almost 100 years, owing to lack of archival information*, the 1984 HSR was not able to document completely the building's original appearance and changes during this period. Photographs, other archival material and accounts of the 1937 work do, however, provide many clues about original elements and those that were altered during this time.

First Floor:

As originally built, the Counting House was a free-standing structure. Buildings of similar form to the east within the site of Mill 6 housed service functions supporting the textile production of the complex's earlier mills. The building had a rectangular footprint that has remained virtually unchanged to date. There was a large vault in the center of the first floor with a masonry wall running north-south. Another N-S masonry wall spanned the building width further to the east, thus subdividing the rectangular floor-plate into three large spaces. Not much is known about other interior partitions but there was presumably a stair in the western end that led up to the second floor. It was accessed by a door on a west façade and the western-most door facing the yard on the north façade. Another four doors on the north façade opened up to the yard, and possibly provided access to workers moving equipment. The structure consisted of load-bearing masonry walls, timber beams, wood joists and flooring and a combination of cast iron and timber columns. The first major change to the structure occurred in 1871 with the construction of Mill 6 directly adjacent to it on the east, covering the entire east wall and two bays of the north wall.

Second Floor:

The second floor was accessed from the first floor by the stair on the west end, and also by a footbridge over the canal from the south. This footbridge connected with the west stair at the landing level via a door on the south façade. This entrance was possibly used by visitors and mill officers whose offices were located on the second

* The HSR notes in a footnote on pg. 167 that the drawing file that contained the records concerning the Counting House, stored at the Boott Mills by Locks and Canals, has been misplaced and therefore was unavailable for research and documentation.

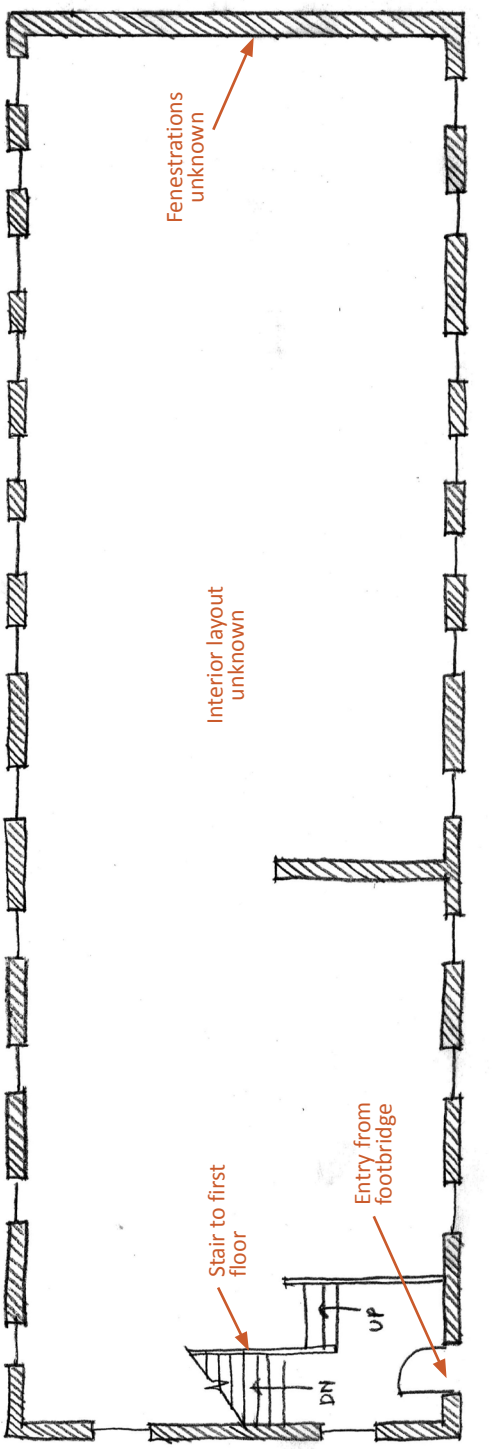


Figure 41. Second Floor - Counting House; 1839
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

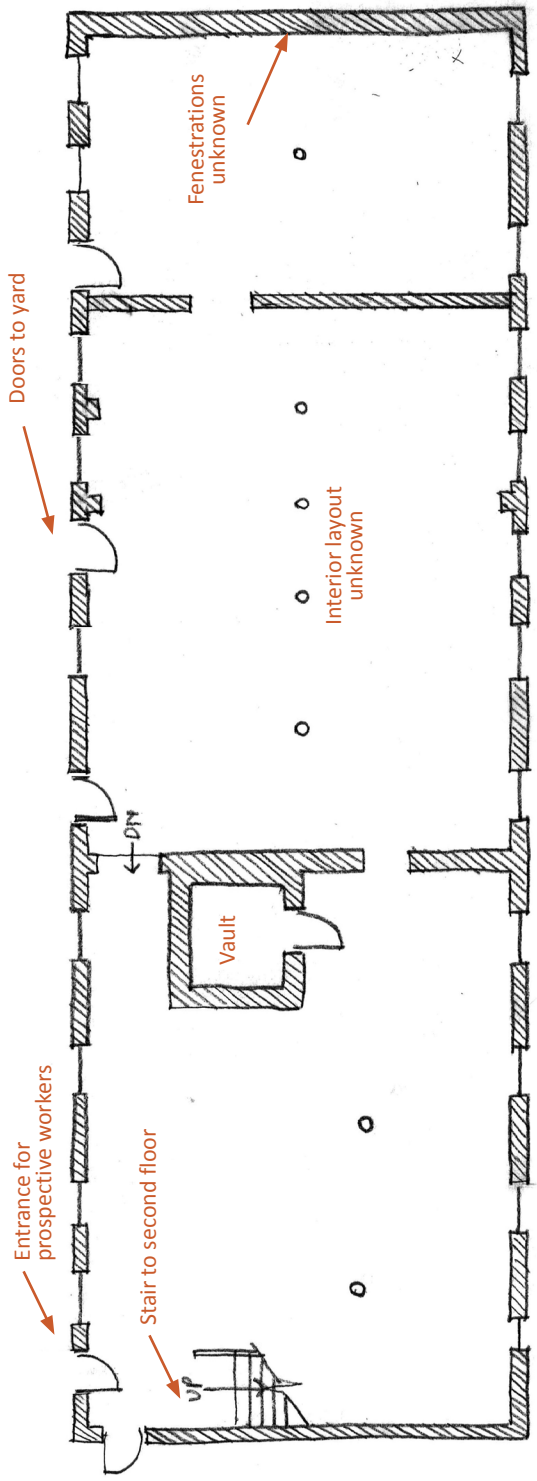


Figure 40. First Floor - Counting House; 1839
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

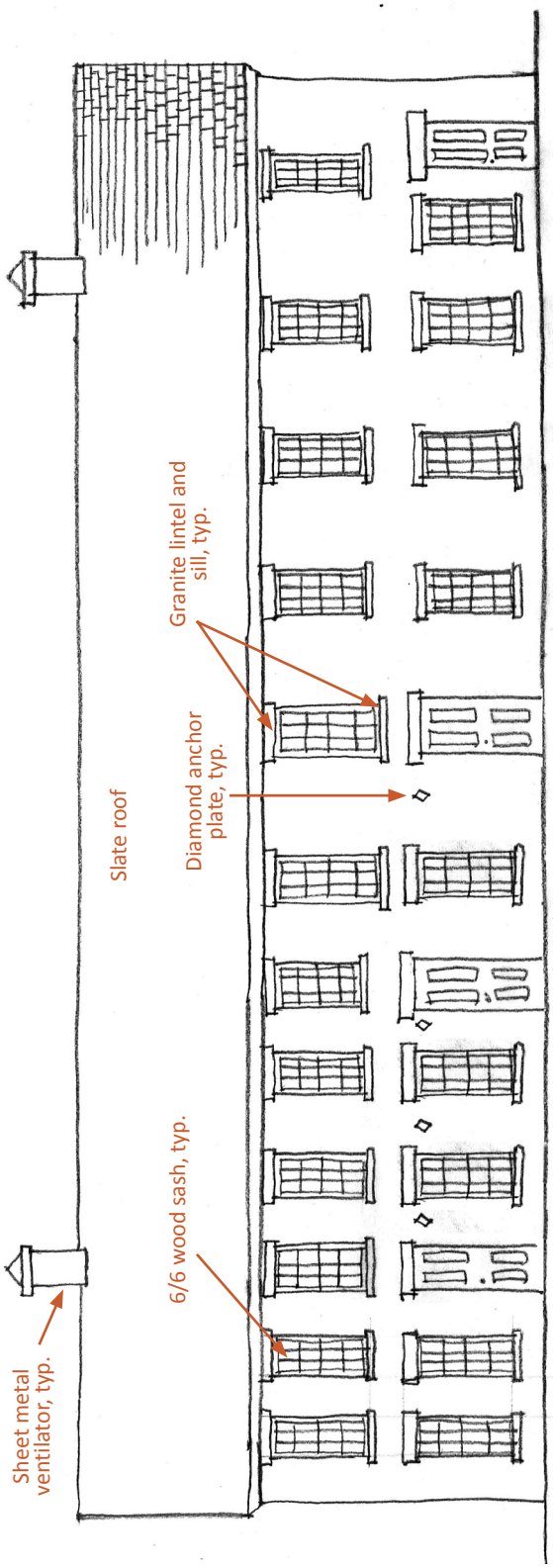


Figure 42. North Elevation - Counting House; 1839
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

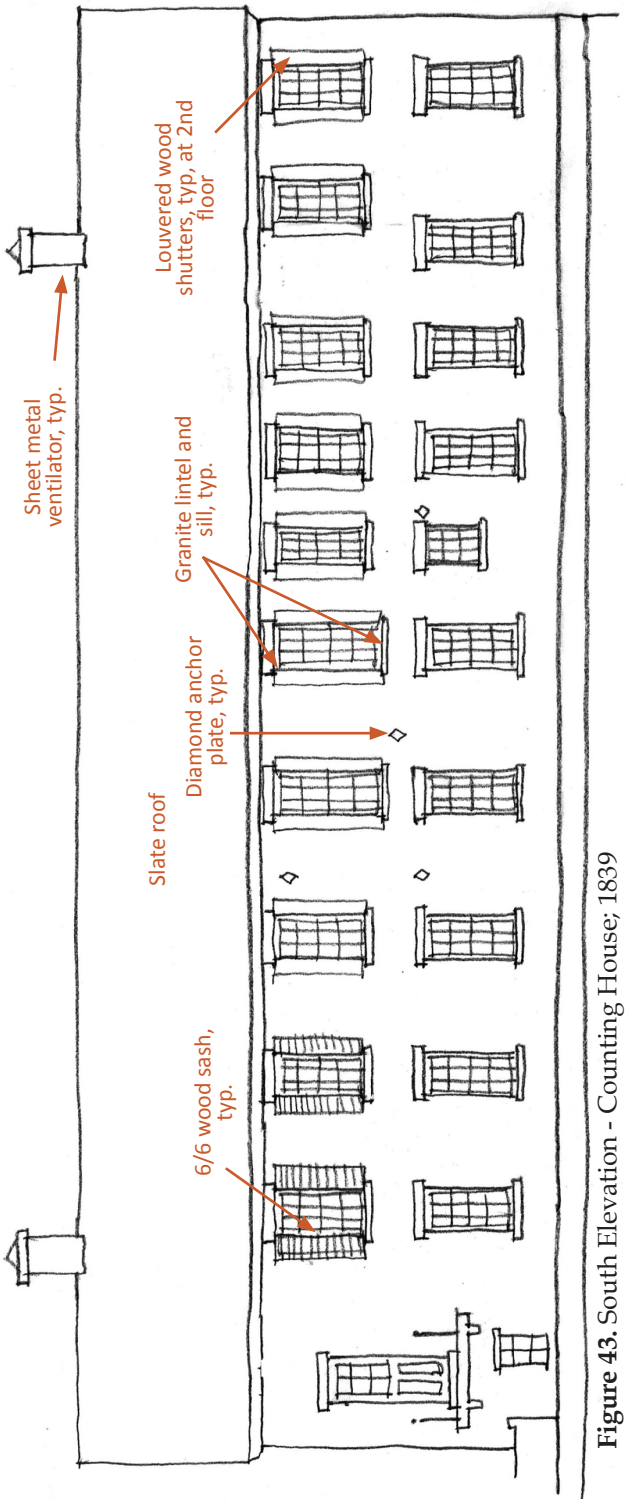


Figure 43. South Elevation - Counting House; 1839
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016



(Reprinted) Photo 14. Stereopticon view of Boott Mill Number 6 and the Counting House, c.1875
Source: UML, CLH, B6456 CN 05

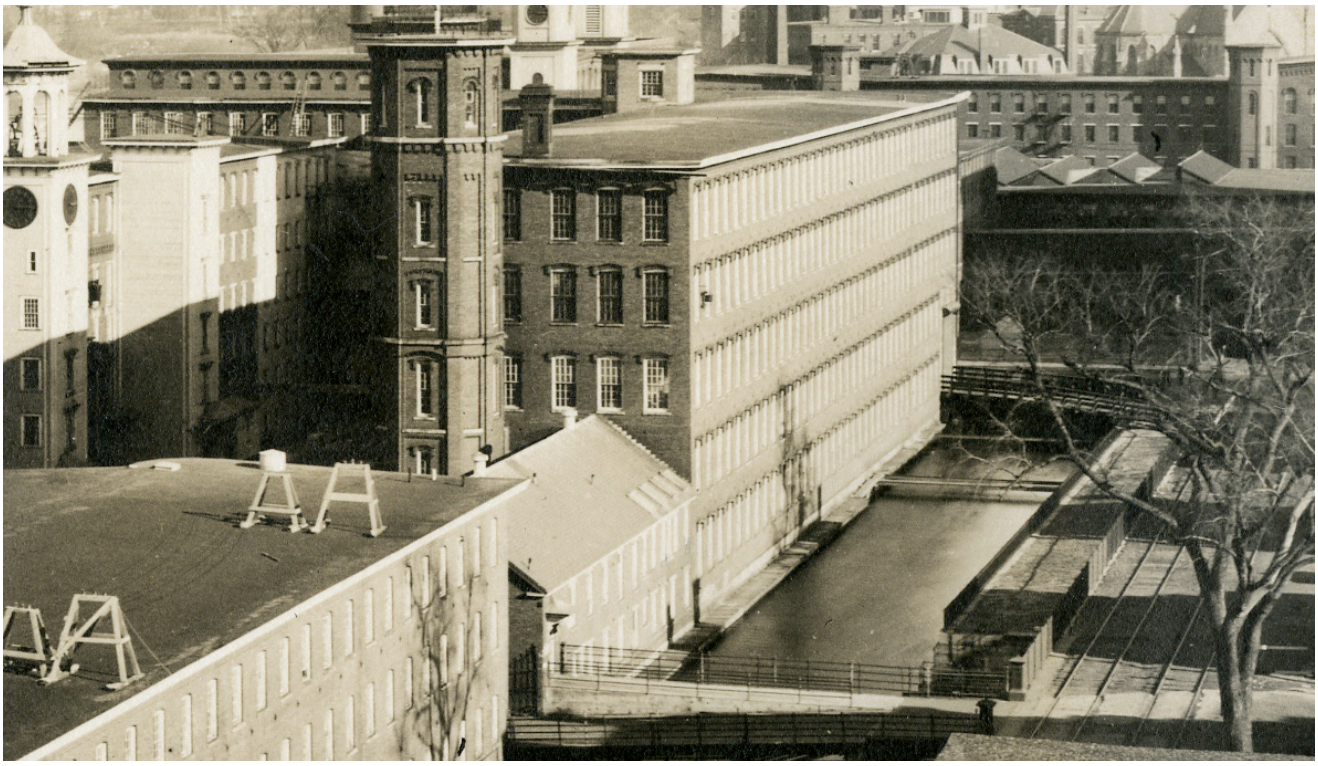
floor. Not much is known about interior partitions on this floor, except that a masonry wall directly above one of the first floor possibly ran N-S thus dividing the floor-plate into two sections. With the construction of Mill 6 in 1871, two of the easternmost windows on the north wall were blocked off as they were now obscured by the octagonal stair tower of Mill 6.

North Elevation:

This is the yard-facing elevation of the Counting House and comprised of thirteen bays at the time of construction. The first floor appears to originally have had four doors that were located in the 3rd, 6th, 8th, and 15th bays starting from the east, as evidenced on the building and an historical photograph. The face of the three surviving granite door lintels each contain penetrations of cut-off bolts near each end, which may indicate later canopy attachments. The lintel of the 6th bay is located well above both the current and somewhat lower original 2nd floor level. That lintel's proximity to the window sill above and the presumably later bolt marks suggest that it was originally lower, most likely right in that same wider door opening, to allow the fit of a window canopy in the spandrel between door lintel and window sill above. All the doors were probably paneled wood doors and had granite lintels. All first floor window openings were roughly the same size and had granite sills and lintels and 6/6 wood sash. The second floor windows varied in size and were organized into twelve bays – the westernmost bay had a window positioned centrally above the twelfth and thirteenth bay on the first floor. All second floor windows were similar to the first floor in having granite sills and lintels and 6/6 wood sash. The building had a slate roof and a sheet metal ridge ventilator near each end of the roof. Due to the construction of Mill 6 in 1871, the two easternmost window bays on both floors were bricked up. The door in the 3rd bay may have been changed then to a window and its function provided in a window bay to the west.

South Elevation:

This is the canal-facing elevation of the Counting House and comprised of eleven bays at the time of construction. The first bay from the west had an entrance door off the footbridge into the building that connected a landing level between the first and second floors. The entrance door was possibly a paneled wood door and was protected by a flared metal hood that is evident in early photos of the building. The concave sheet metal hood was similar in concept to those installed at the doorways on the new stair towers of Mills 1 through 4 in the early 1860s, and thus may date from the same period. It was removed sometime between 1928-1936. All windows had granite sills and lintels and 6/6 wood sash similar to the north façade. A peculiar feature noted in the earliest photo



(Reprinted, zoomed) Photo 26. "Boott Mills Looking East, March 1928" Mill Number 6 is at right, with Counting House in front of it.
Note flared metal hood at footbridge entrance door, absence of window shutters and presence of roof skylights
Source: LNHP, Museum Collections, LOWE 8658

(1871-1882) of the Counting House, shows that the second floor had louvered wood shutters on every window. It is unclear if they existed on the first floor of the north façade windows and when they were removed. But as evidenced by later photographs, they were certainly absent by 1928. Another change to the south façade happened between 1899-1928 with the addition of four skylights on the eastern end of the south roof.

East Elevation:

Not much is known about the original appearance of this wall-whether it had any window openings etc. It was completely altered in 1871 with the construction of Mill 6 and serves as the party wall between the two buildings. It is unclear whether there were any openings in this wall that connected the Counting House to the shops at this end of Mill 6.

West Elevation:

This is the gable end elevation of the building and featured a door opening at the north end on the first floor and two window openings on the second floor. This probably remained fairly unaltered until the renovations in 1937.

1937-1983:

Figures 44 - 47 show the physical conditions after the 1937 renovations with dates for changes that occurred prior to 1937.

Figures 48 - 51 show the physical condition of the building in 1983 with dates for changes that occurred from 1938-1983.

This time period begins with a renovation of the Counting House in 1937 and ends with the publication of the previous HSR. 1983 is also the year in which detailed HAER drawings were prepared for the Counting House allowing one to accurately date building features. 1937-1982 roughly covers the last two time periods of the previous HSR. A lot happened during this time span- Lowell's worst flood shut the Mill down for 4 days in 1936 and flooded the first floor of the Counting House. This is probably what prompted the 1937 renovations (initiated in 1936, executed in 1937). After 18 more years of operation though, Boott Mills closed in 1955 and the Counting House was re-organized to serve as offices for the Locks and Canals in 1960.

First Floor:

The major changes to the first floor in 1937 were new interior partitions, creating new office spaces and toilets for men and women. The stair at the west end was rebuilt- the access door to it on the north façade was retained while the one on the west façade was converted to a window, with a new window added to the south of it. A second stair to the second floor was added on the east end of the building, and an opening was created in the party wall between Mill 6 and the Counting House with a ramp leading to additional office space in the west end of Mill 6.

In preparation of the mill sale in 1955, the opening between the Counting House and Mill 6 was bricked up. In 1960, Locks and Canals made some renovations to the building before occupying it as office space- the opening to Mill 6 was opened up again- the ramp was replaced with steps with a new door. This opening was infilled with concrete block again sometime before 1983, as shown on the HABS/HAER drawings created in 1983 and reproduced graphically in Fig. 48. Other major changes included a new concrete vault that was added in the west part of the building, and the removal of a N-S brick wall in the east part of the first floor.All new interior wood partitions were put up, probably in 1960 when the office space was reorganized. Sometime during this period new concrete pilasters were also added on the first floor along the north and south brick walls and at building corners as shown in Fig. 48, to strengthen the existing masonry structure.

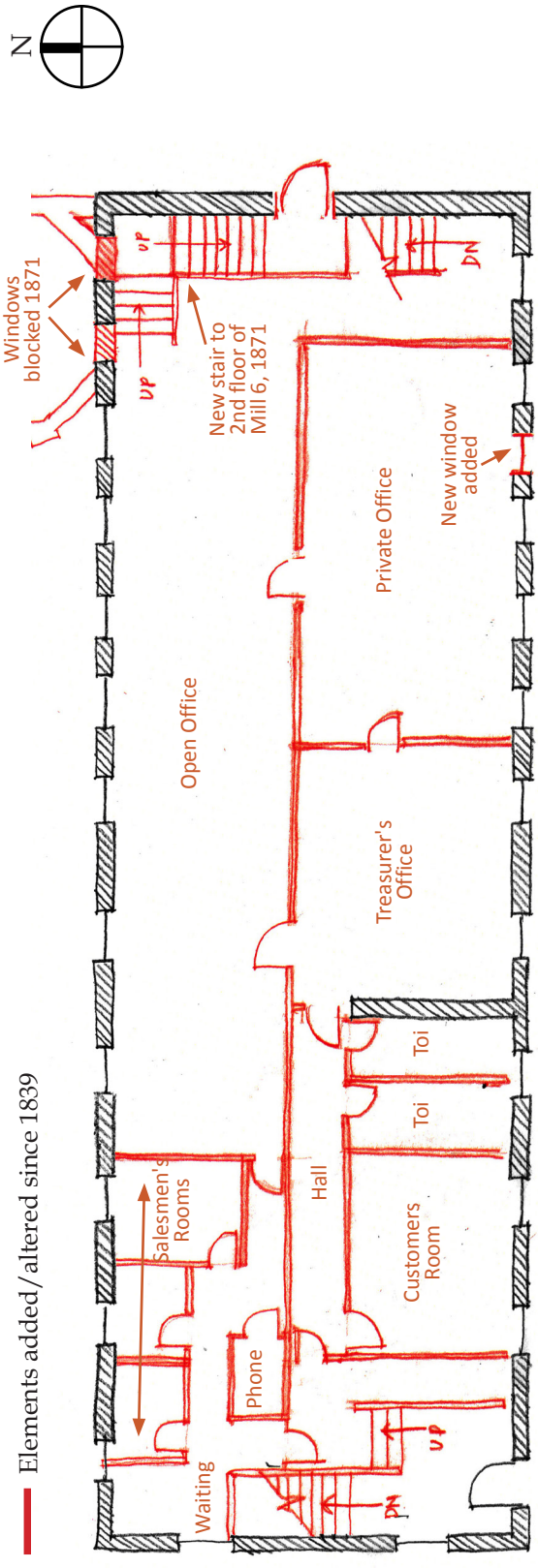


Figure 45. Second Floor - Counting House; 1937
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

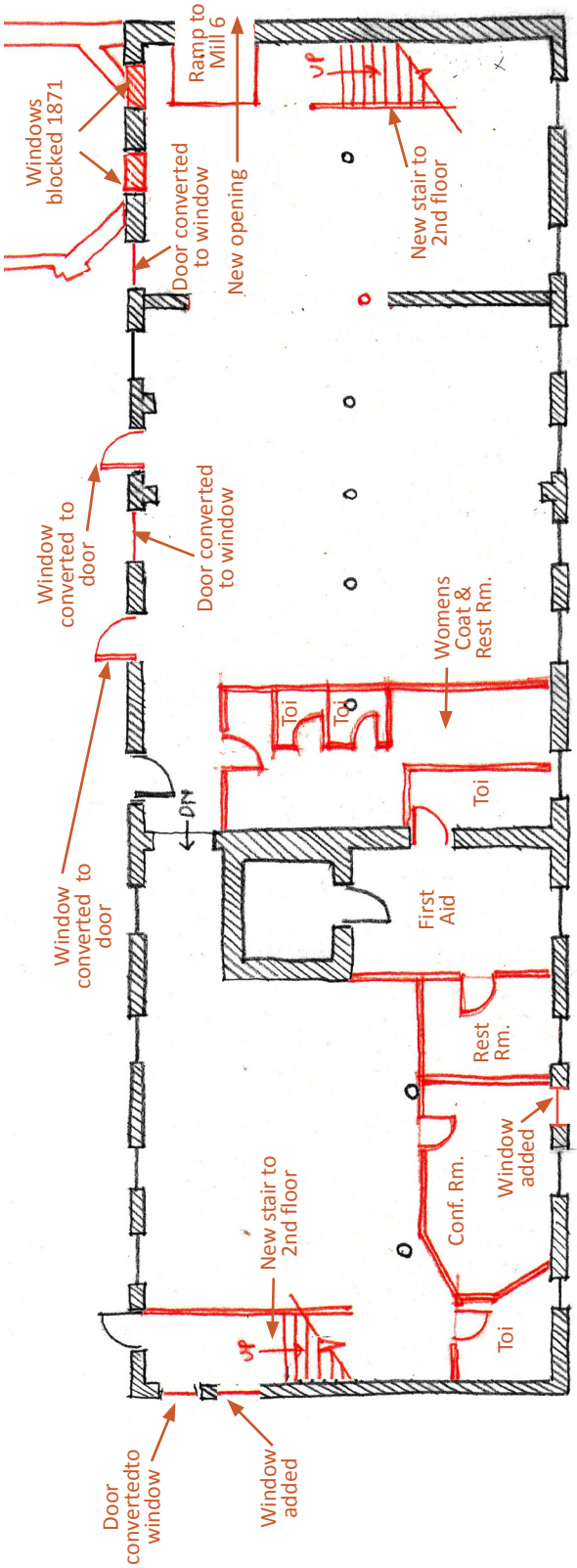


Figure 44. First Floor - Counting House; 1937
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

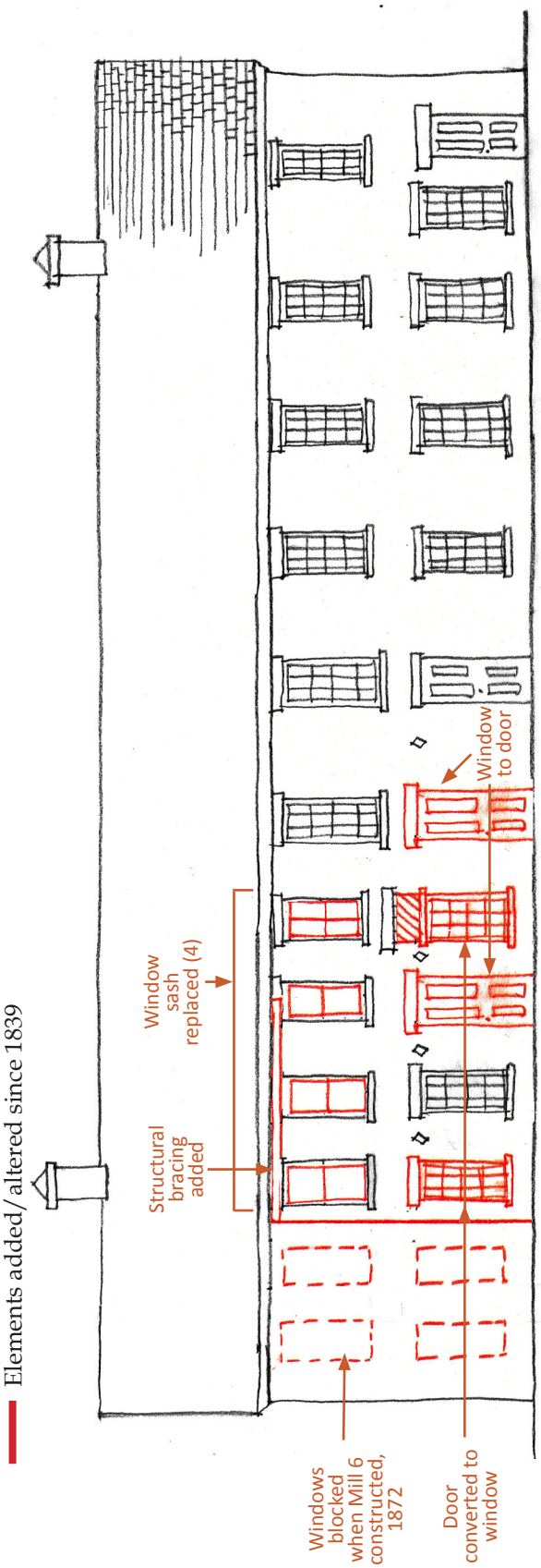


Figure 46. North Elevation - Counting House; 1937
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

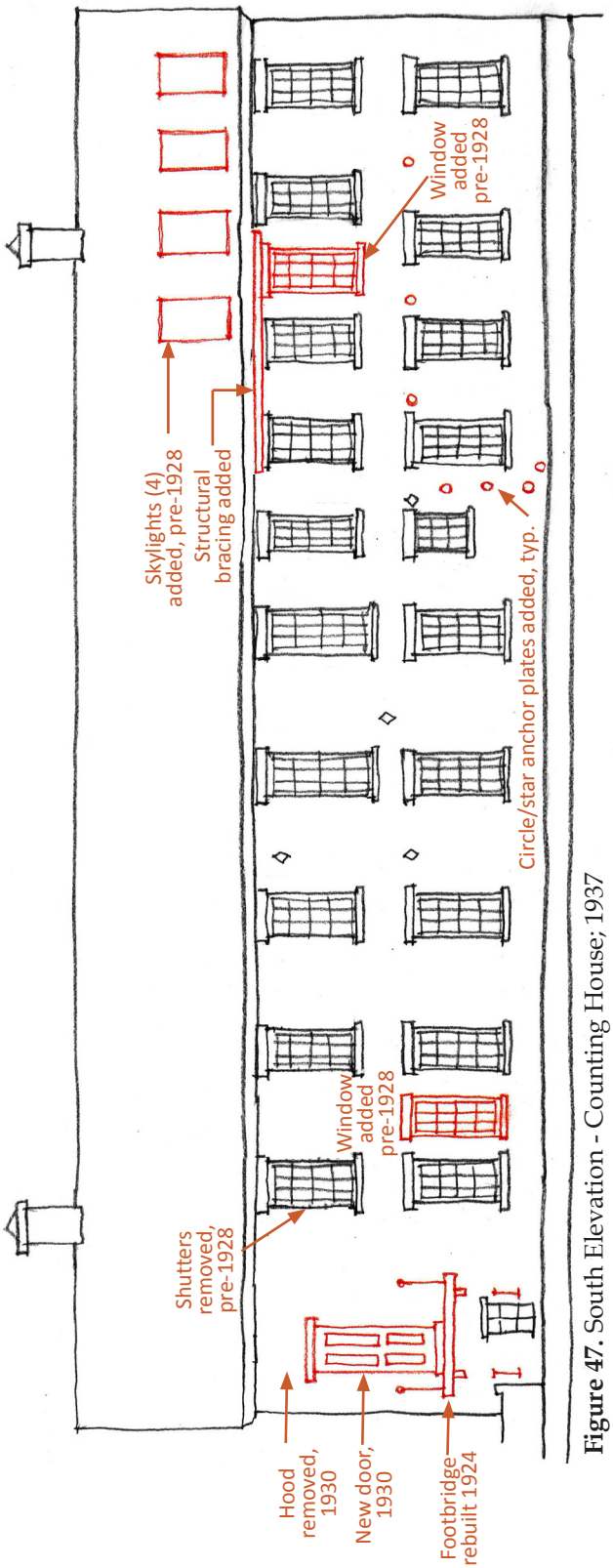


Figure 47. South Elevation - Counting House; 1937
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

Second Floor:

In 1937, the second floor interior layout was revamped to create new open and private office space. A new straight run stair at the east end connected this floor to the first floor of the Counting House while a second L-shaped stair wrapped along the inside northeast corner to connect the Counting house to the second floor of Mill 6. Since the 1937 plans note this stair as 'present', it is likely that this was added prior to the 1937 work, probably when Mill 6 was constructed in 1872.

By 1983, the second floor connecting stair and opening between Mill 6 and the Counting House had been removed, a completely new interior layout had been built to house offices of Locks and Canal and concrete pilasters had been added on the first floor along the north and south brick walls and at building corners as shown in Fig. 49.

North Elevation:

There were originally a set of four doors on this facade, as shown in Fig. 42, that provided access to the yard. The westernmost door provided access to the interior stair at this end. Some of these doors were altered by 1937 as shown in Fig. 46—the doors in the third and sixth bay from the east (count includes bays covered by Mill 6) were converted to windows and existing windows in the fifth and seventh bays from the east were converted to doors. Window sash in the four easternmost windows on the second floor had been replaced with 1/1 and 2/2 sash, different from the 6/6 lites of the original. By this time, angle braces had also been added to the brick wall atop the three easternmost second floor windows as an effort to stabilize this wall and also the adjoining Mill 6, which had reportedly been suffering from vibrations due to loom operation. These structural repairs may have pre-dated 1937.

By 1983, there had been a marked change in the appearance of the north façade. The two ventilators were gone from the roof, which itself had been re-shingled with asphalt in lieu of the original slate tiles. On the first floor, in the seventh bay from the west a door was converted to a window, while in the fourth bay from west, a window was converted to a door. This door-window configuration is the same as that exists at the building in 2016, confirming that it was retained since the Park acquired the building in the 1980's. Simple wood hoods were added atop the four doors on this elevation probably between 1938-1955.

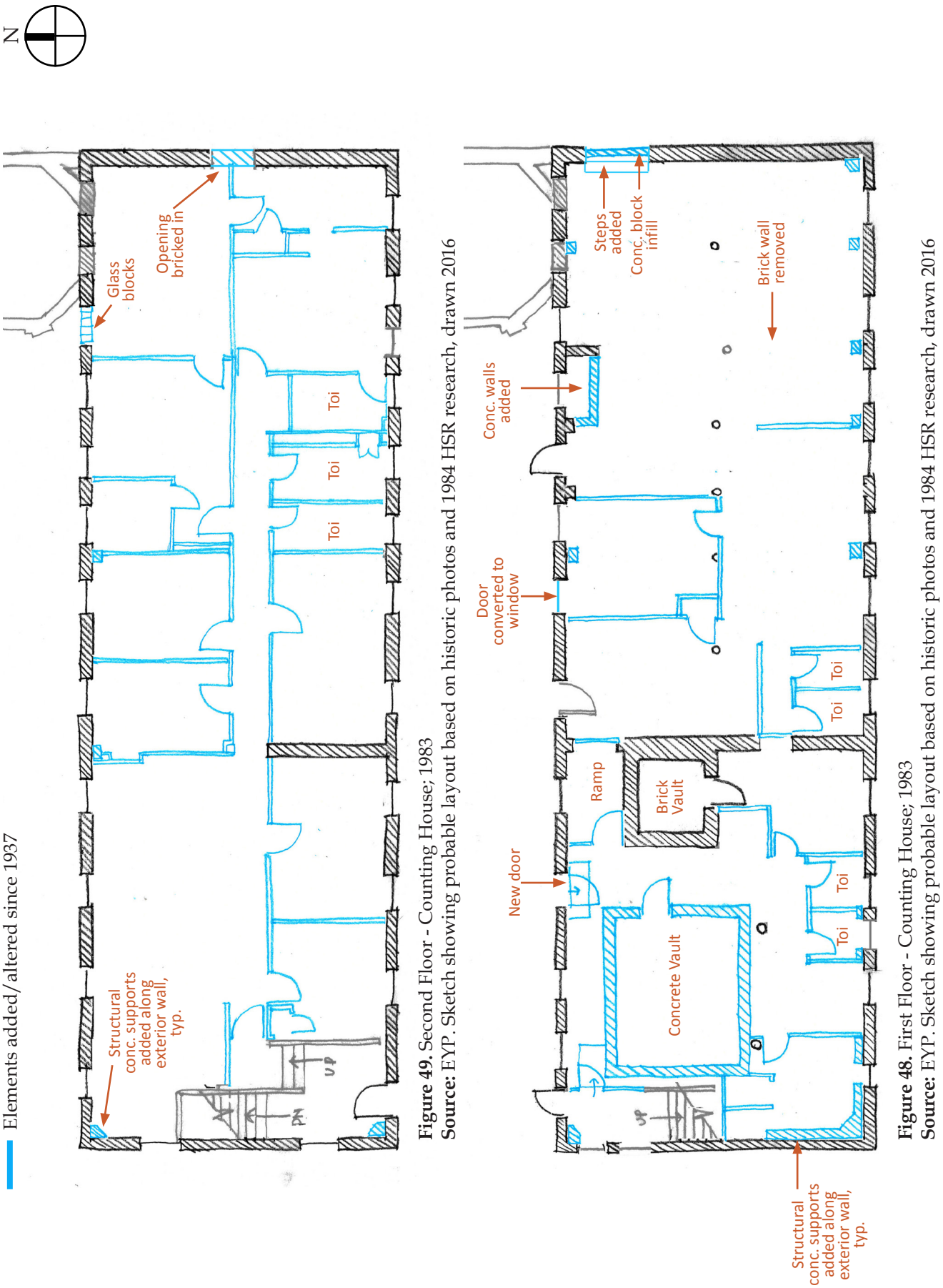


Figure 49. Second Floor - Counting House; 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

Figure 48. First Floor - Counting House; 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

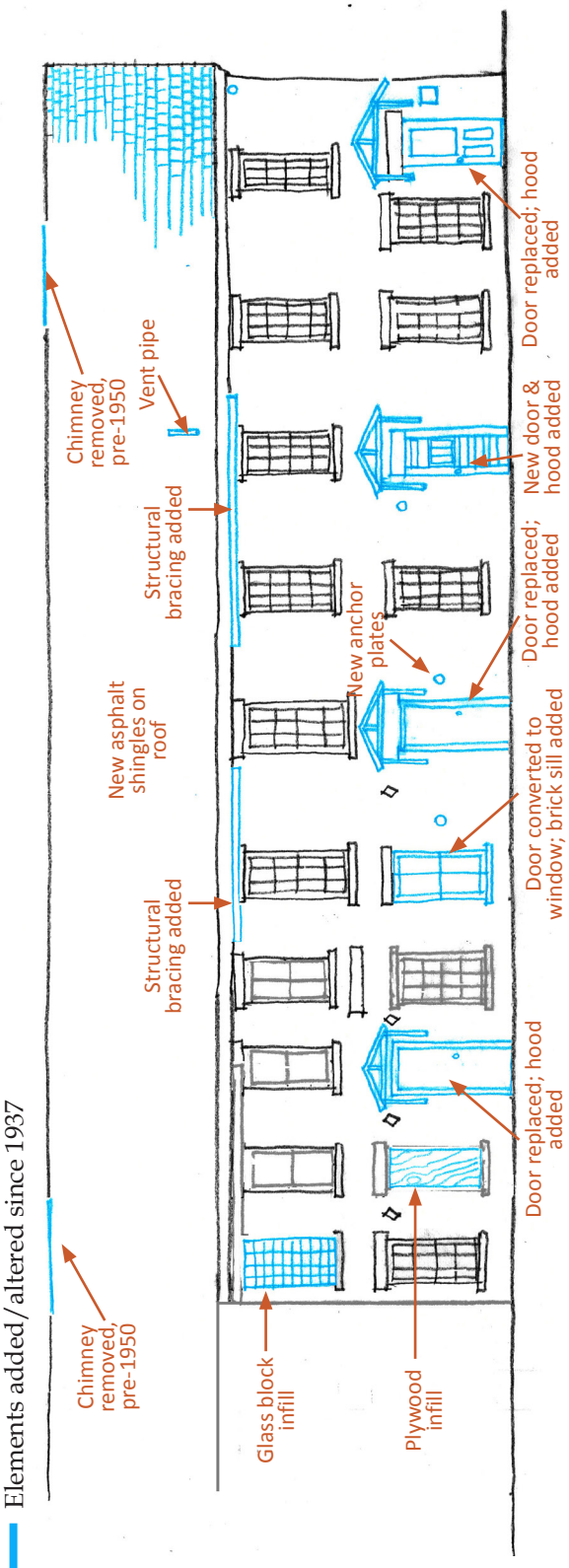


Figure 50. North Elevation - Counting House; 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

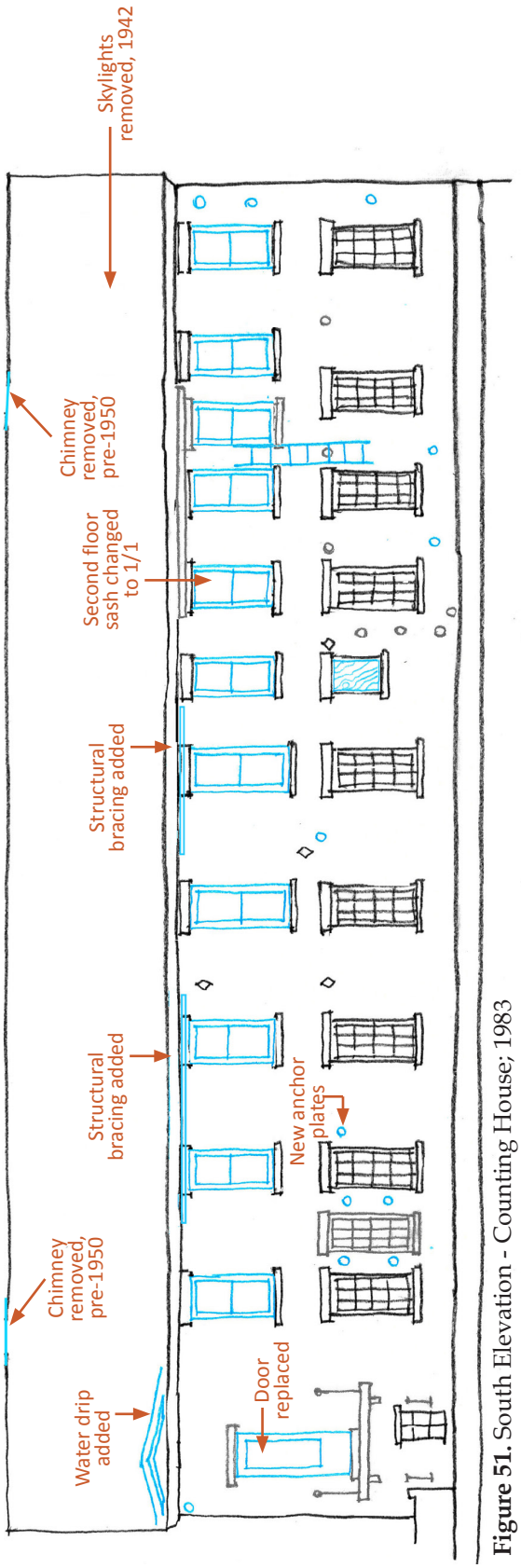


Figure 51. South Elevation - Counting House; 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016



Photo 50. South Elevation of Counting House, 1982
Source: HAER, Reproduction Number: HAER MASS,9-LOW,7--17



(Reprinted, zoomed) Photo 19. North and west elevations of Counting House, June 1985
Source: HAER, NPS, MA-16, 1985

South Elevation:

By 1937, a few minor changes had taken place at the south, canal-facing façade of the Counting House. Most noticeable was the addition of two windows- one at the first floor between the second and third bays, and second at the second floor between the ninth and tenth bay from the west. Both were 6/6 wood windows with granite sills and lintels similar in detailing to others on this façade. The shutters seen on an early pre-1882 photo on the second floor windows were gone, and so was the flared metal hood atop the footbridge entrance. A few circular star-shaped metal anchor plates could be seen and an angle brace over four second floor windows was also documented on the 1937 drawings. The four skylights in the south roof were removed in 1942.

By 1983, a number of other changes were visible in this façade- apart from the removal of the slate shingles and sheet metal ventilators noted in the north wall discussion above. These included replacement of all the 6/6 wood window sash on the second floor windows with 1/1 versions, addition of more angle braces over second floor windows and a new glazed door at the footbridge entrance with a sloped water drip integrated in the roof above.

1984 – 1993

The Park did not formally acquire the Counting House from the Locks and Canals Company/Boott Hydropower, Inc. until May, 1987. From the sketches (Figures 52 & 53) , it is unclear what the intended use of the building was, but there is definitely an intent to restore the exterior of the building, to improve public access to it and create a community area along the north side called the 'Counting House Courtyard'. The sketch (Figure 52) retains the elevated footbridge on the south with an entrance between the two floor levels. The entry itself was proposed to be widened with new double doors and signage above. Landscape improvements to the sidewalks and canal-walk were also suggested. On the south façade, the four door openings and hoods that existed in 1983 were proposed to be retained with the westernmost one widened to incorporate a double door similar to the south side.

This early sketch evolved to more detailed 'Comprehensive Design Drawings' prepared by Earl R. Flansburgh & Associates, Inc. dated 2/28/1986. These drawings were prepared for the Counting House in conjunction with Mill 6. It is therefore clear that by this time it had been decided that the future use of these two buildings will be tied together and would be of a cultural nature with space for a museum, offices and educational activity areas as evidenced by the floorplans.

It is believed that at this stage the project was split into two phases- the first phase included core and shell improvements to Mill 6,

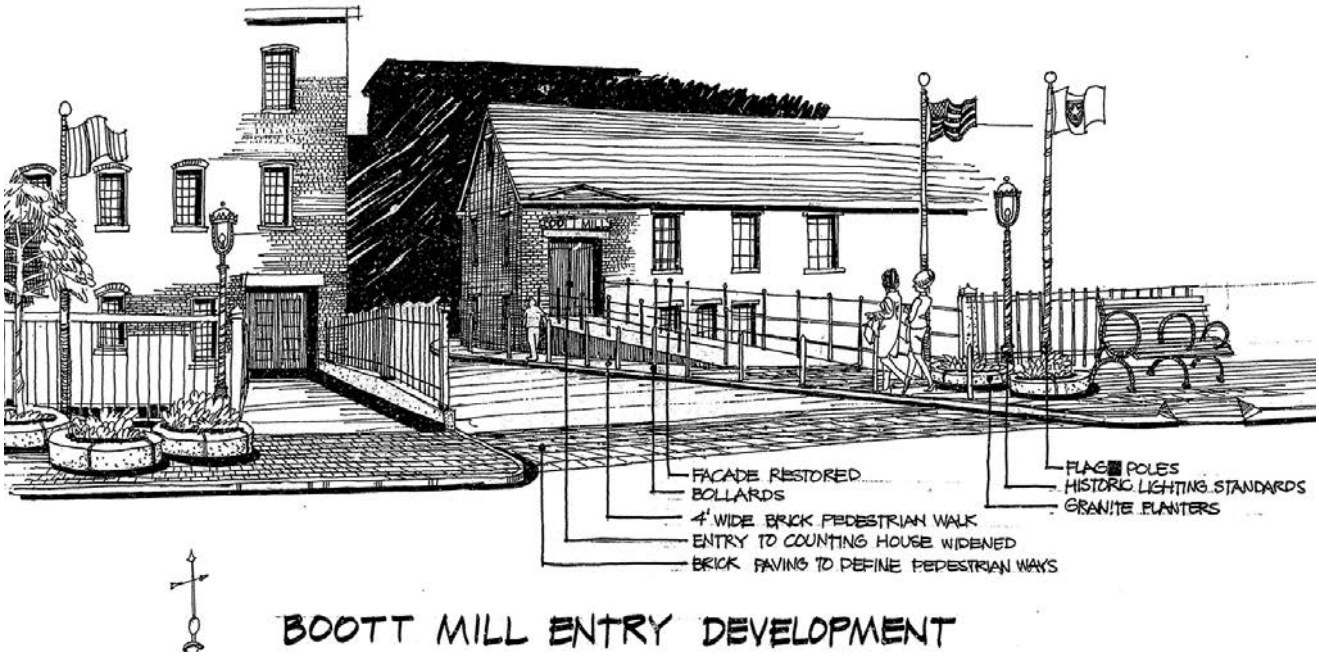


Figure 52. "Preliminary Study of Boott Mills", Boott Mill Entry Development, 1983
Source: DSC Archives, File No. LOWE_475_40014_[id36299]

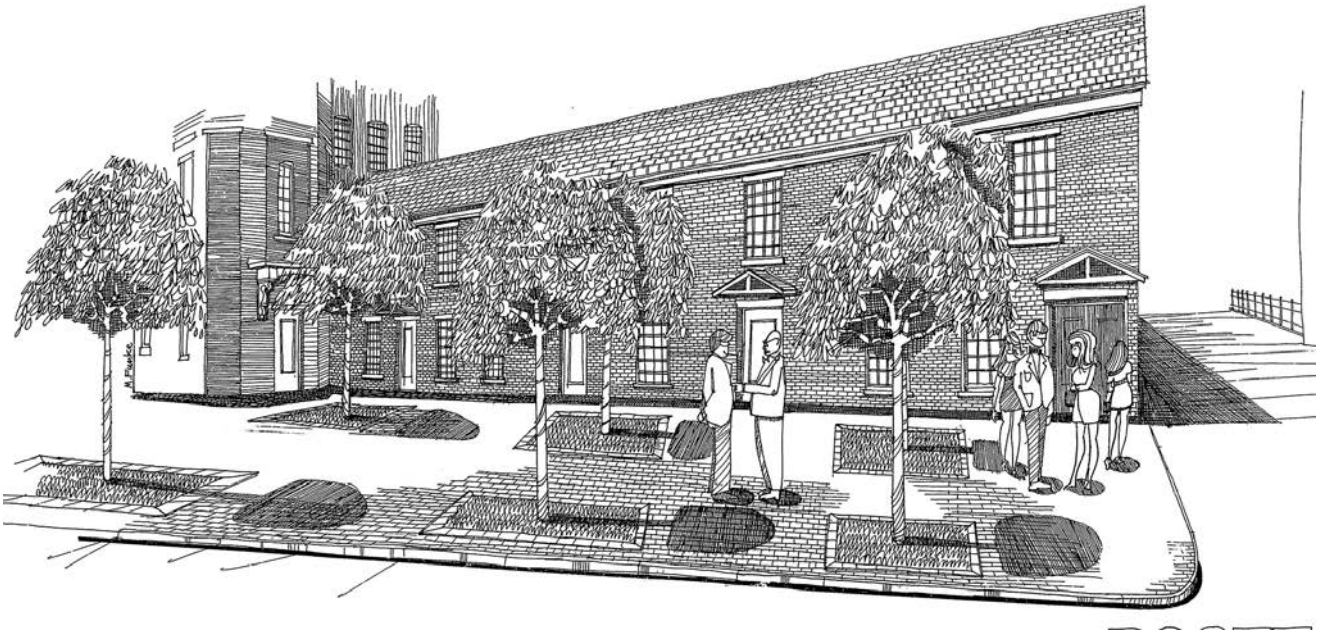


Figure 53. "Preliminary Study of Boott Mills", Counting House Courtyard, 1983
Source: DSC Archives, File No. LOWE_475_40014_[id36299]

and the second phase included interior fit-out and additional shell improvements to Mill 6 and both core and shell and interior fit-out of the Counting House. The first phase was completed in 1989, as suggested by as-built drawings prepared by Flansburgh Associates revised March, 1989. However, since the first phase apparently did not include the Counting House, the changes to it appear in the as-built set documenting the second phase, also prepared by Flansbugh Associates and dated March 1993.

The interior of the Counting House was completely re-envisioned for use by the Park. The new design and construction program for the building was carried out during the 1984-1993 period. Basic to the reuse of the building was the almost complete gutting of the interior down to the exterior brick walls. The entire first and second floor structures were removed. Only stubs of the remnants of the two historic brick cross walls and the concrete pilasters of earlier 20th century structural repair work attached to the exterior walls were retained. The work on the new first and second floors and its related exterior effects is described following:

First Floor:

The 1986 drawings show a departure from the early 1983 sketches for the footbridge- it is now shown level with the adjacent sidewalk and enters the Counting House at the first floor level on the south façade via a semi-open passageway that cuts across the building

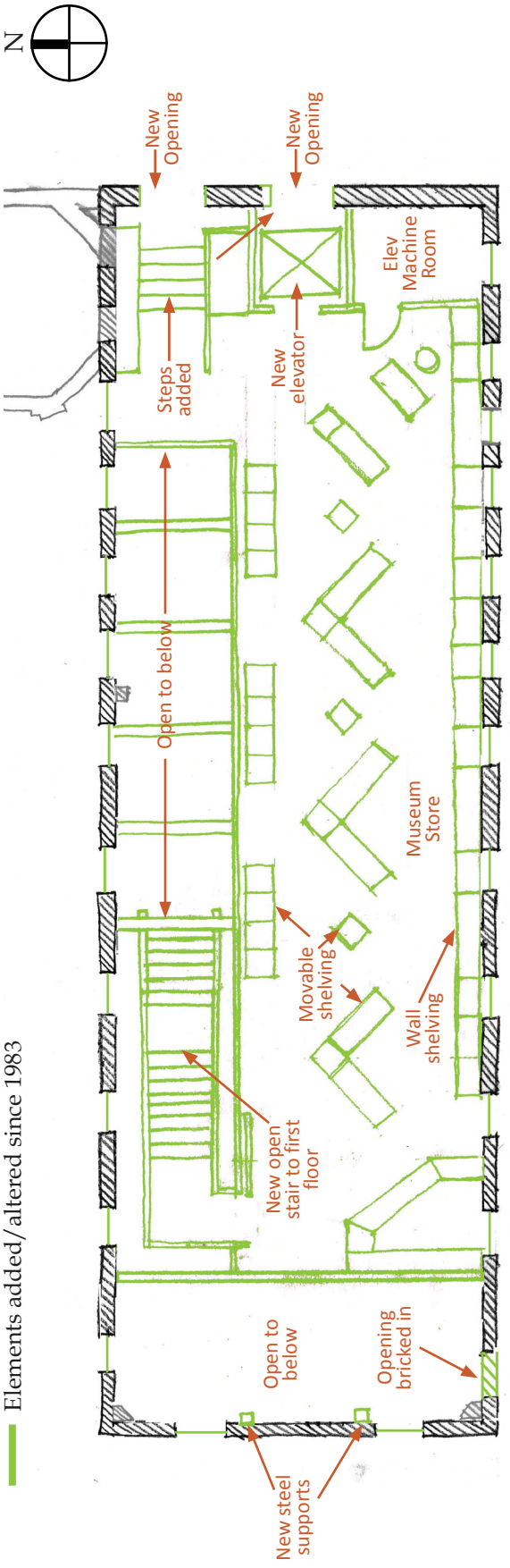


Figure 55. Second Floor - Counting House; 1993
Source: EYP.

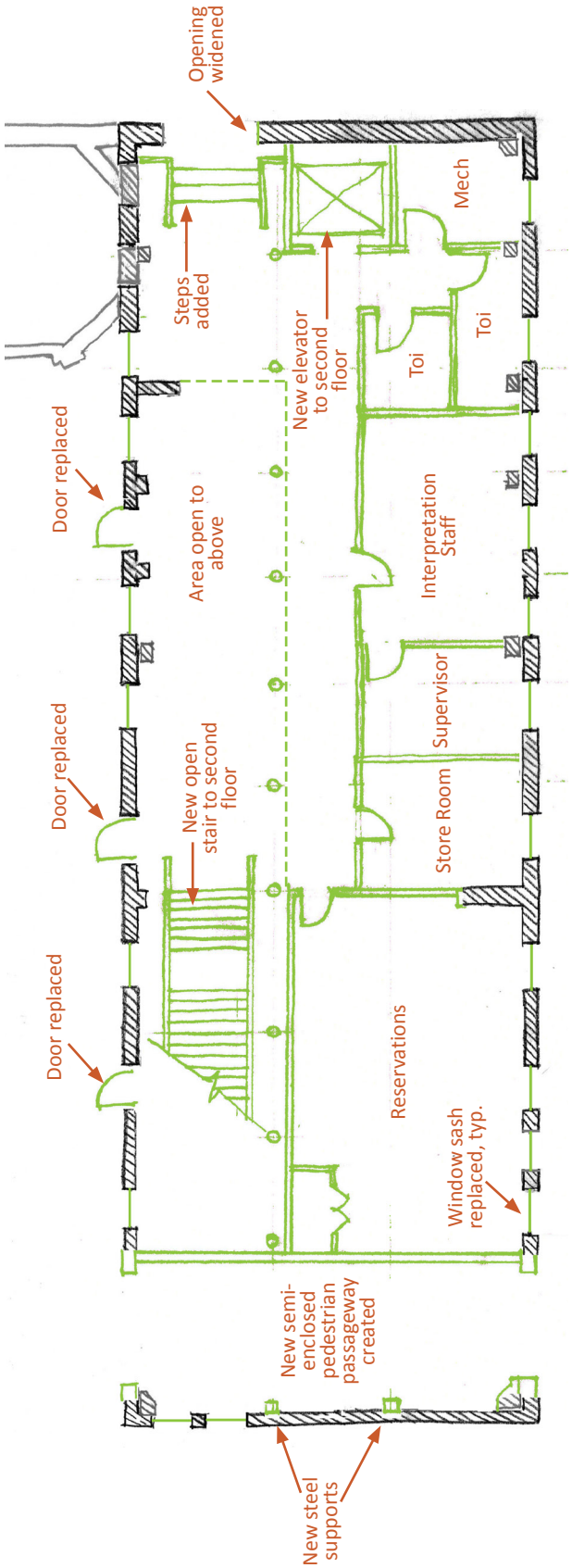


Figure 54. First Floor - Counting House; 1993
Source: EYP.

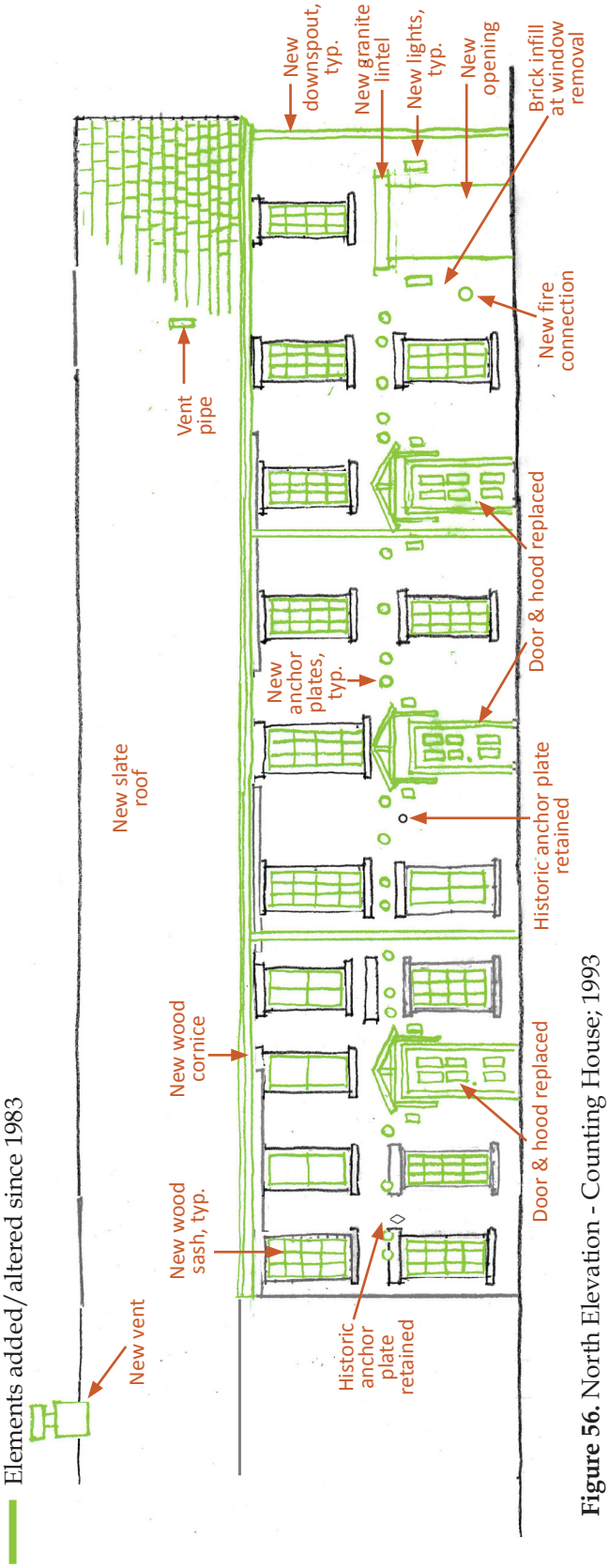


Figure 56. North Elevation - Counting House; 1993
Source: EYP.

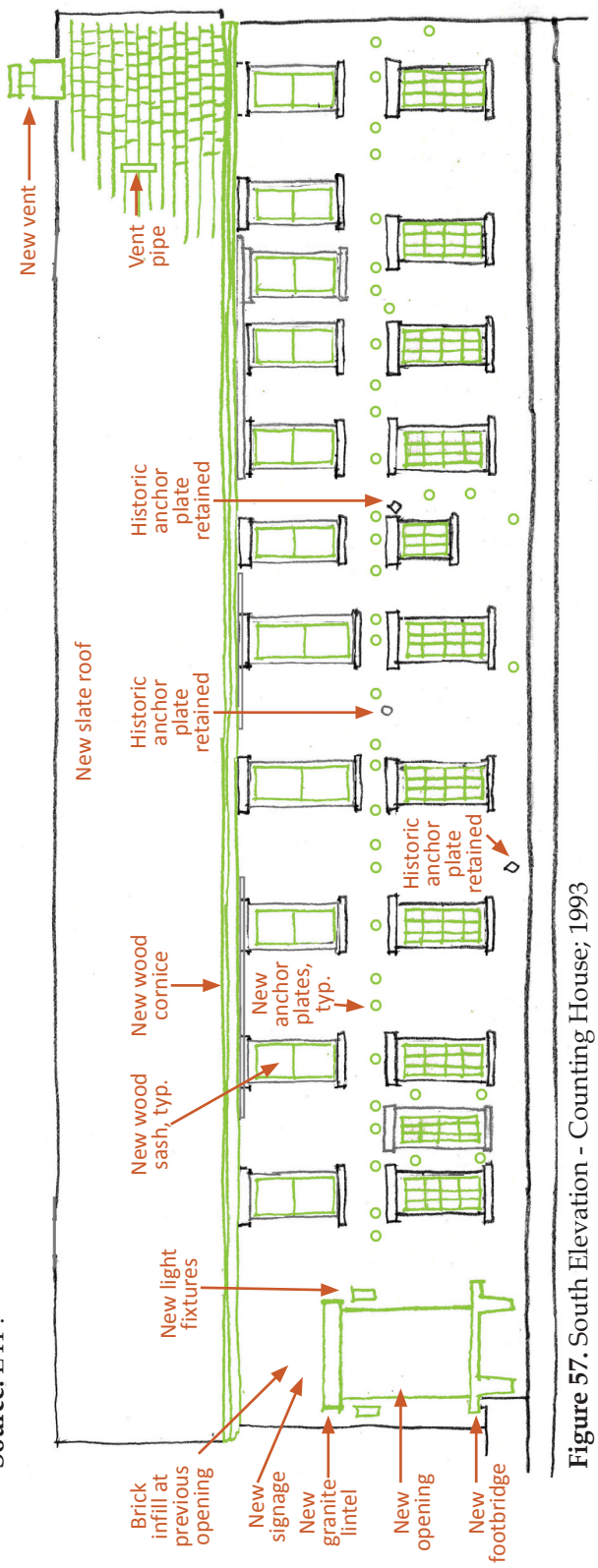


Figure 57. South Elevation - Counting House; 1993
Source: EYP.



Photo 51. South Elevation - Counting House; c. 1993
Source: Flansburgh Architects, http://flansburgh.com/projects/boott-cotton-mills-museum/

from north to south. This coincides with what currently exists and is documented in the 1993 as-built plans. This semi-open passageway was accomplished by creating a new north-south wall that took up the entire westernmost fenestration bay on the south façade and two of the westernmost fenestration bays on the north façade. The original west façade of the Counting House was retained, and the new passageway left open to the roof framing above in this area to essentially create a double-height pedestrian entry portal to the Boott Mill Complex.

The entire two-story Counting House was designed as a public entrance and the exit for the adjacent Boott Mill Museum housed in Mill 6. Once visitors made their way to the former mill-yard via the double-height passageway described above, they followed the originally brick sidewalk along the north façade of the Counting House to access the lobby on the first floor via a set of three exterior doors (in the same openings as pre-1983).



Photo 52. Double- height pedestrian passageway at west end of Counting House, 2016
Source: EYP

Re-imagining the Counting House as it existed in 1983, as a new public space necessitated a complete change to the interior floorplan. First was the removal of the original brick vault and the later 1960 concrete vault from the western portion of the plan. Second, the entire first floor slab was removed and an entirely new reinforced concrete slab on grade was poured under the building.



Photo 53. Entrance lobby at first floor of Counting House, 2016. Note the double height space created in 1993 by removing a section of the second floor slab and re-framing the area with new beams and columns.
Source: EYP



Photo 54. Open stair to second floor in Counting House lobby, 2016
Source: EYP



Photo 55. Concrete pilasters at exterior wall of Counting House retained in the 1993 renovation, 2016
Source: EYP

This slab ties into the existing exterior brick walls of the building and rests on the existing penstock granite piers in the southern portion of the building. Third, the new lobby was imagined as a partial double height space in the re-framing of the second floor with heavy timber beams and a structural wooden deck supported on a line of steel pipe columns. An open straight-run stair with an intermediate landing was situated in the west part. With its longer axis running east-west, this metal stair with wood plank treads and risers, and metal railing, connected the first floor with the second floor. At the east end of the lobby was a new elevator that provided handicap access to the second floor of the Counting House and the first and second levels of Mill 6. Adjacent to the elevator shaft was a set of three steps that led up to the first floor of Mill 6, which now housed the Weave Room of the Mill Museum. The southern half of the first floor plan was given up for offices of the Reservations and Interpretation staff, a store room, public toilets and an elevator machine room.



Photo 56. Museum bookstore at second floor of Counting House, c. 1993
Source: Flansburgh Architects, http://flansburgh.com/projects/boott-cotton-mills-museum/

While a large part of the interior was re-imagined in the renovations completed in 1993, many elements from the building's original and subsequent renovations were retained. These included the interior of all the exterior brick walls which were left exposed and simply painted white, re-calling the original whitewash finish on the brick walls that had historically not been finished otherwise in the business offices. Other elements like the post-1937 concrete piers that were added to the inside of the exterior walls as stabilizing elements were also retained.

Second Floor:

The second floor was designed to be the new museum store. It was open to the north and looked onto the double-height lobby space. The floor-plate was entirely open with no columns. At the east end was the new elevator and a set of nine steps that led up to additional museum exhibit space in the second floor of Mill 6. The south wall was covered with wooden bookshelves and window seats with a new wooden counter table in the south-west corner. Additional display racks and items occupied the rest of the second floor space.

The new second floor deck was supported with new paired 8 "x 14" timber beams running north-south and paired 6" x 12" beams running east-west. At the exterior walls, the new beams were through bolted with star shaped anchor plates.



Photo 57. North Elevation of Counting House, 2016
Source: EYP

The attic floor was removed to expose the roof structure to the interior of the Counting House. The existing roof trusses were retained and strengthened by the addition of new 7/8" diameter stainless steel tie rods.

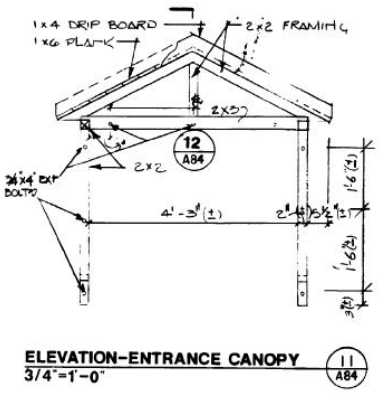


Photo 58. Detail of hood reconstruction , 1993
Source: 1993 As-built drawings, Flansburgh Architects, LNHP

North Elevation:

The approach to the exterior renovation of the Counting House was that of restoration. It was decided to bring the exterior appearance back to 1955 – the last year of its operation as Boott Mills. This involved removal of later window infills and bringing the lost finishes back to 1955. The existing window sash was replaced with new wood 6/6, 1/1 and 2/2 versions to replicate the 1955 condition. The existing window frames were reconstructed and fitted with new wood sash. A comprehensive paint analysis was carried out on the existing windows and frames to determine historic paint colors. From the analysis it appeared that the windows were originally an off-white/white color, they were painted a 'green/gray' color in 1937, and re-painted white in c. 1960. This was the color scheme chosen for the 1984-1993 renovation, with all new sash painted white.

New steel doors designed to emulate the configuration of the historic paneled design were created with six glass lites on each door leaf. It was decided to retain the 1938-1955 wooden hoods above each door opening. Since the existing versions were in poor condition, they were replaced in kind during this renovation with a closely matching design. The existing roof was entirely removed to the roof planks and a new slate roof was installed on the building, with a new wood soffit, wood gutter and three new copper downspouts on the north façade.



Photo 59. Opening on north facade of Counting House for pedestrian passageway, 2016
Source: EYP

The entire brick façade was re-pointed with new mortar based on a mortar analysis. This was accomplished by collecting various mortar samples from the building – it was determined that the existing mortar was a lime/sand mix in the 2:5 to 3:5 ratio. The specifications for the 1993 renovation have not been yet located-these would be essential to documenting the exact mortar mix that was utilized for the repointing initiative in 1993.

The most major change on the north façade was the entry to passageway that was created at the west end of the building. This had necessitated the removal of a door and window opening at the extreme west end of the façade, and the creation of a new wider masonry opening with a new granite lintel. New light fixtures were installed on each side of every door opening and the westernmost passageway opening. Other obvious changes on this façade were the new star-shaped anchor plates at the second floor level. A representative example of a historic diamond and circle

shaped plate was retained on both the north and south facade of the building.

South Elevation:

The strategy for renovating the canal-side elevation was the same as the north elevation, in terms of bringing the appearance back to 1955. This meant that all the first floor windows received new 6/6 sash while the second floor windows got new 1/1 wood sash. The impact of the new lowered footbridge and new passageway at the west end of the Counting House was most visible on the south façade. The new opening was topped by a granite lintel. New brick was infilled above and around this opening to meet and match adjacent construction. New metal signage with the words 'Boott Cotton Mills Museum' was affixed directly to the brick façade atop this new entrance passageway with new light fixtures on either side of the opening.

System Improvements:

A large part of the 1993 renovation was the complete replacement of all building systems- mechanical, electrical, plumbing, fire protection and telecommunications. Most of the mechanical ductwork in the Counting House was left exposed . Other visible impacts of the new system improvements were fire sprinklers, fire alarms, light fixtures, electrical outlets and plumbing pipes and vents. The 1993 as-built drawings by Flansburgh Associates, filed at both DSC and the LNHP should be referenced for more details of the systems design and layout.

1994-2016

While the exterior appearance of the Counting House and a large part of the interior has remained largely unchanged from 1993, there have been some interior changes on the first and second floors that merit attention.

First Floor:

The biggest change on the first floor has been on the west and south portion and appears to have been brought about by programmatic changes. The single-user male and female toilets built in 1993 were expanded to create multi-stall versions. In order to create space for these, the office space for the interpretation staff was moved. More recently in 2014, a new kitchen was added in the west section of the Counting house in the space that used to be occupied by the Reservations staff. The finishes and appearance of the new alterations are meant to blend in with the 1993 work.

Second Floor:

On the second floor, the major change since 1993 has been the relocation of the museum store to the first floor of Mill 6 in early



Photo 60. Multi-stall toilets created at first floor of Counting House since 1993; 2016
Source: EYP

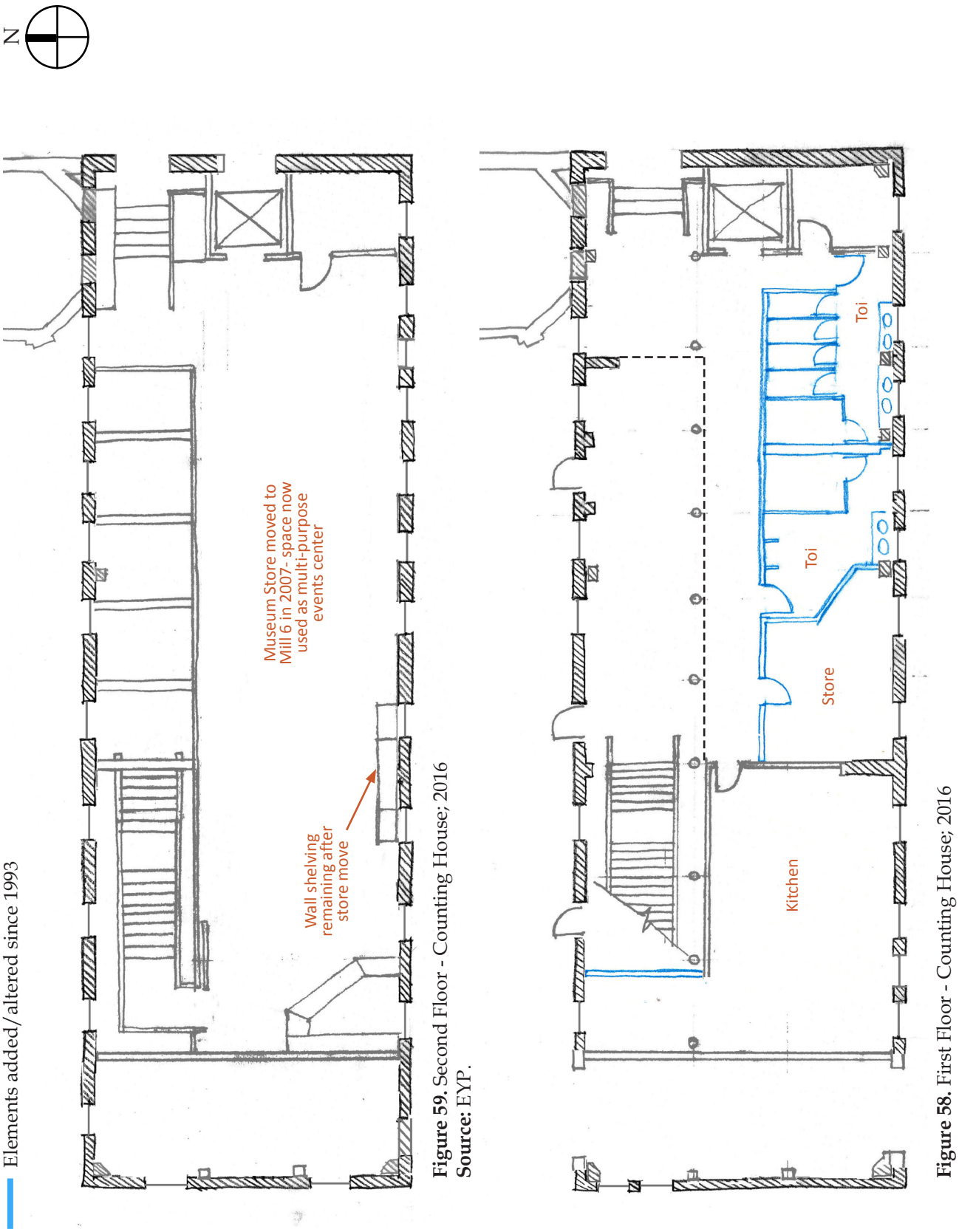


Figure 59. Second Floor - Counting House; 2016
Source: EYP.

Figure 58. First Floor - Counting House; 2016
Source: EYP.

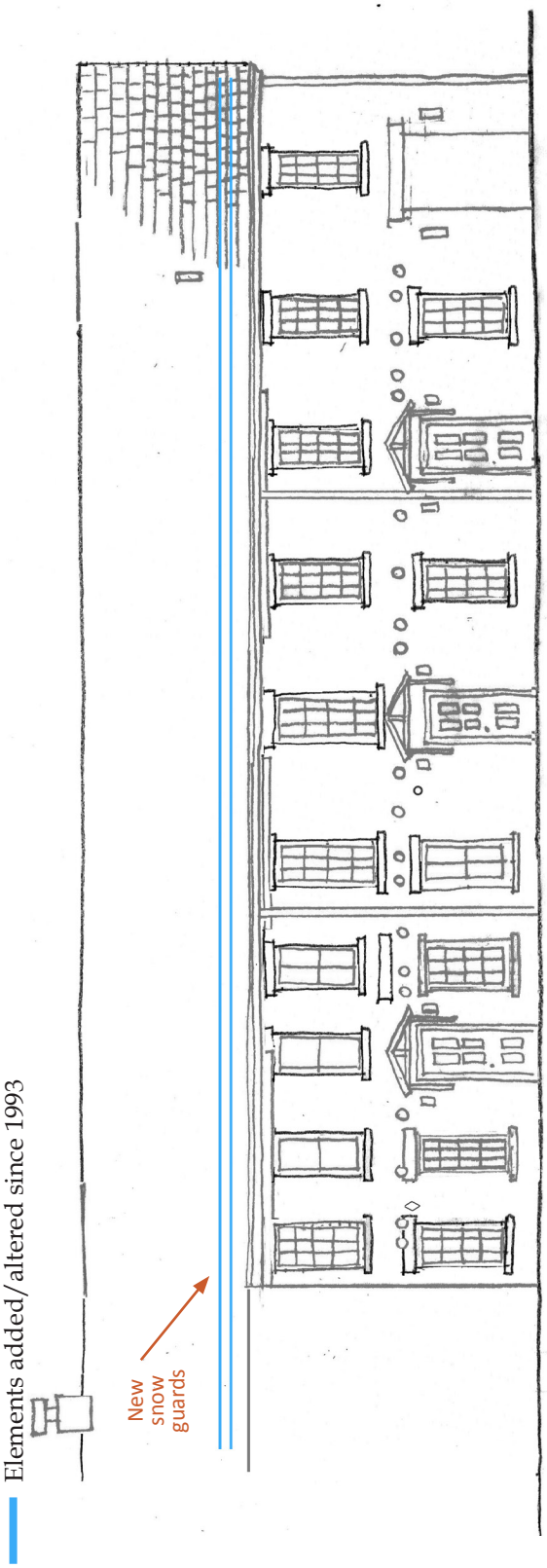


Figure 60. North Elevation - Counting House; 2016
Source: EYP.

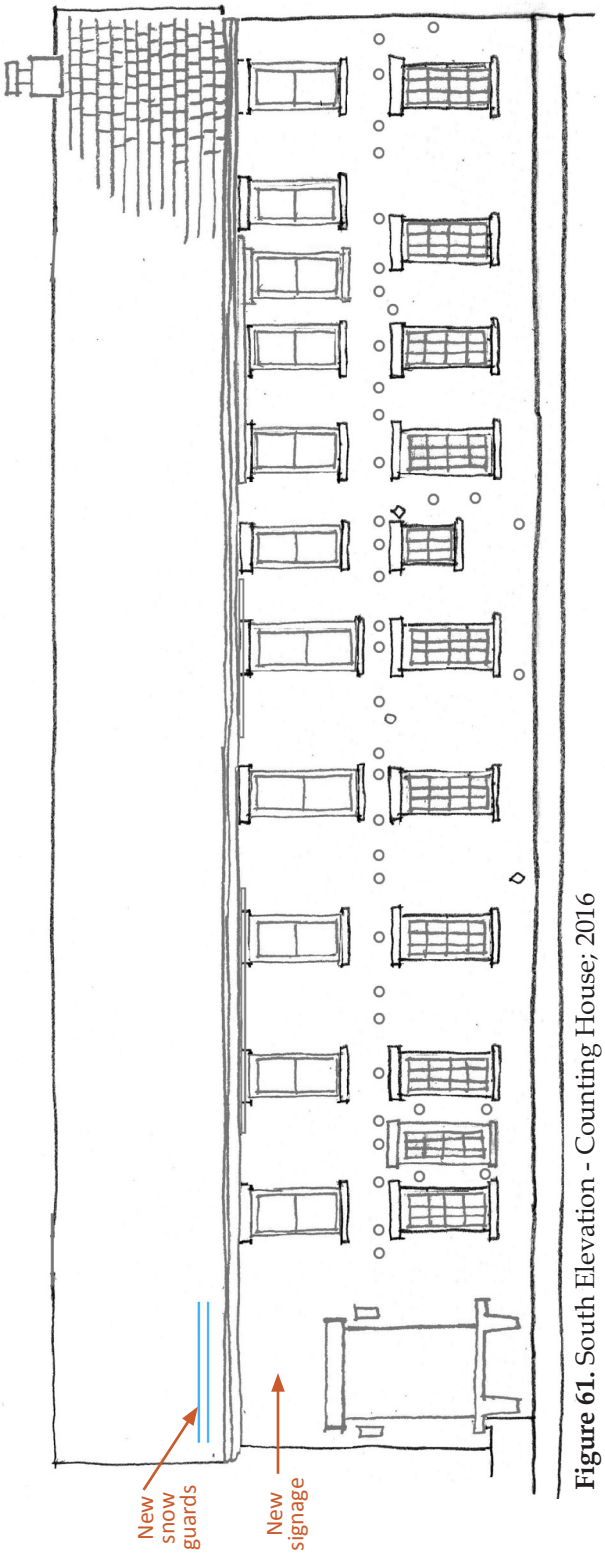


Figure 61. South Elevation - Counting House; 2016
Source: EYP.

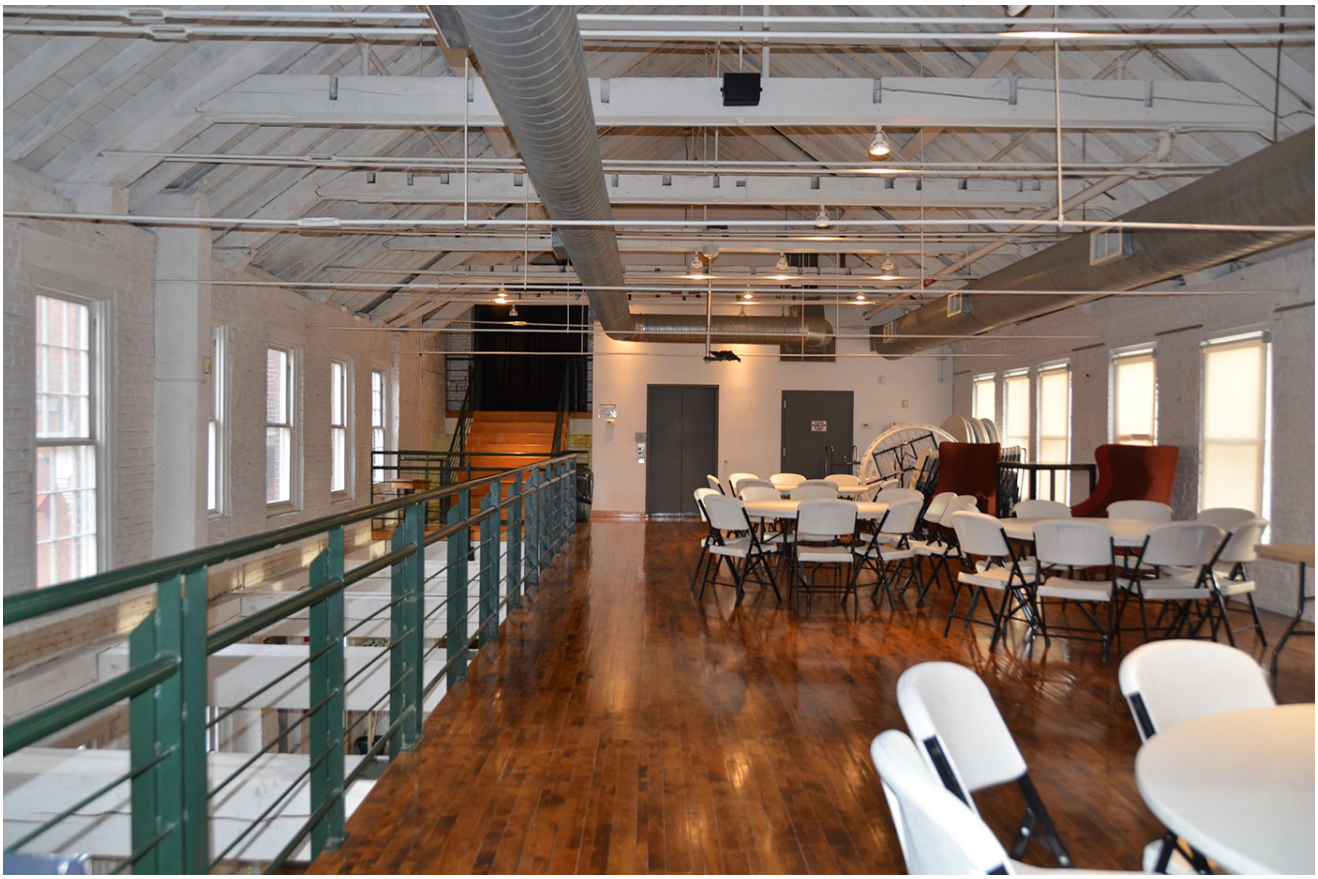


Photo 61. Multi-purpose events space at second floor of Counting House, 2016
Source: EYP



Photo 62. Pedestrian passageway entry at south facade of Counting House, 2016
Source: EYP

2007. A majority of the wood bookshelves and window seats along the south wall were removed at the time of this move. The cashier counter in the southwest corner remains as is. This space is currently used a multipurpose events space with movable furniture.

North Elevation:

There have been no noticeable changes on the north façade since 1993, except for the undated addition of snow guards on the roof. The wood gutter was replaced in kind in 2015.

South Elevation:

The south façade has remained largely unchanged as well, except for the addition of snow guards on the roof above the pedestrian entry passageway and the replacement of signage on the brick above this entrance. Instead of individual metal letters fixed to the brick wall, the current sign comprises of a semi-circular and rectangular metal plate with a cut out of the NPS logo.

Other Changes: Substructure

In November 2014, structural distress was noticed in the substructure of the Counting House that forms the entrance to Penstock 1 of the Boott canal system. This area was last impacted in the Phase II renovations completed 1993 when the Counting House received a completely new reinforced concrete slab (partially on grade and partially above the penstock/ gallery area). The primary area of concern is the easternmost bay of the penstock entrance that lies directly below the west end of the Counting House. The granite arch at the south end of this bay is displaying 'flattening' and bulging of the east thrust-block outwards. Other defects noted were partial collapse of the brick vault at this bay and deterioration at the heads of two brick piers that were added pre-1976. Another visual assessment of the structure was conducted in November 2015. Preliminary recommendations include partial rebuilding of the easternmost arch that is displaying movement, rebuilding of the collapsed brick vault and replacement of deteriorated brick piers with new granite columns. This work is expected to be completed in 2016/2017 at the time of writing of this report.



Photo 63. Deterioration at brick pier at Counting House substructure, 2015
Source: EYP



Photo 64. 'Flattening' of granite arch (towards right) supporting southwest corner of Counting House above, 2015
Source: EYP



Photo 65. Failed brick vault at Counting House substructure, 2015
Source: EYP

MILL 6:

1872-1955

This time period begins with the construction of Mill 6 in 1871-72 and ends with the closing of Boott Mills in 1955. It combines roughly the first three time periods for Mill 6 outlined in the previous HSR. Mill 6 remained virtually unchanged from its construction right up to 1905 when 'Boott Cotton Mills' officially closed and the company was reorganized as 'Boott Mills' producing 'coarse' goods. This necessitated the switching of machinery housed in the building in 1906 and the relocation of some original program elements like the shops in the lower floors of the west part. A mix of big and small changes continued to be made to Mill 6 for the next 50 years as it maintained operation within Boott Mills. These changes will be briefly summarized in the following sections.

First Floor:

As originally built in 1872, the first floor comprised of a an L-shaped floor plan with two arms- the longer was the east-west arm that stretched along Eastern Canal, directly to its north. This is commonly referred to as the west part of Mill 6. The shorter arm of the L extended in a north south direction along Bridge Street, and is referred to as the east part of Mill 6. The building design was based on rather traditional mill design practices for its time, with loadbearing brick walls (without pilasters or buttresses), and timber beams that pocketed and anchored directly to the exterior walls. The long narrow floorplates were designed based on limitations imposed by natural light streaming through the numerous closely spaced windows on the exterior façade. The interior was largely open to allow for flexibility in accommodating the mill equipment, except for a central row of cast iron columns in the west part and two rows of similar columns in the east part. These columns supported paired timber beams and a wood floor deck above.

Other plan features included a double height passageway at the eastern end of the building. This area referred to as the coal pocket, allowed off-loading of coal from railroad cars at the rear of Mill 6 to fire the boilers located formerly in Mill 7 to the north. Blind windows that copied the hood detail of the true windows throughout the building elsewhere continued the window pattern along the first floor wall of the East Elevation to enclose the coal pocket rail track that ran inside the building. However, that two-story trackway was naturally lit by standard mill windows in the second floor above. A loadbearing masonry partition wall was constructed at the intersection of the east and west parts of the

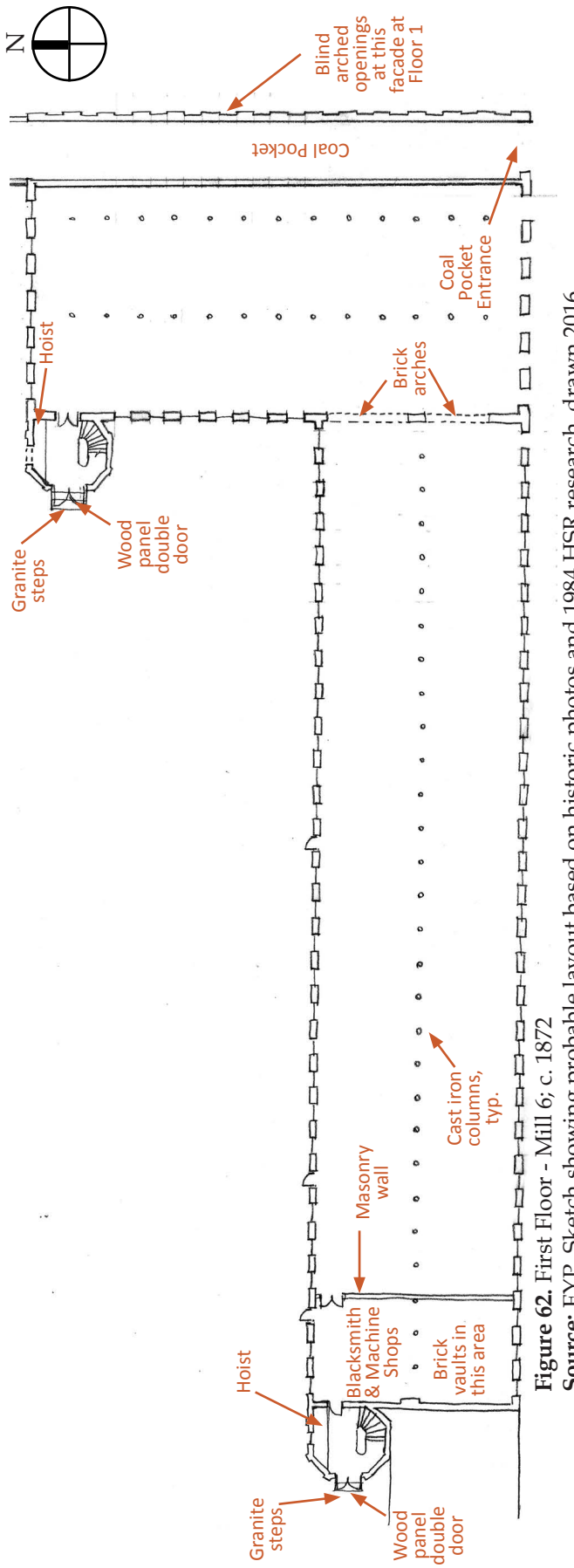


Figure 62. First Floor - Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

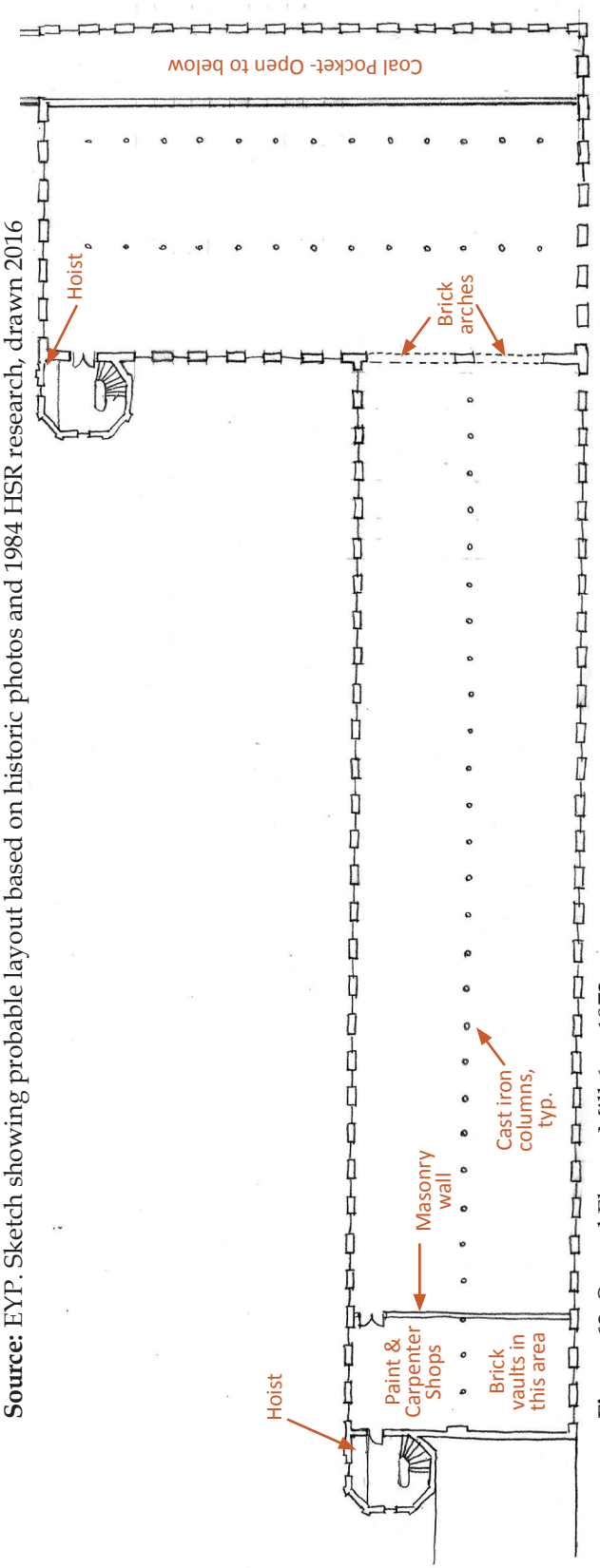


Figure 63. Second Floor - Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

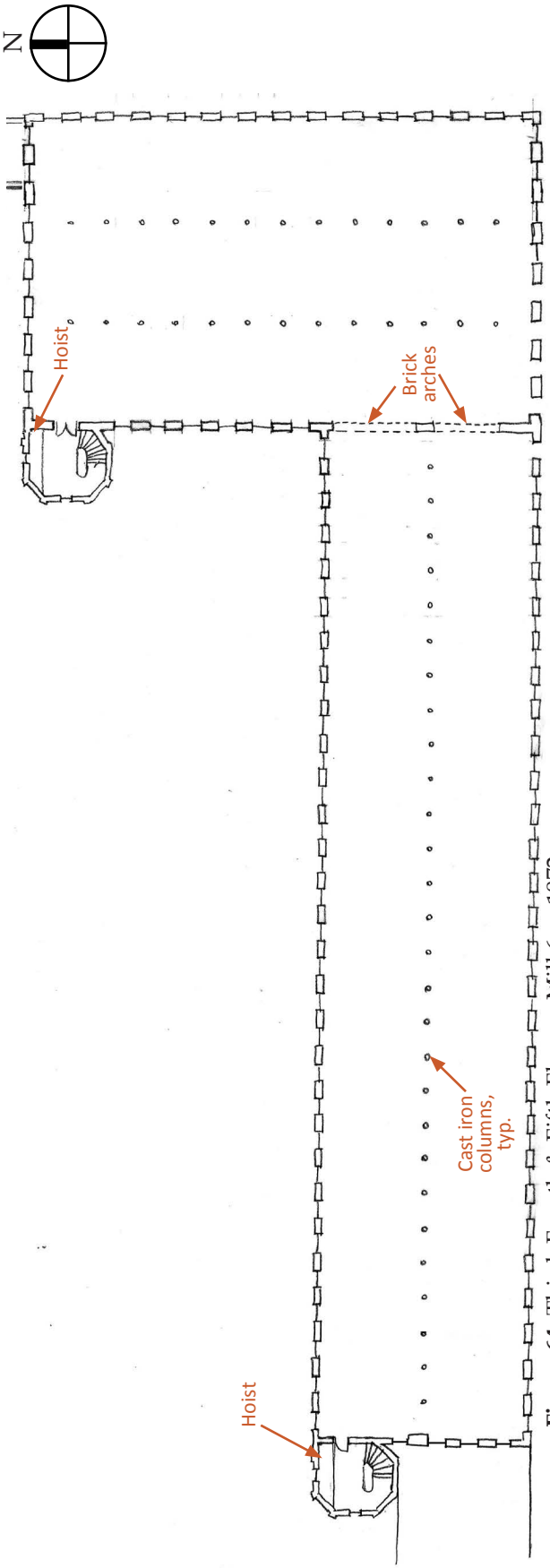


Figure 64. Third, Fourth & Fifth Floors - Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

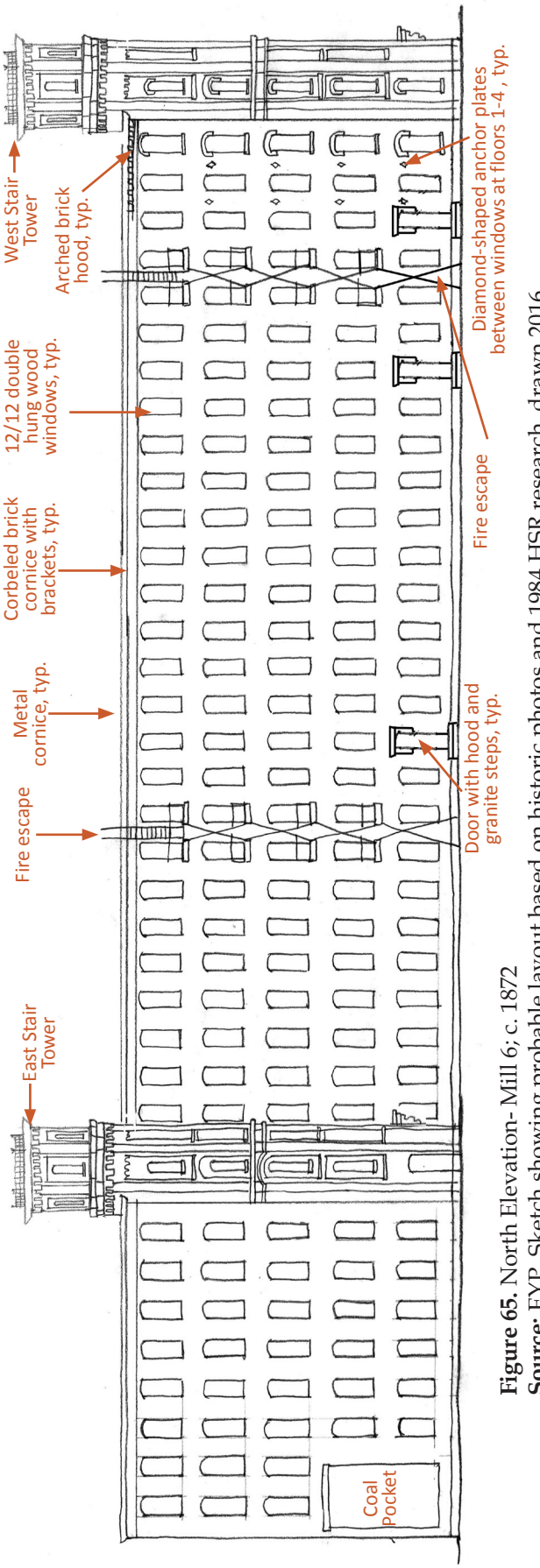


Figure 65. North Elevation- Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

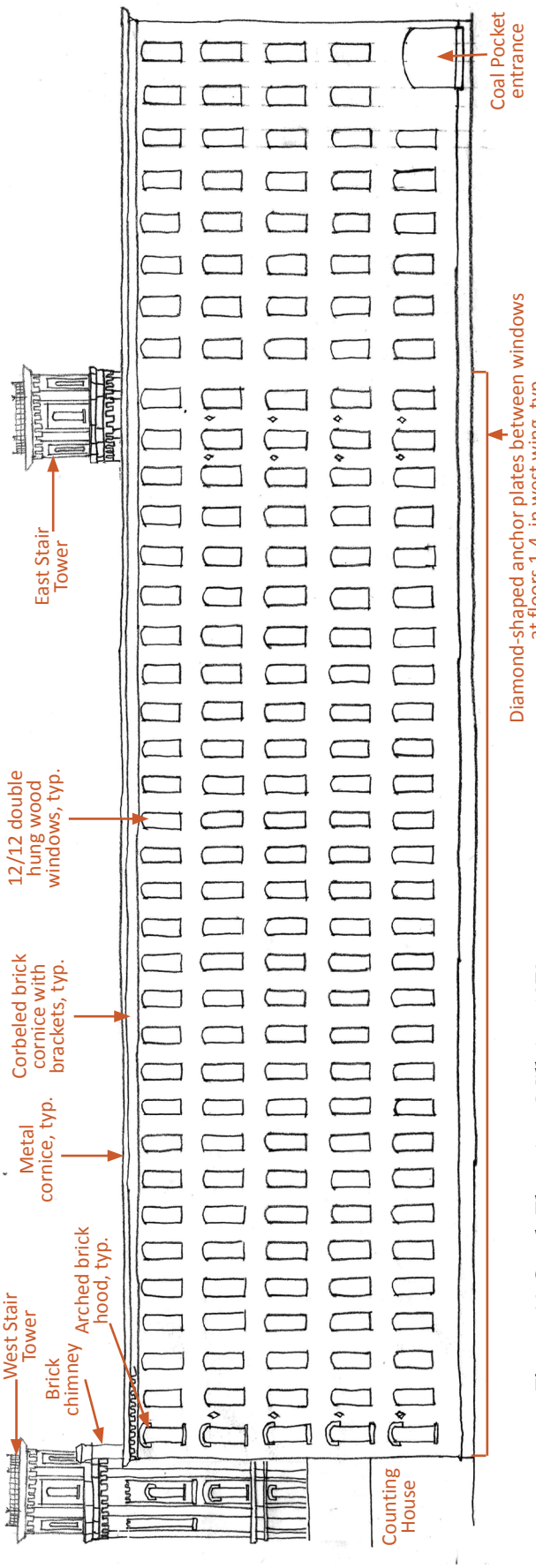


Figure 66. South Elevation- Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

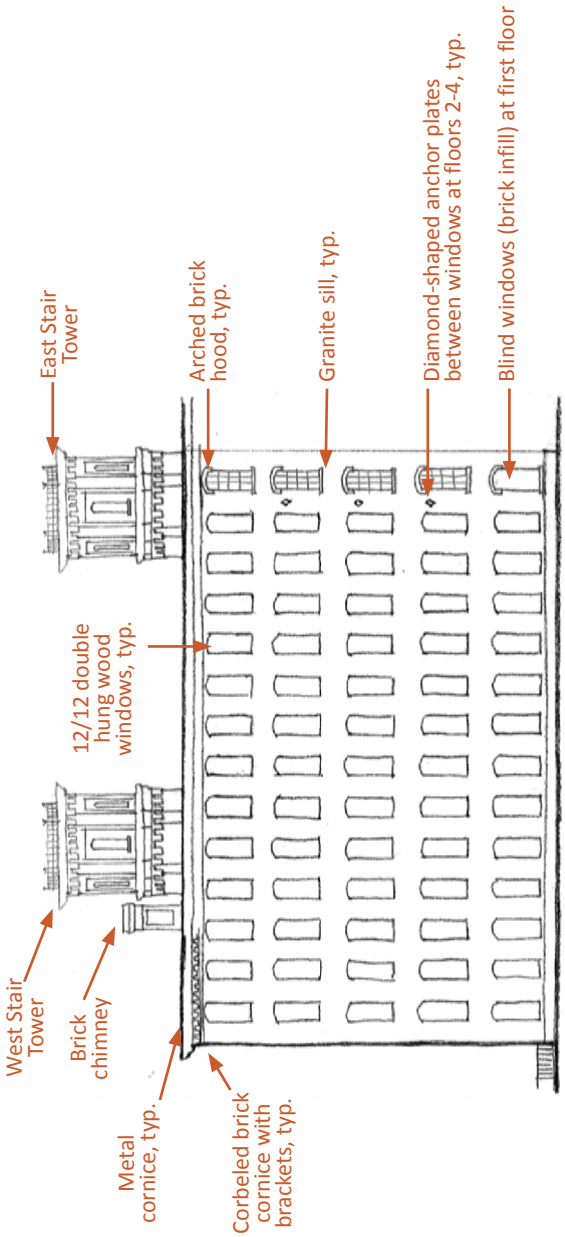


Figure 67. East Elevation- Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

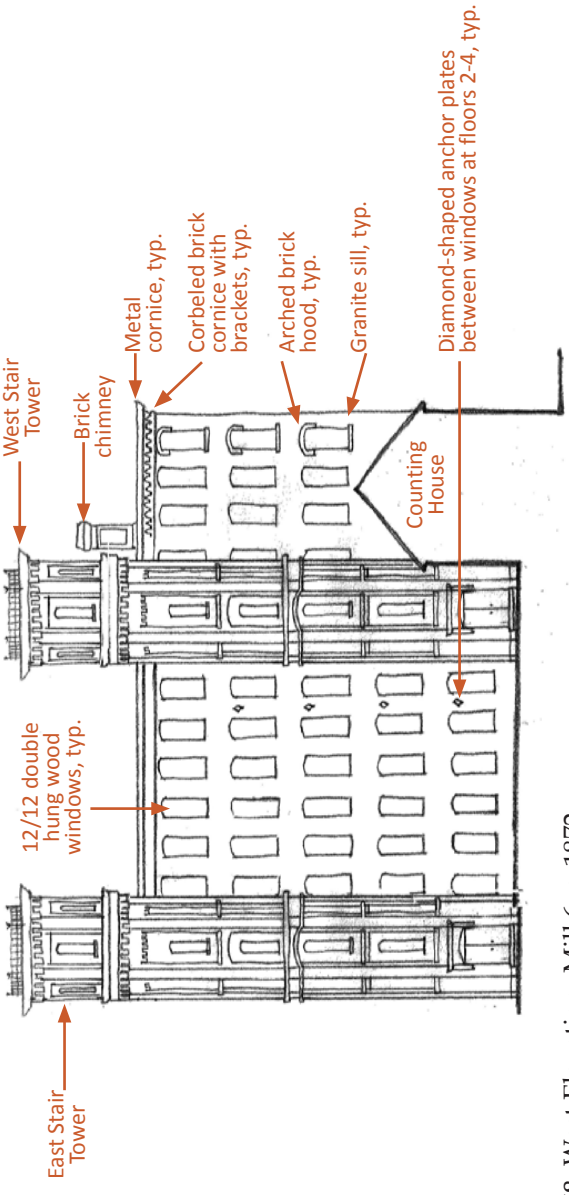
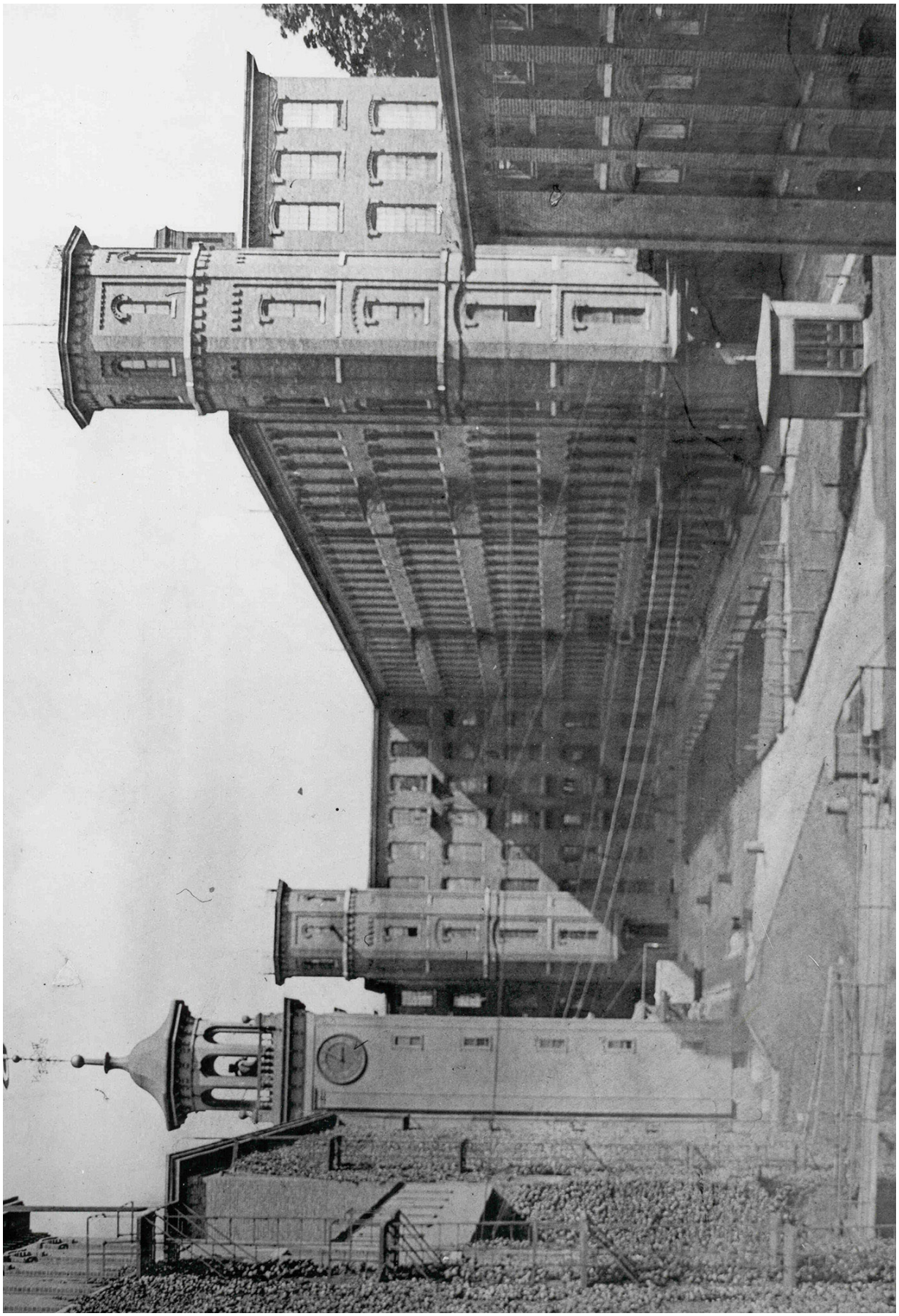


Figure 68. West Elevation- Mill 6; c. 1872
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016



(Reprinted) Photo 24. Note the top floor of the stair towers with metal cresting, and the west elevation close in appearance to how it was built., 1899
Source: UML, CLH, LHS, LM, Pin 4111

building. It provided access through it via two large triple row-lock arched openings.

Two octagonal brick stair towers, one each in the east and west wings of the building was attached to the west facing walls at their respective northwest corners. Access to the mill was provided though these towers via a centrally located opening in each, protected by an overhanging bracketed wood hood. Each entrance was reached by a set of three granite steps. Once inside the tower, there was a wood spiral staircase that occupied the southern half of the space while the northern half constituted a landing and a hoist for transferring materials between the floors. An arched opening at each floor in the wall between the stair tower and the mill area provided access to the hoist. Directly south of this opening at each floor was another arched opening with a set of double doors that provided access to the stairways.



Photo 66. Wood spiral staircase in octagonal stair tower. Railings were added in 1914, undated
Source: LNHP Archives, LOWE 16552

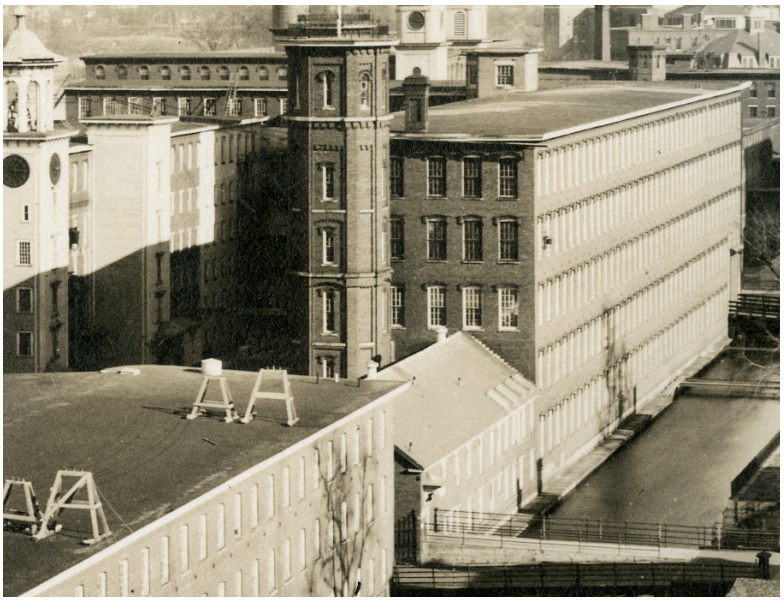
The west end of the first floor (and second floor) was slightly different in construction than the upper floors in having a masonry partition wall demarcate a space with brick vault construction. These housed the Blacksmith Shop and the Machine Shop serving the entire complex, and were therefore vaulted for better fire protection. Present in 1899 and probably original to the building were three hooded doorways with granite steps along the north elevation of the west wing, as seen in Photo 24. These doorways were removed and seamlessly converted to windows by 1955, and probably in 1906 when their proximate first and second floor shop functions were removed from the building.

Between 1876 and 1911, numerous bridges and connectors were constructed between Mill 6 and Mill 7, primarily, and Mill 1 to the north. All of these attached to the north wall of the east wing of Mill 6. The largest undertaking was a 5-story brick connector at the two easternmost bays of this north wall. It was originally 2 stories, but was expanded to 5 stories by 1886. By 1911, enclosed wood frame bridges were added to the west of the brick connector at the second, third and fourth floors. All these connectors necessitated change in many original window openings in this façade to door openings. In 1906, the Mill changed its operation to producing 'coarse' goods and this required an overhaul of the machinery in place. The shops in the west end on the first and second floors were moved to other locations on the site. In 1914, metal pipe railings were added to the spiral stairs in the octagonal stair towers.



Photo 67. Bridges between Mills #6 and # 1 looking east
Source: HAER, Reproduction Number: HAER MASS,9-LOW,7--24

The first major change to the exterior appearance of Mill 6 took place in 1917 with a construction of a new freight elevator tower at the inside corner of the L-shaped building plan. Consequently, the hoists in the stairwells were removed and the openings bricked up. Despite being built in brick, the elevator tower was distinctively



(Reprinted, zoomed) Photo 26. "Boott Mills Looking East, March 1928". Note the appearance of west stair tower and the addition of the 1917 elevator tower (at the inside corner)
Source: LNHP, Museum Collections, LOWE 8658



(Reprinted, zoomed) Photo 30. Mill yard between Boott Mills Number 1 and 2 and Number 6, Dec. 1933. Note 1917 elevator tower and one-story 'shipping shed in front built in 1928.
Source: LNHP, Museum Collections, LOWE 8986

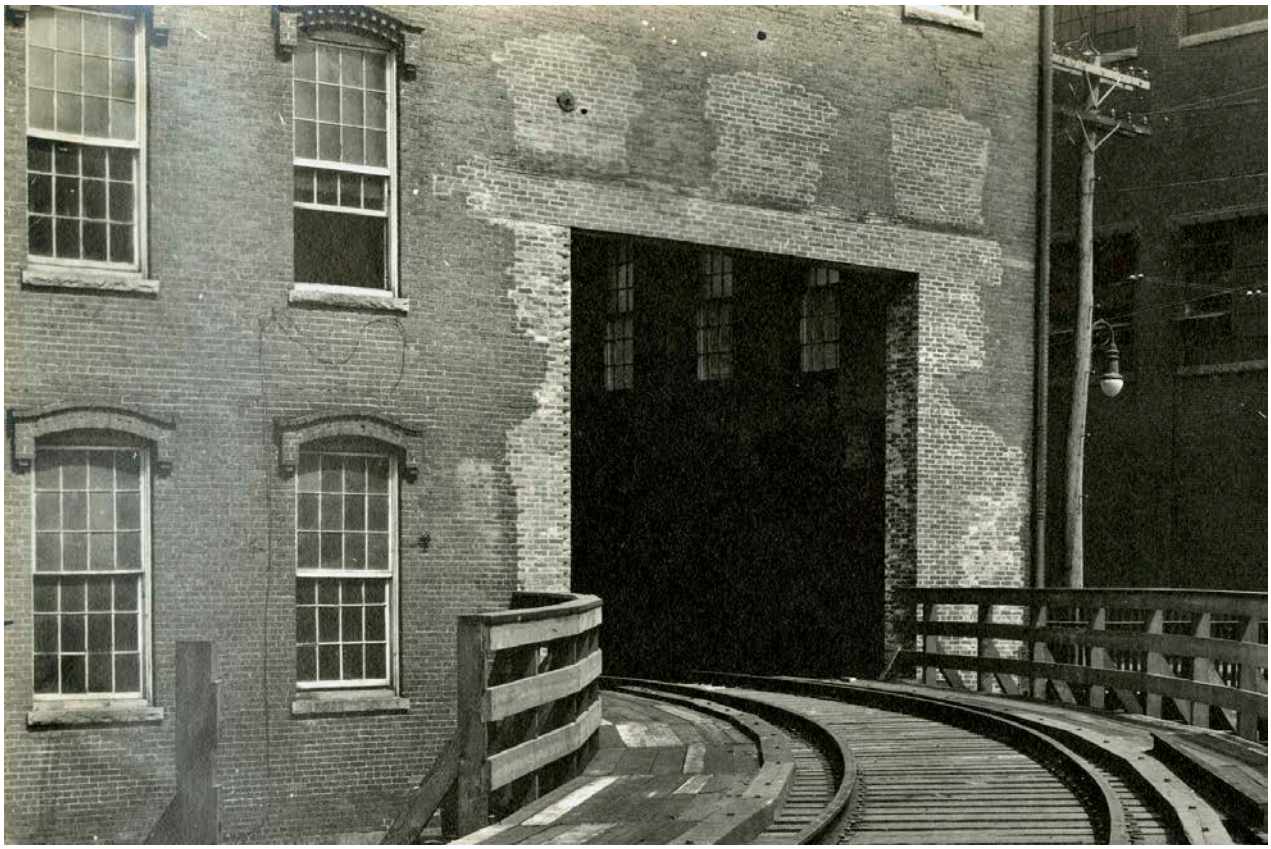
different from the original building. This was largely the result of larger window openings with 9/9 wood sash and flat granite lintels instead of arched brick hoods. The elevator obscured two window bays on north and west walls of the inside corner of the original building footprint. Three of these openings were bricked up on each floor and one in the north wall was widened to serve as the access to the elevator. The yard track formerly adjacent to the east stair tower was re-routed to the new elevator tower.

The second major change that took place during this time, happened in 1928 with the expansion of the coal pocket entrance on the south façade. The entry was both widened and increased in height. This led to the loss of one window on the first floor and other alterations on the second floor. Around this time, a small wood frame shipping shed was also added on the first floor, directly west of the 1917 elevator tower.

In 1955, as preparation for the sale of Boott Mills to new owners, several repairs were made to the building. These included removal of all the machinery and infilling all masonry openings that connected with adjacent buildings. In anticipation of three new transformers to be installed in the yard between Mill 1 & Mill 6, all first floor windows in the north wall of the east wing were bricked in at this time.



(Reprinted) Photo 17. "Bridge and Coal Pocket at Mill No. 6 (1912)." Note wood picket fence and sliding door
Source: LNHP, L&C, LOWE 7638



(Reprinted) Photo 27. "Boott Mills Railroad Bridge Showing Bridge Floor and Tracks, Aug 1927
Source: LNHP, Museum Collections, Lowe 8581



(Reprinted) Photo 21. Connecting wall between east and west sections of Boott Mill Number 6, third floor. June 1985
Source: HAER, NPS, MA-16, 1985



(Reprinted) Photo 20. Cast iron columns at first floor of Boott Mill Number 6, June 1985
Source: LNHP

Second Floor:

The second floor plan was almost identical to the first as built in 1872. Being a double height space, the coal pocket occupied the east end of the second floor as well. The vaulted section on the west end was replicated on the second floor, except here it house the Paint Shop and the Carpenters Shop.

The construction of connectors at the north wall of the east wing from 1876-1911 and the new elevator built in 1917, all had effects on the second floor plan similar to first floor as described above. The major change happened with the expansion of the coal pocket entry when three of the easternmost window openings on the south façade were removed to make way for the expanded masonry opening.

Third Floor & Fourth Floor:

Changes on the third and fourth floors during 1872-1955 were largely brought on by the construction of connectors at the north wall of the east wing from 1876-1911 and the new elevator built in 1917. The nature of the changes was similar to those experienced on the lower floors.

Fifth Floor:

In addition to changes brought on by the construction of connectors at the north wall of the east wing from 1876-1911 and the new elevator built in 1917, the other major change at the fifth floor occurred at the arched masonry partition wall. In 1929, owing to structural concerns, the arches and brick pier at this wall were removed, and replaced by a pair of I-beams supported by metal columns.

North Elevation:

All the elevations of Mill 6, including the north were characterized by a rhythmic fenestration pattern of closely spaced arched window openings at each floor topped with ornamental brick hoods and featuring 12/12 wood sash. The walls were topped with a corbeled brick cornice, which surrounded the eaves and was supported by deep corbeled pendant like brackets that terminated at a brick stringcourse. The two octagonal stair towers broke the monotony of the façade by virtue of their shape, exposed pilasters, granite beltcourses, narrower window openings, and most importantly their 6-story height which extended an entire floor above the rest of the mill building. Topped by ornamental metal cresting,

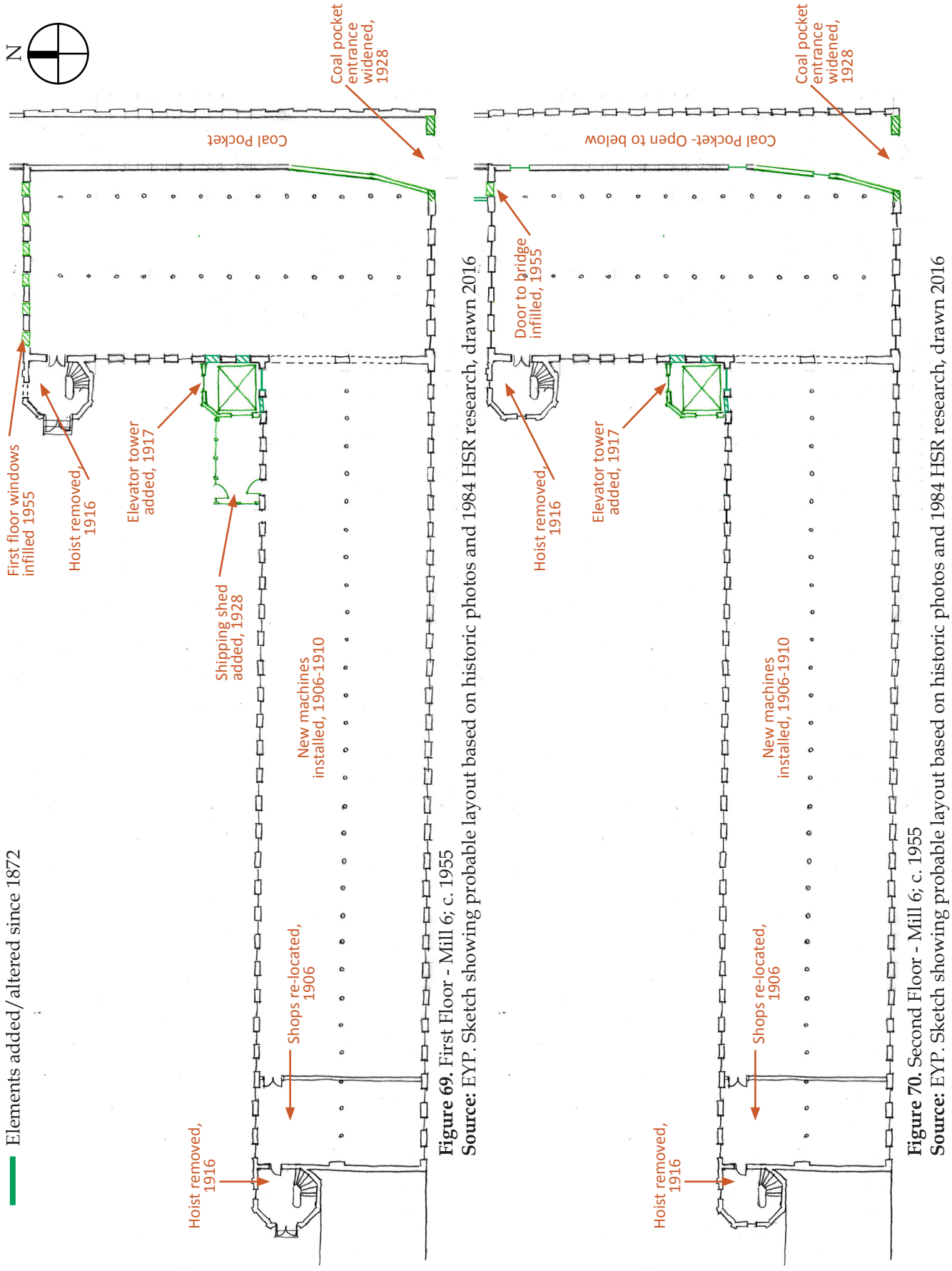


Figure 69. First Floor - Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

Figure 70. Second Floor - Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

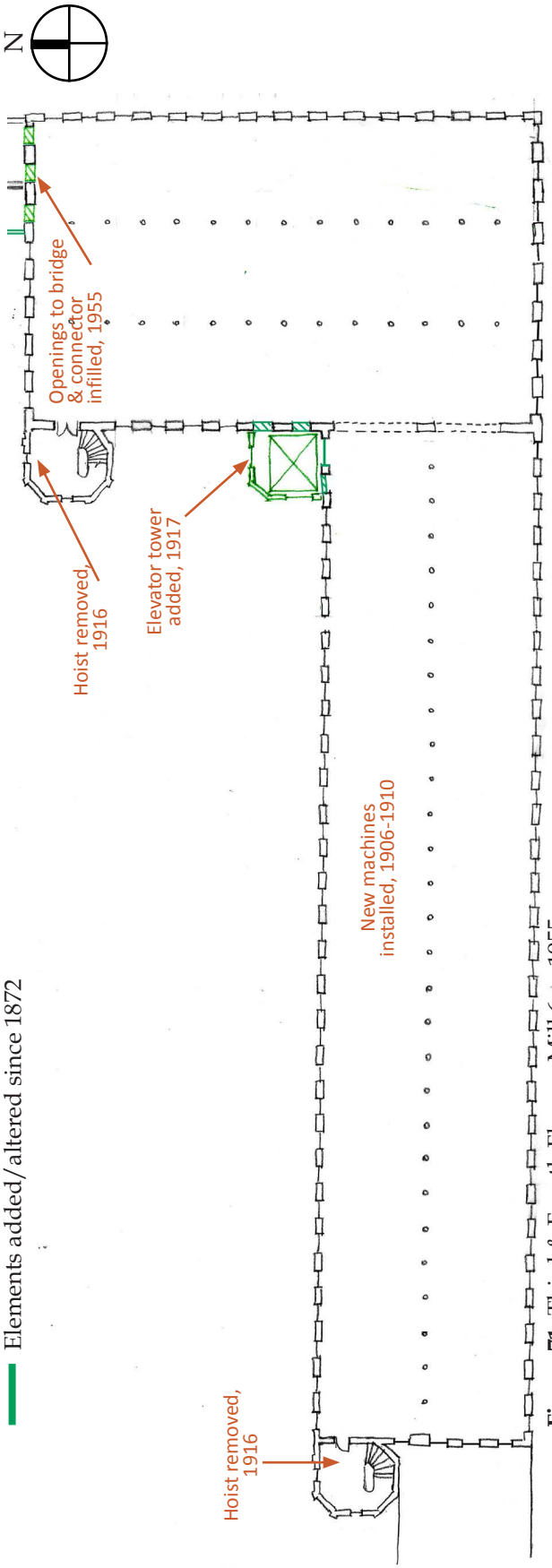


Figure 71. Third & Fourth Floors - Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

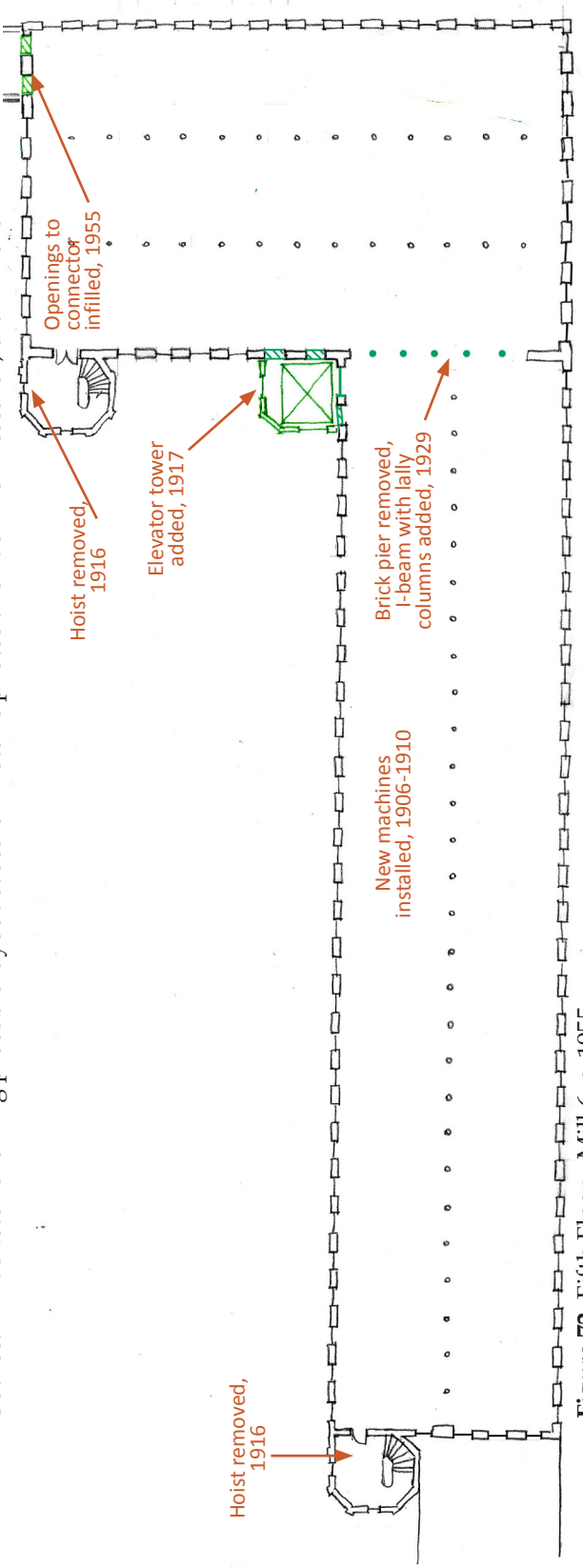


Figure 72. Fifth Floor - Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

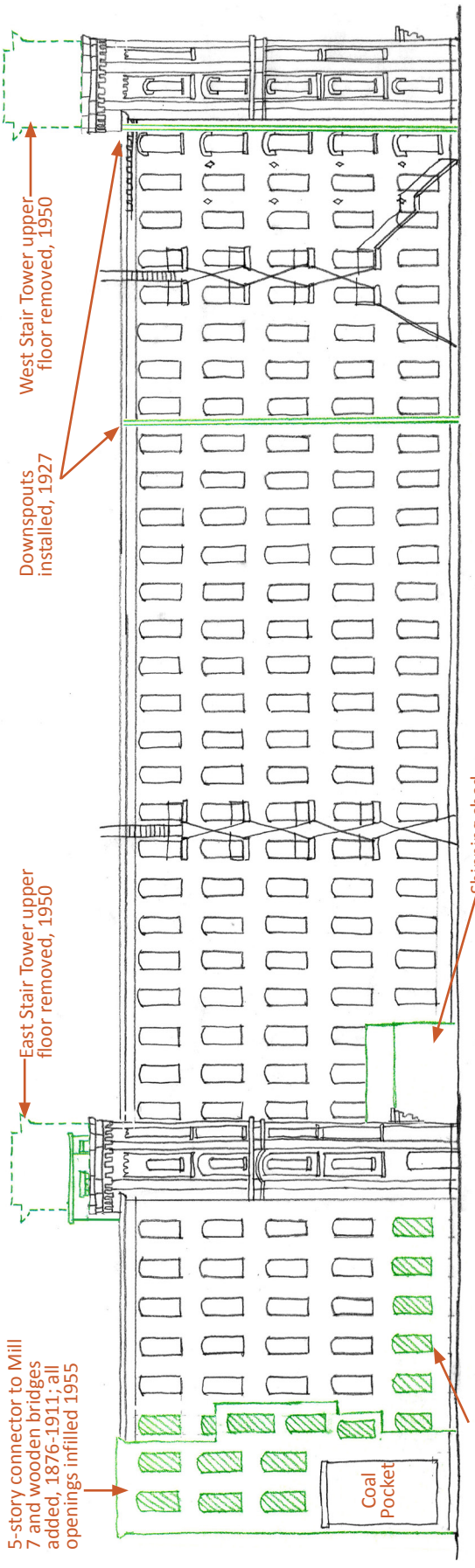


Figure 73. North Elevation- Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

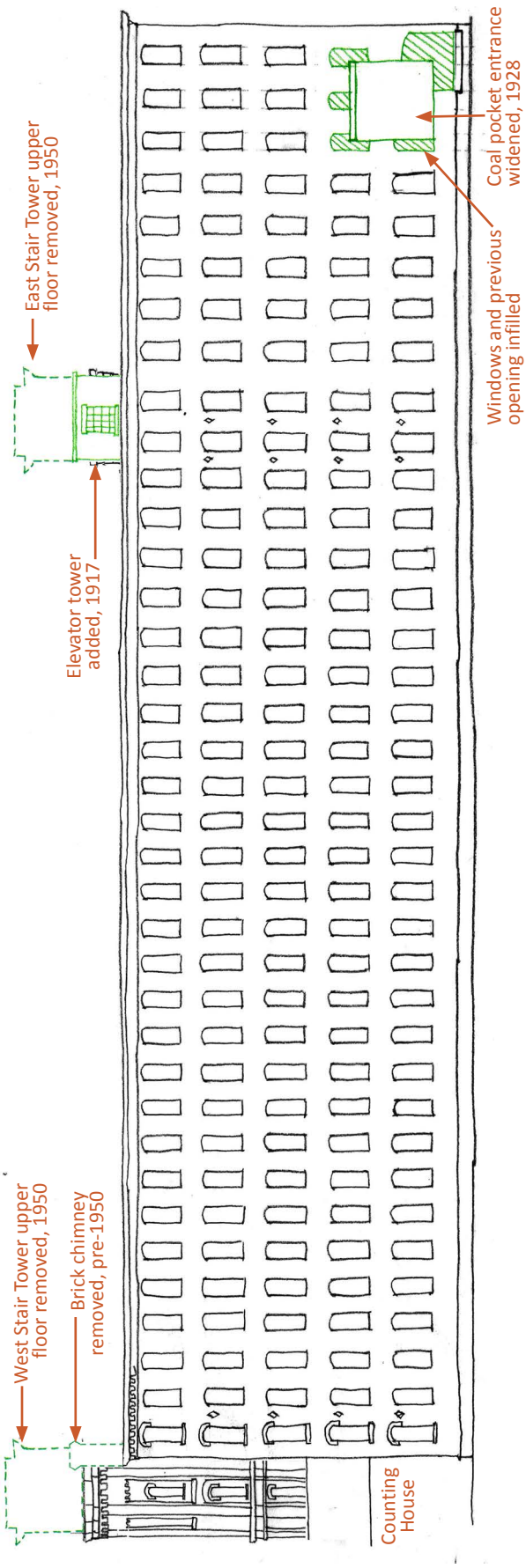


Figure 74. South Elevation- Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

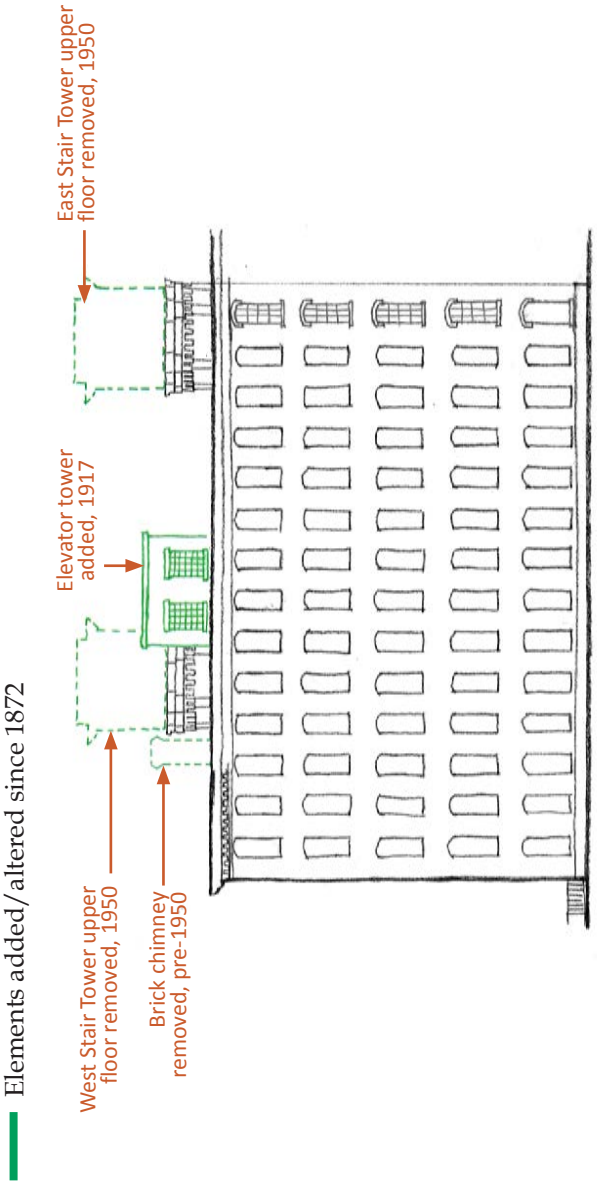


Figure 75. East Elevation- Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

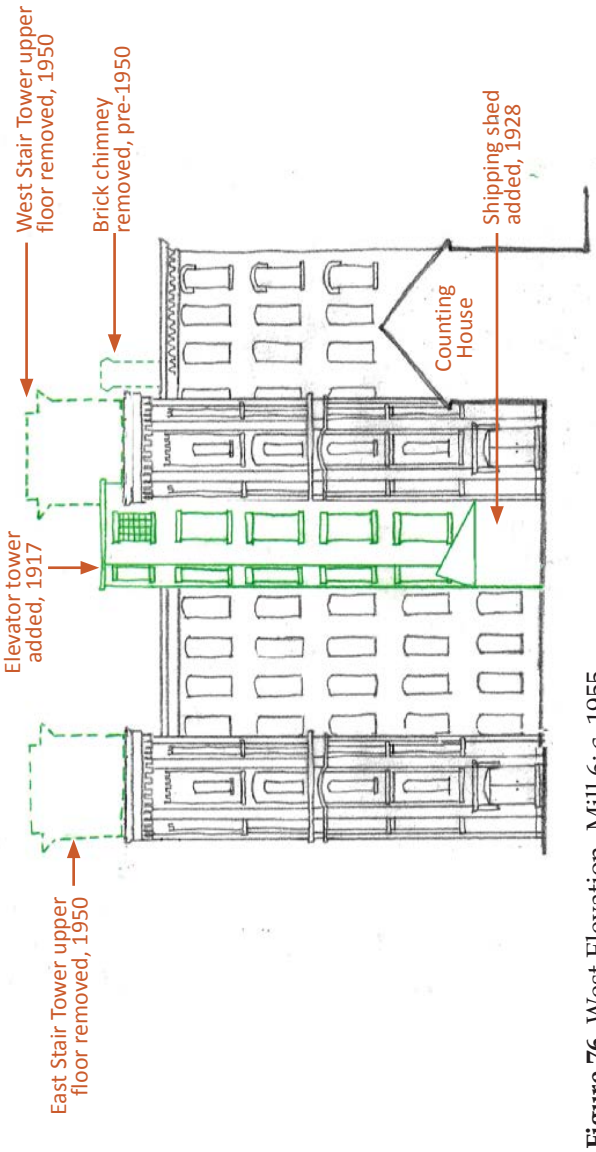


Figure 76. West Elevation- Mill 6; c. 1955
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

these towers soared above the flat roof of Mill 6, and their richer architectural palette corresponded with other stair towers at other Boott Mill buildings around the yard.

Other original features of the façade were the ubiquitous diamond-shaped anchor plates between each window opening where the individual interior floor beams were anchored to the exterior wall. Two metal fire stairs were spaced along the north façade and a third in the same scissors-like configuration was located in the courtyard west wall.

With the construction of the 5-story connector to Mill 7 in 1886, and subsequent wooden bridges on the second, third and fourth floors, many windows on the eastern end of the east wing wall were converted to doors and/or infilled. Exterior downspouts were installed in 1927. Arguably, the most significant change to the exterior appearance happened in 1950 when the top (sixth) story of the two stair towers was removed in a misinformed attempt to address vibration in Mill 6. The truncated towers were topped with a new flat roof and simple overhanging bent flashing.



Photo 68. East elevation, Mill 6. Note the blind windows on first floor at coal pocket location. **Source:** HAER, Reproduction Number: HAER MASS,9-LOW,7--8

Another change occurred in 1955 when all the first floor windows at the east wing were bricked in to allow for installation of new transformers in this area. Openings at the upper floors in the connectors were also infilled in preparation of the Mill's sale in 1955.

South Elevation:

The south canal-facing elevation presented a simple flat façade with the same detailing as the north. The original entrance to the coal pocket was a one-story arched opening that took up less than two easternmost bays of the façade. This was of course enlarged in 1928 to three bays wide and 1.5 stories tall.

East elevation:

The east, street facing elevation of Mill 6 was similar to the other ones, except one major difference. All the first floor windows were blind, with recessed brick infills, owing to the coal pocket in this area. The construction of the 5-story brick connector to Mill 7 in 1886 essentially extended the east façade all the way to Mill 7, owing to its similar exterior appearance.

West Elevation:

Effects of the 1917 elevator tower and the removal of the top story of the stair towers in 1950 are very apparent on the west, yard-facing elevation of the building.

1956-1983:

This time period begins with new ownership of Mill 6, before it was sold once again in 1972, and was used for light manufacturing uses and storage right up to 1979. Then a focus on the preservation and redevelopment of the Boott Mills in response to the establishment of the Lowell National Historical Park began. The Park had been created by an act of Congress in 1978. That legislation also created the Lowell Historic Preservation Commission (LHPC), part of whose mission was to assist private property owners with financial and technical assistance in the rehabilitation and adaptive reuse of their historic buildings in the Federally designated Lowell Historic Preservation District to both preserve the historic character of the Park environs and aid in its economic redevelopment.

In 1975 a gas leak in a building across the river caused a massive explosion that damaged some 1000 windows in the Boott Mills. Worst affected were those in the two northerly ranks of buildings, but there was some glass breakage in Mill #6 as well, presumably more extensively on windows higher up on the upper courtyard and Bridge Street elevations. Many of those damaged sash and others were replaced with full 1/1 or smaller blocked-down units or simply removed and boarded up by Capehart Corporation , then owner of the building. Soon, the Capehart Corporation declared bankruptcy and was not in a position to make more comprehensive repairs to the building. The LHPC wanted this derelict, but fairly intact and visible mill building to be adaptively reused by new owners that would restore the exterior according to preservation standards. They found the perfect partner in Wang Laboratories, a growing technology firm that was building its new headquarters in Lowell. Wang purchased the building and LHPC provided $500,000 in grant money over the next three years to renovate the exterior with new windows and roof. Wang acquired the building at the behest of LHPC to prevent its being purchased by a salvager, and land banked it for the hoped-for eventual purchase by the National Park Service. Wang undertook roof and window replacement with a $500,000 grant from LHPC and installed a new boiler in 1980. Wang used the building in the interim for warehousing and storage. In 1983, Wang became interested in another building for development as a training center. The Park's plan of acquiring the Wannalancit Mills for its museum and other functions did not materialize, and the Park turned its gaze to Boott #6 instead. Its rehabilitated exterior shell, and prime location for these Park functions, helped prompt the Park to acquire the building from



Photo 69. View from mill yard of north and west facades of Mill 6, c. 1979. Note the 1917 freight elevator tower at the corner, the 1973 freight elevator tower next to it, and missing window sash.
Source: LNHP Archives, LOWE 16552

Wang in 1984. Following is a summary of the physical changes that occurred at the building during this time:

First Floor:

The first major change to the site post-1955 was the construction of a second freight elevator tower adjacent to the outdated 1917



(Reprinted) Photo 36. Eastern Canal elevation of Boott Mill Number 6, July 1979. Note curious sheet metal shaft at fourth bay, third floor to roof.
Source: HAER, NPS MA-7 #4, 1976



Photo 70. Entrance at west stair tower, 1982. Note altered opening, non-historic door, replacement windows above in Mill 6.
Source: HAER, Reproduction Number: HAER MASS,9-LOW,7--30



Photo 71. View of Mill 6, looking west, 1982. Note the new wood window sash, restored wood frames and new metal cornice at west end wall and 1981 reproduction of the removed brick chimney to vent the Wang boiler and eliminate the boiler flue previously routed through an adjacent upper floor window
Source: HAER, Reproduction Number: HAER MASS,9-LOW,7--29

tower in 1973. It extended 6" above the roof line & was built with a combination of concrete masonry units and brick. The construction of this tower led to the bricking in of the 3rd and 4th bays of the west wall of the east wing. A one-story machine room was built to the north of the tower with a flat roof, concrete block walls and a modern flush door. Unlike the 1917 tower, the windowless 1973 tower was a marked deviation from the original building. Another



(Reprinted) Photo 35. East stairtower, Mill Number 6, June 1985. Note later elevator shaft at right, and altered door at stair tower.
Source: HAER, NPS MA-16, 1985

change during this period was the construction of a masonry wall that subdivided the vaulted section at the western end of this floor into 2 rooms and the creation of a new boiler room in this space.

Repairs by Wang Corporation in 1981 involved replacing upwards of 400 window sash with replacement wood windows that closely matched the original and were designed to receive an integrated storm panel. It appears that while the frames were restored and the replacement sash installed in 1981, the storm panel was not installed at this time and was added later in renovations completed sometime after 1993. The 1981 restoration work was designed by Moore & Heder Architects and was executed by Erection Specialties, Inc. (ESI). A paint analysis was carried out on the existing sash and frames. This revealed that up until the late 19th century, most of the exterior wood work of the Boott Mills was painted in a white/off-white color. This was therefore chosen as the color for the restored frames and new wood sash†.

A new boiler was installed at the first floor in the boiler room created in 1973, and various floor improvements were made to ready the buildings for use as a storage facility.

Second, Third, Fourth and Fifth Floors and Roof:

† A letter by Charles Parrott, LNHP Architect to Allen Moore of Moore Heder Architects, dated December 15, 1980 notes that the exact shade of off-white chosen was Benjamin Moore-O-Matic II system, designated OW-13. This color or a similar alkyd gloss or semi-gloss was recommended for use at the windows and cornice. The chimney cap was proposed to be painted a dark charcoal gray.LNHP Archives, LOWE 16552.

The impact of the new 1973 freight elevator was felt on all the upper floors similar to the first floor. One of the biggest changes to occur during the 1981 repairs was the complete replacement of the roof. The existing tar and gravel roof over the building was removed in its entirety and replaced with a new insulated elastomeric roof and all new metal flashings. The ornamental brick cornice at the west face of the west part of the building had been lost during the years during an undated event and had been replaced with a short parapet wall. The parapet was removed and the cornice was reconstructed in 1981 to match the historic design. The historic brick chimney at the west end of the building, which was demolished prior to 1950, was also reconstructed in 1981. The roofs over the stair and 1917 and 1973 elevator towers were also replaced.

North Elevation:

Between 1956 and 1983, major changes on the north elevation included the creation in 1974 of a large opening on the first floor adjacent to the 1917 elevator. Spanning two window bays, this



Photo 72. View of Mill #6 from the south (1982). Note the new wood window sash and restored wood frames.
Source: HAER, Reproduction Number: HAER MASS,9-LOW,7--9

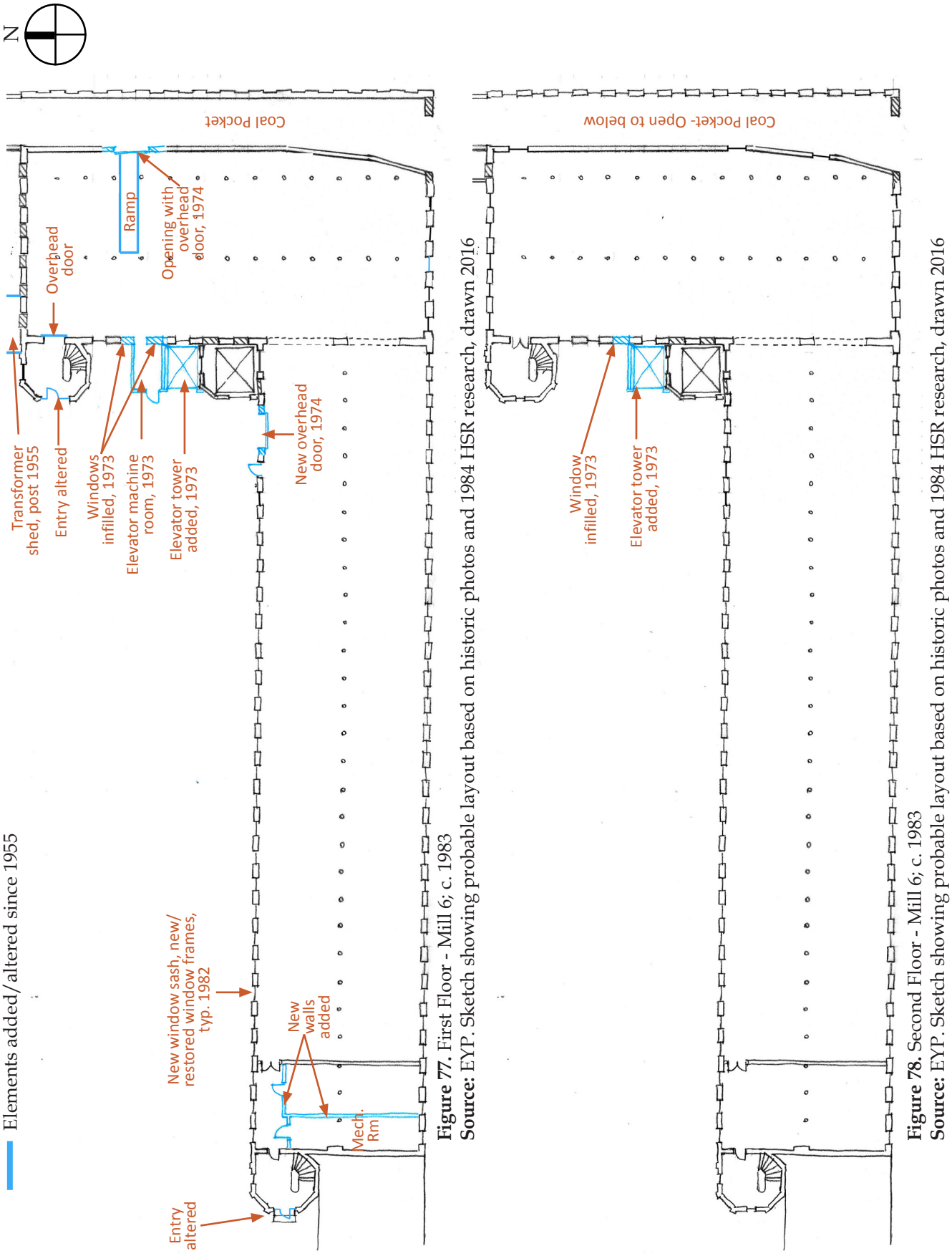


Figure 77. First Floor - Mill 6; c. 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

Figure 78. Second Floor - Mill 6; c. 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

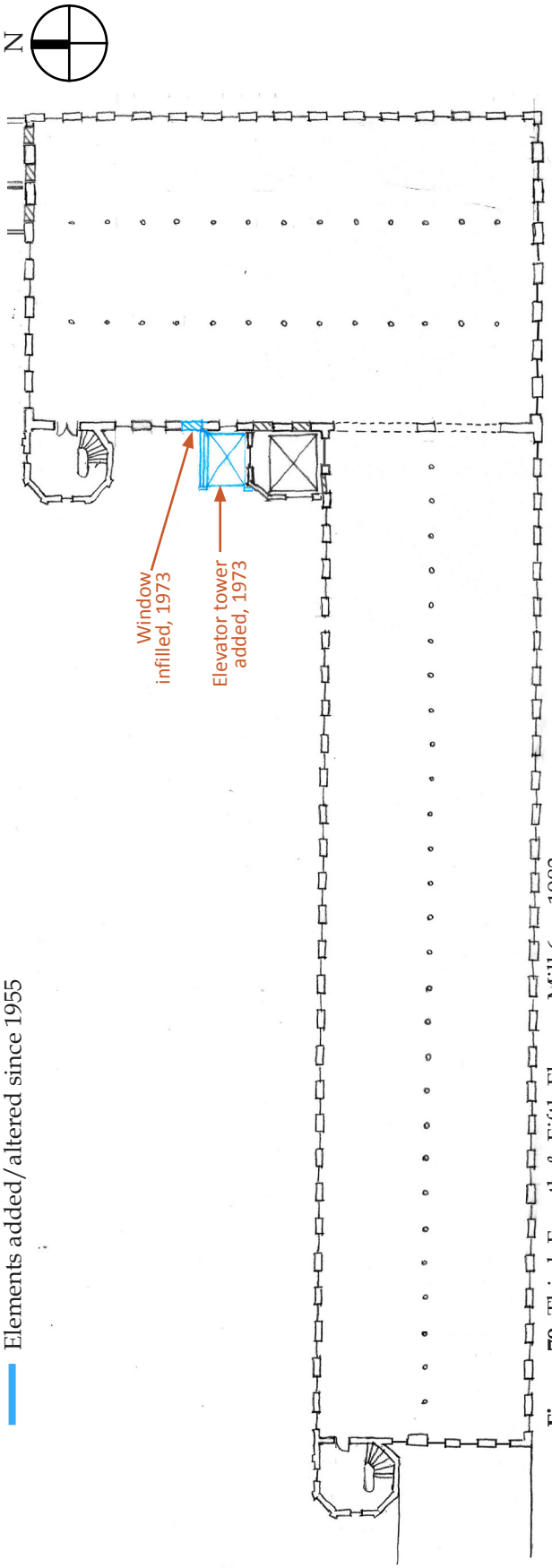


Figure 79. Third, Fourth & Fifth Floors - Mill 6; c. 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

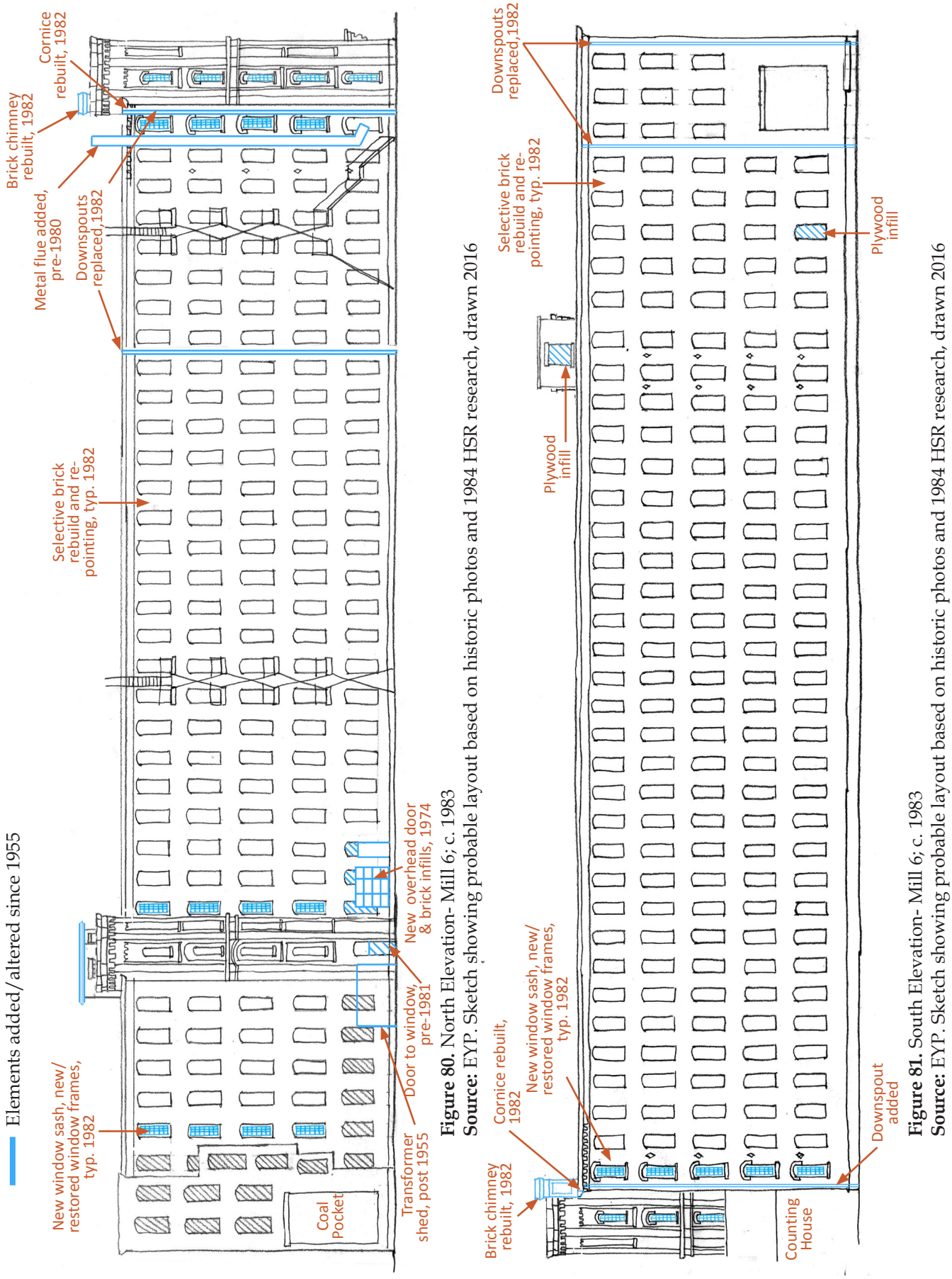


Figure 80. North Elevation- Mill 6; c. 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

Figure 81. South Elevation- Mill 6; c. 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

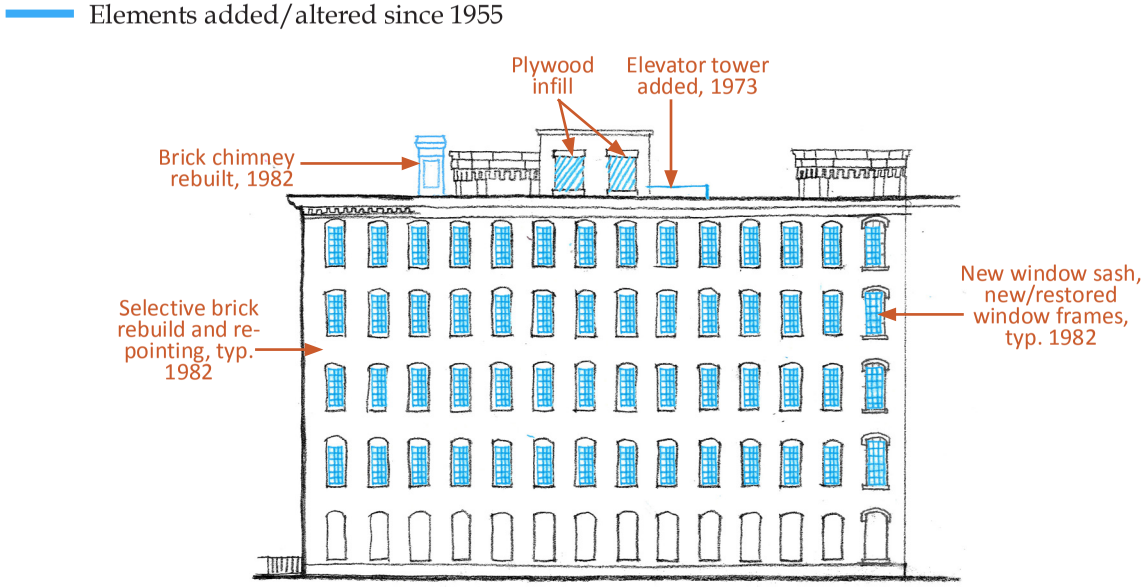


Figure 82. East Elevation- Mill 6; 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016

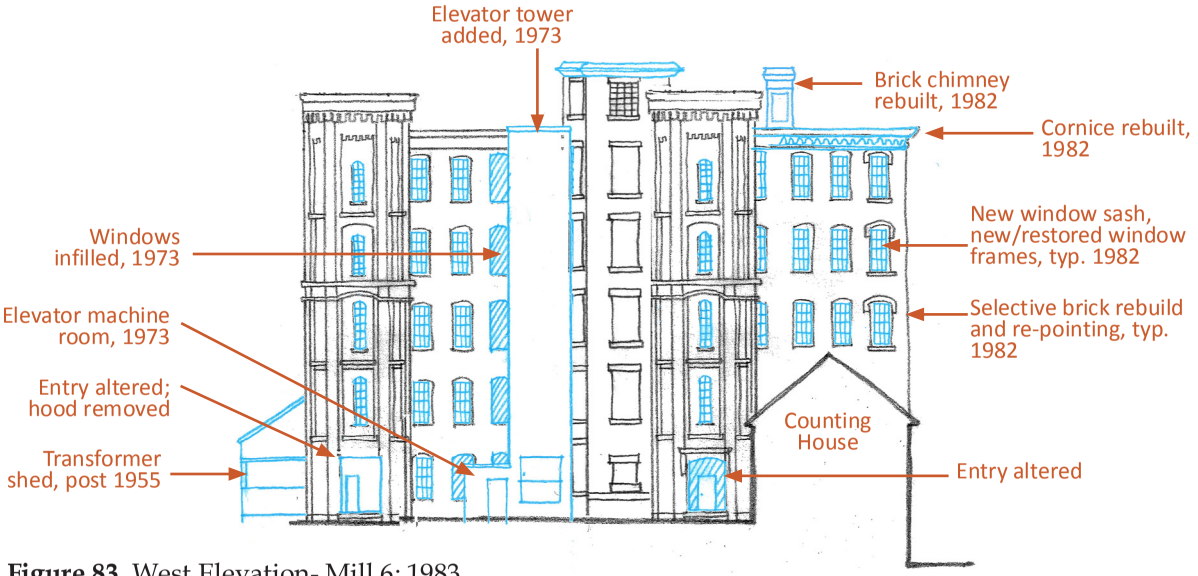


Figure 83. West Elevation- Mill 6; 1983
Source: EYP. Sketch showing probable layout based on historic photos and 1984 HSR research, drawn 2016



Photo 73. View of west elevation of east wing of Mill 6, 1976. Note the altered entrance at east stair tower, the 1973 freight elevator tower with adjacent one-story machine room, window openings with brick and plywood infills and mechanical flues.
Source: HAER, Reproduction Number: HAER MASS,9-LOW,8--27 (zoomed from original)



Photo 74. View of Mill 6 looking west, 1982. Compare with Photo 70 and note the restored window openings with replacement wood sash and removal of mechanical flues. Also note rebuilt metal cornice at west end of the building.
Source: HAER, Reproduction Number: HAER MASS,9-LOW,8--27 (zoomed from original)

new opening was fitted with an overhead door with a new fire-rated pedestrian door installed to the west of it. During this period several exhaust flues and ducts were installed through window openings and run on the exterior to above the roof. These elements were removed in the 1981 rehabilitation, with the one venting the Wang boiler routed through a brick reproduction of the original forge chimney located on the west wall of the west wing. The Wang rehabilitation project replaced all the building's multiple pane wood window sashes, which has been largely removed, as described above. These new sashes, installed in the original window frames, which had mostly survived, recreated the original true-divided light 12/12 main windows and the 4/4 windows in the original stair towers. This work had a major impact on the condition and historic appearance of the building's facades. This was enhanced by the partial repointing of deteriorated and poorly repaired brick joints, removal of unused conduits, equipment, etc from the facade and the replacement of missing and damaged brick units. All the brick hoods over the window openings were completely repointed at this time and lead-burning repairs made to the window hood flashing. New downspouts were installed on the exterior roof drains that c. 1927 had apparently taken the place of failed interior leaders and the existing metal cornice was repaired and replaced as needed around the building.

South Elevation:

The south façade had followed a pretty similar pattern to the north elevation. From 1956 to right before the Wang repairs, many of the original window openings were missing sash and vertical mechanical flues marred the appearance of the façade. In 1981, all of the windows were replaced, a large flue at the west end of the façade was removed and new downspouts near the southwest and southeast corners were installed.

East Elevation:

The east elevation had remained virtually unchanged from 1956-1980. In 1981, as part of the Wang Corporation repairs, new sash was installed in all the windows and portions of the façade were repointed.

West Elevation:

A large mechanical flue had been installed between the two northernmost bays of the of the west wall of the east part of Mill 6. Owing to this many of the adjacent window openings had been boarded up prior to 1980. The 1981 repairs involved removing this flue and installing new sash in the blocked openings. The 1973

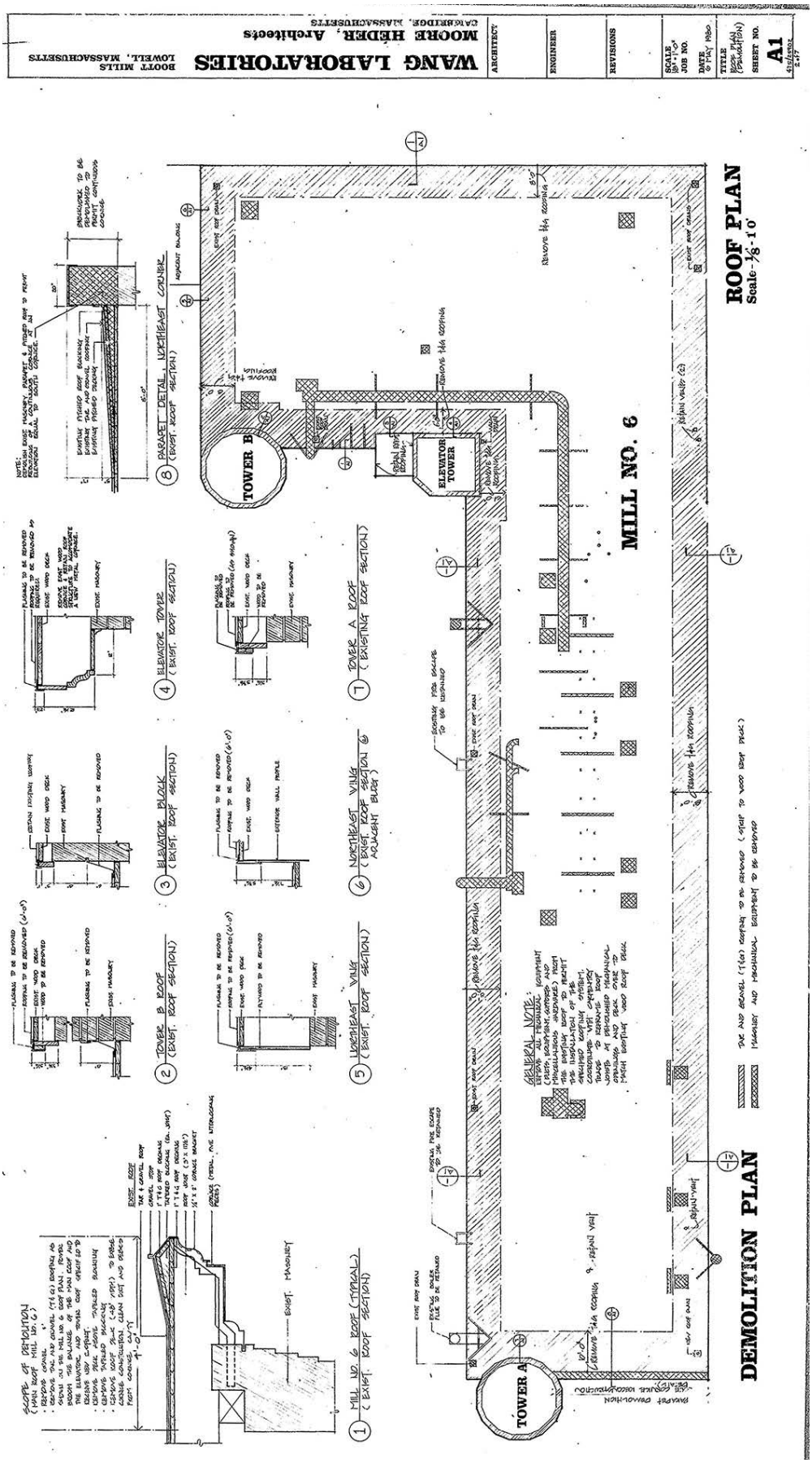


Figure 84. Roof Plan-Demolition, Mill 6, 1980
Source: Drawing A1, Boott Mill No. 6 Repairs and Restoration, Moore-Heder, 6 May 1980. LOWE_475_25902_[id14563]- DSC Archives.

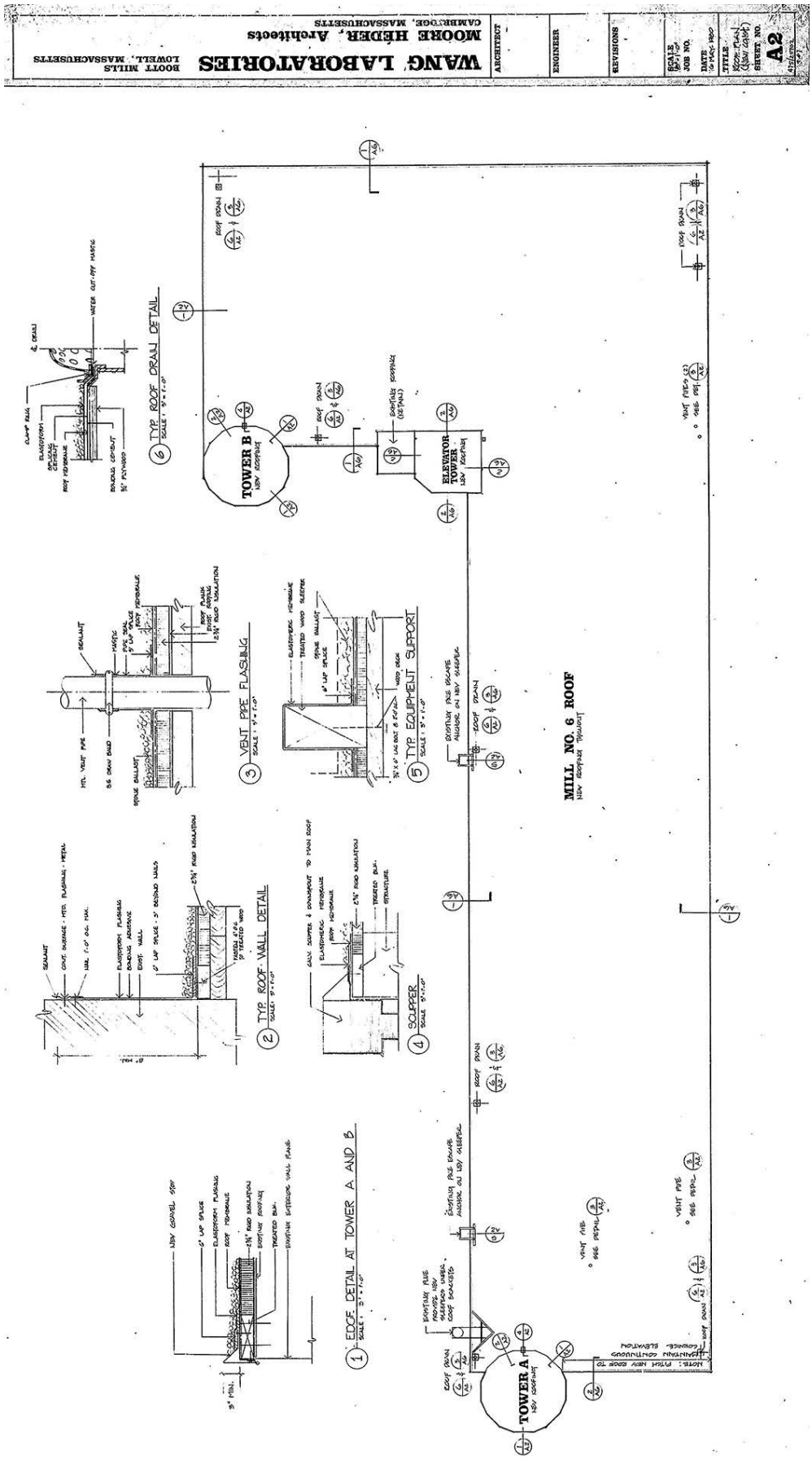


Figure 85. Roof Plan-New Constriction, Mill 6, 1980
Source: Drawing A2, Boott Mill No. 6 Repairs and Restoration, Moore-Heder, 6 May 1980. LOWE_475_25902_[id14563]- DSC Archives

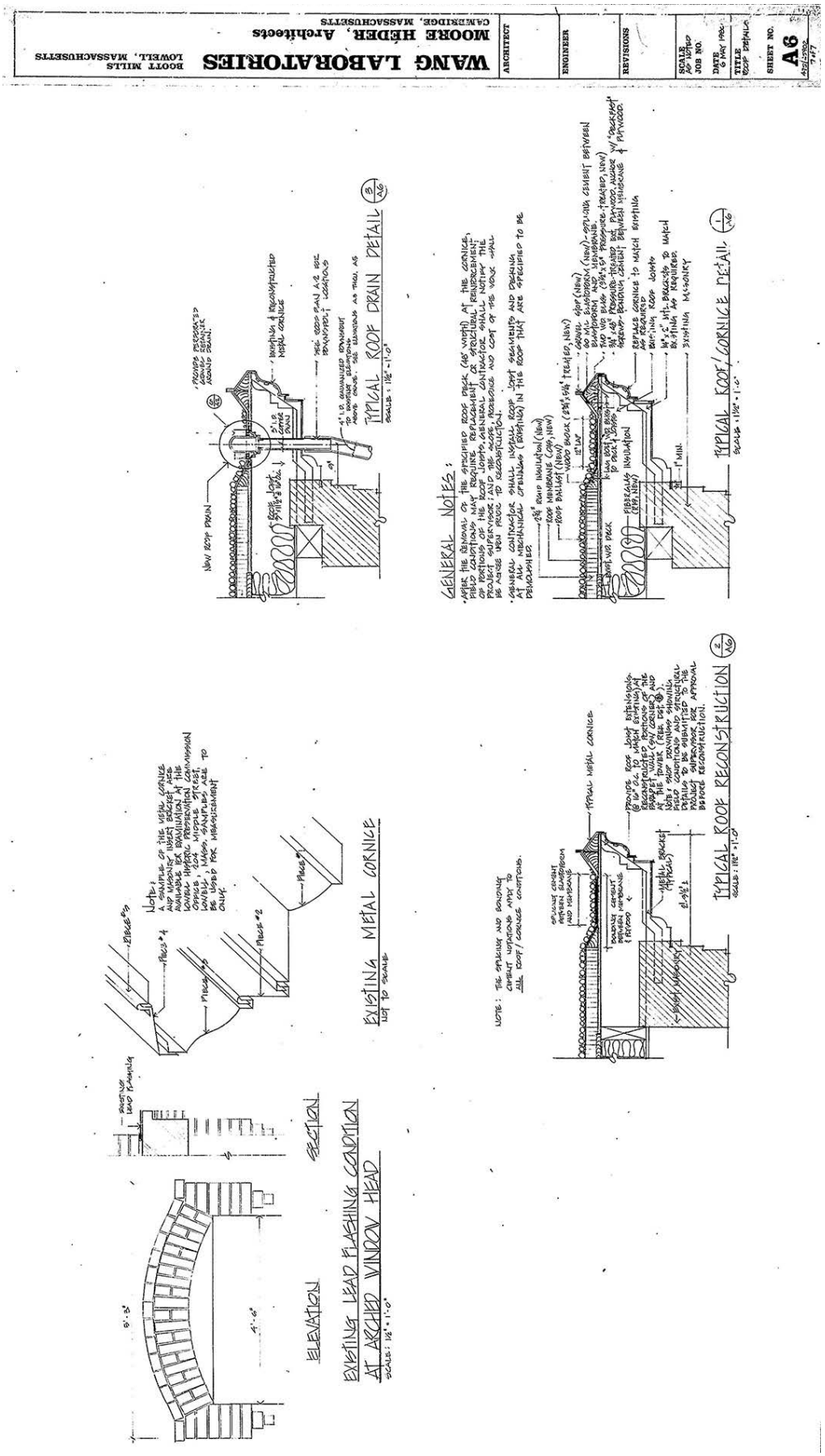


Figure 86. Roof Details, Mill 6, 1980
Source: Drawing A6, Boott Mill No. 6 Repairs and Restoration, Moore-Heder, 6 May 1980. LOWE_475_25902_[id14563]- DSC Archives

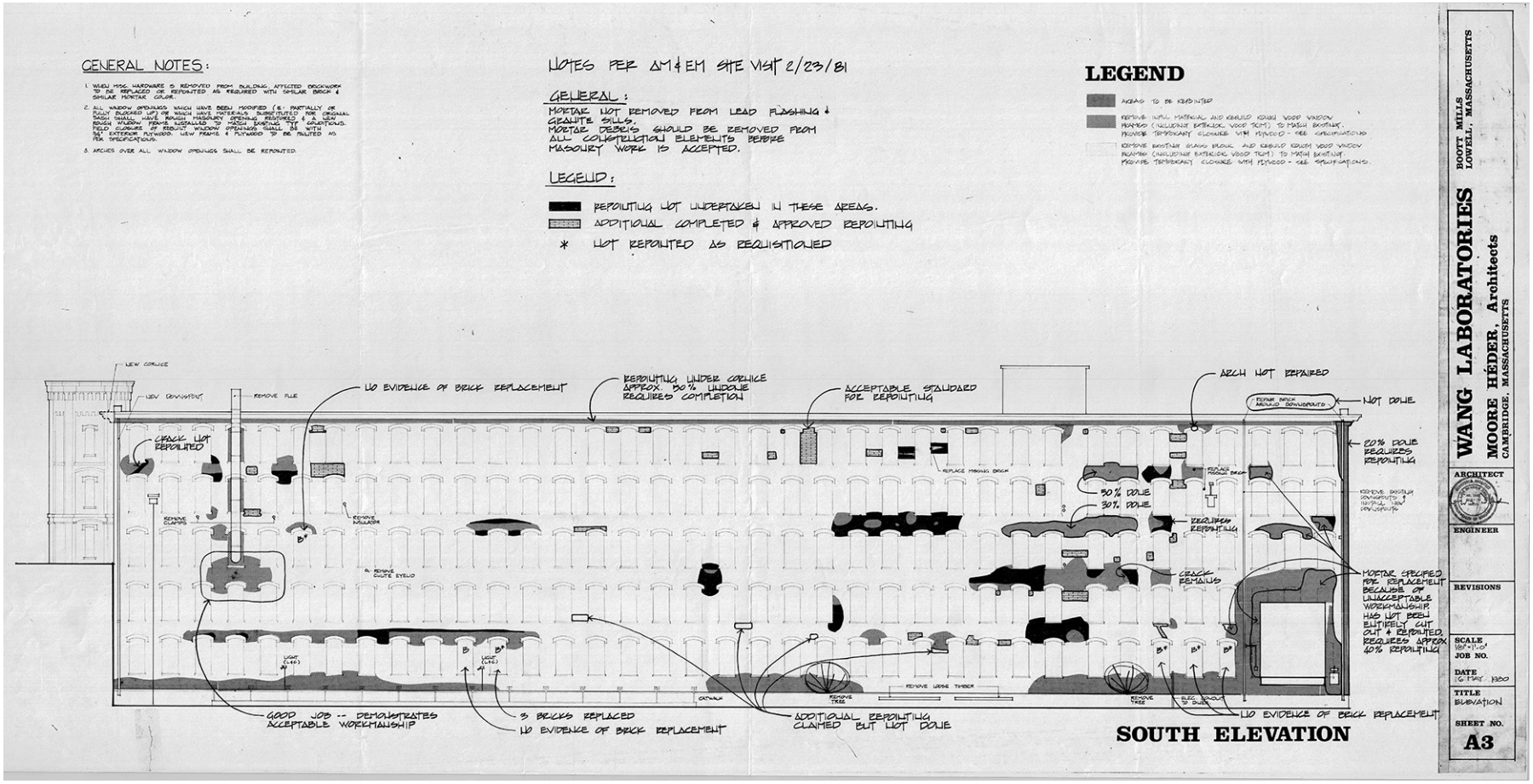


Figure 87. South Elevation, 1981
Source: Drawing A3, Boott Mill No. 6 Repairs and Restoration, Moore-Heder, 6 May 1980, Notes per site visit 2/23/1981. LNHp Archives

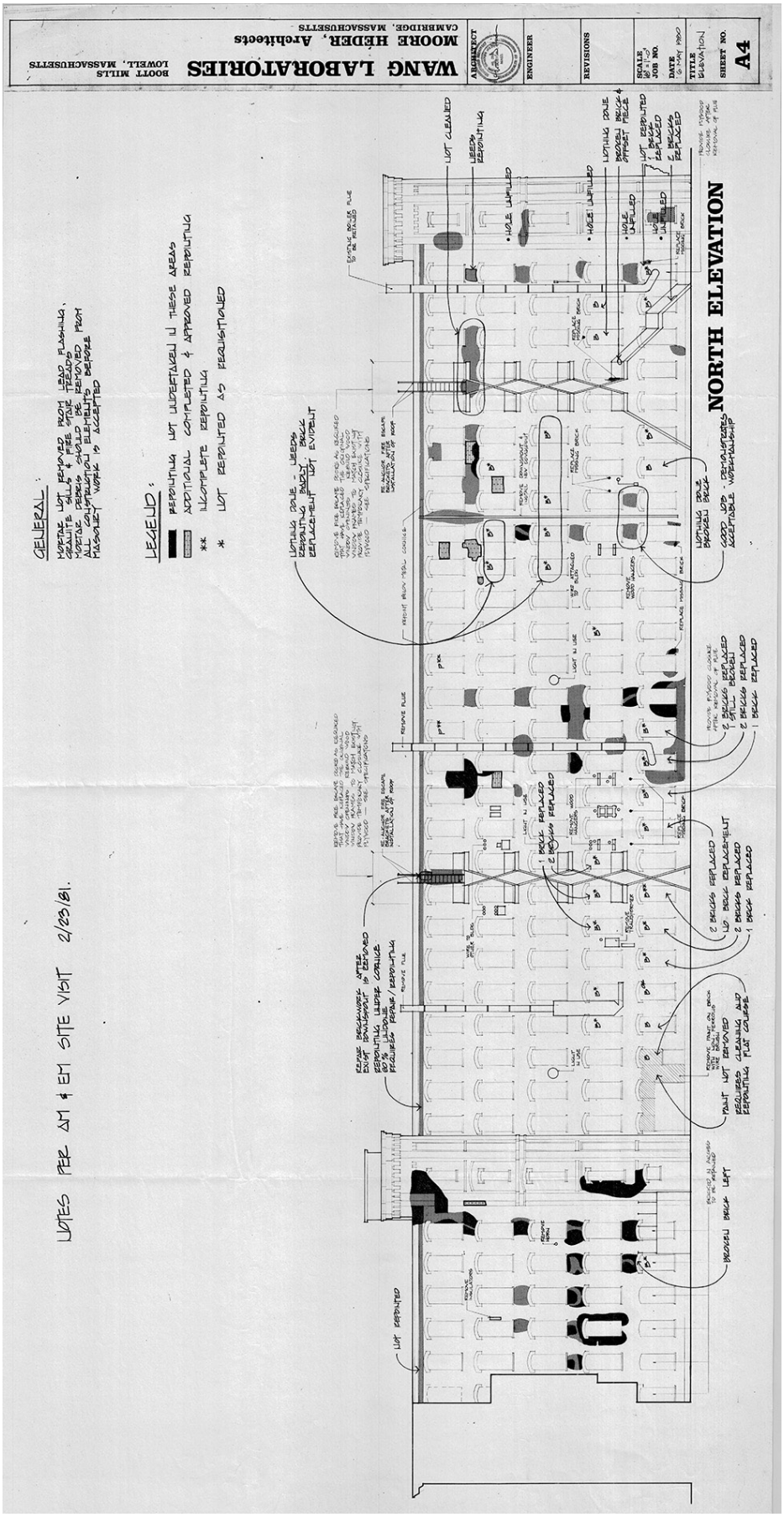


Figure 88. North Elevation, 1981
Source: Drawing A4, Boott Mill No. 6 Repairs and Restoration, Moore-Heder, 6 May 1980, Notes per site visit 2/23/1981. LNHP Archives

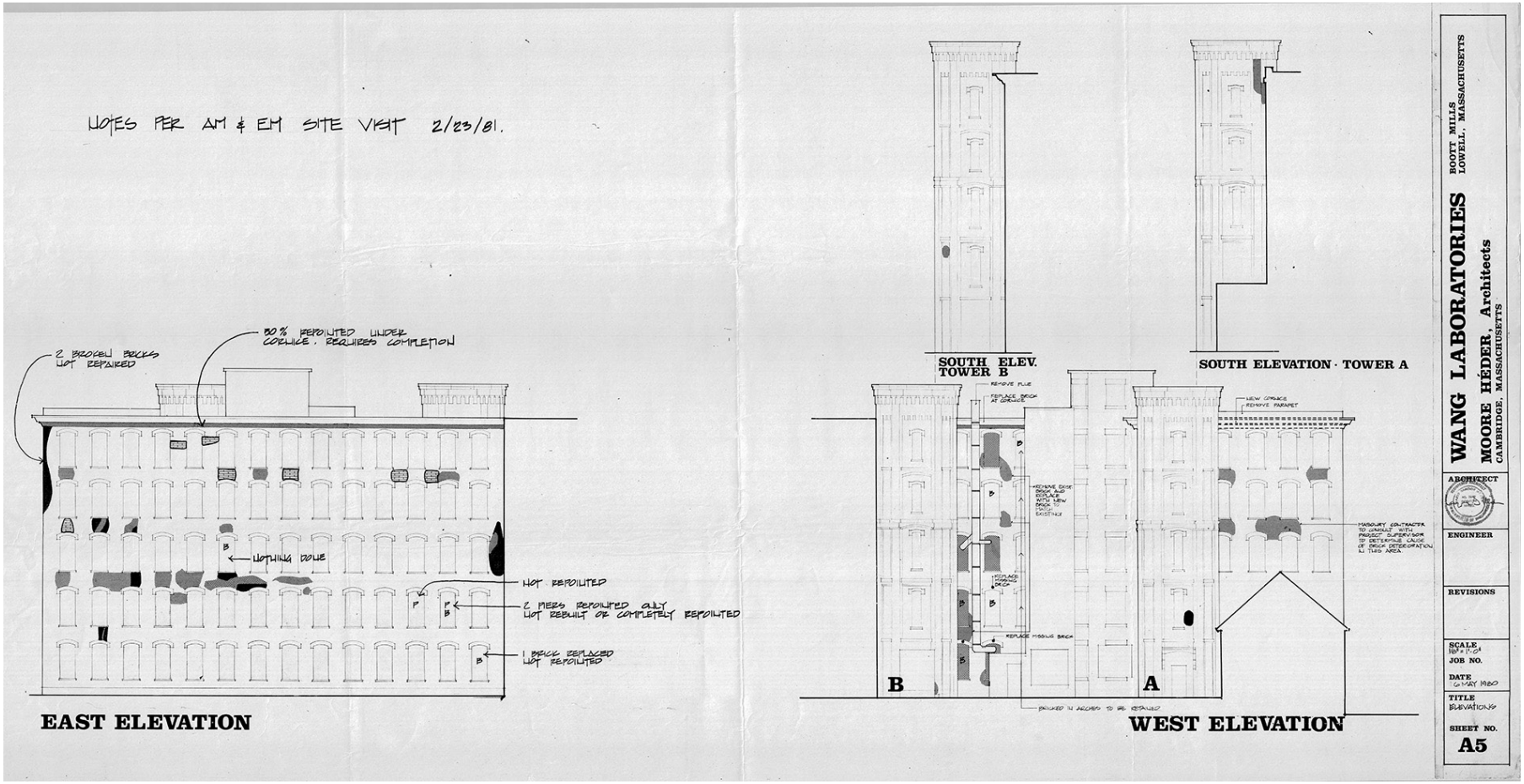


Figure 89. East & West Elevation, 1981
Source: Drawing A5, Boott Mill No. 6 Repairs and Restoration, Moore-Heder, 6 May 1980, Notes per site visit 2/23/1981. LNHP Archives

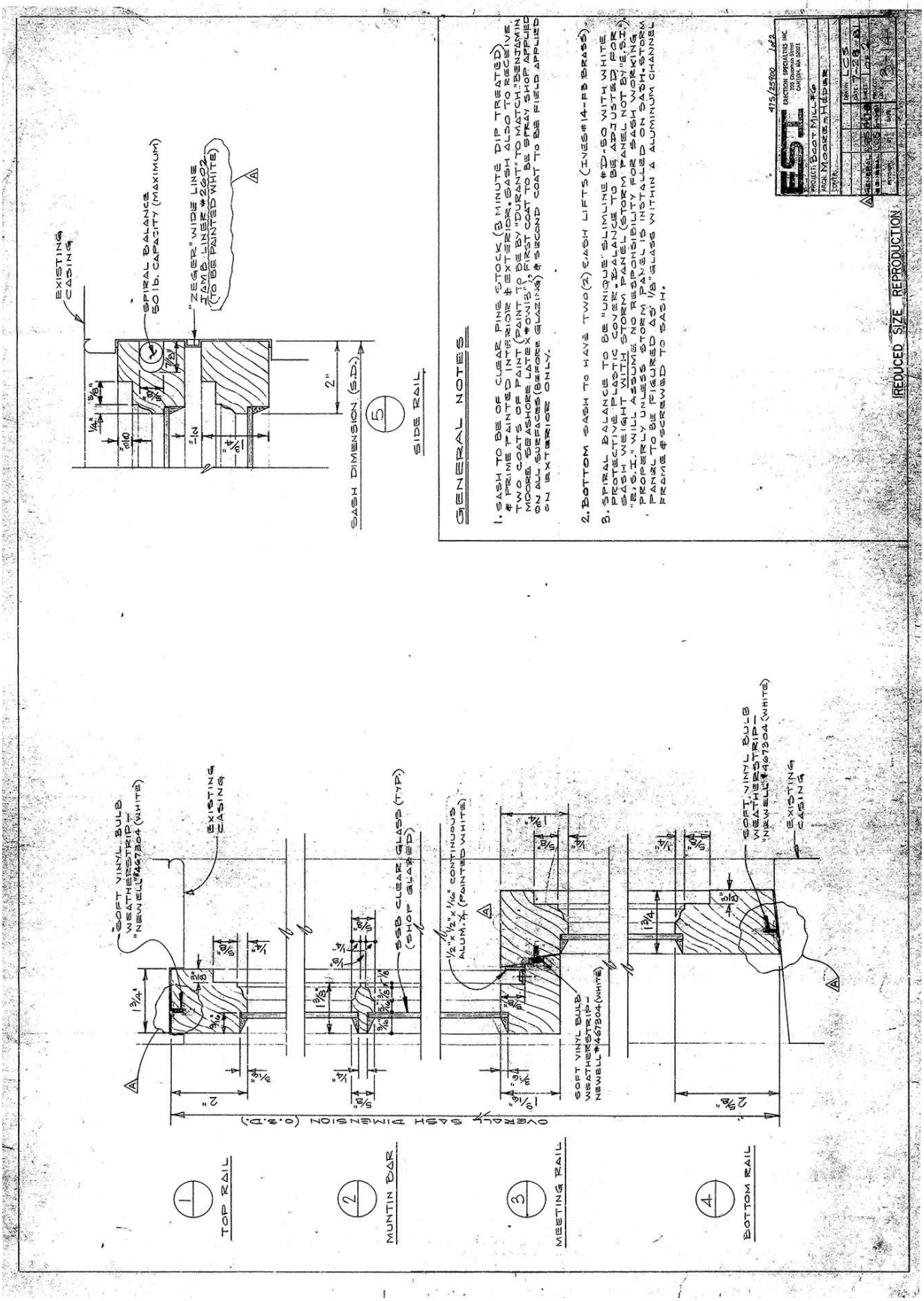


Figure 90. Window Details, 1981
Source: Drawing 1 of 2, Boott Mill No. 6, ESI & Moore-Heder, 7/28/1981. LOWE_475_25900_[id19242] - DSC Archives

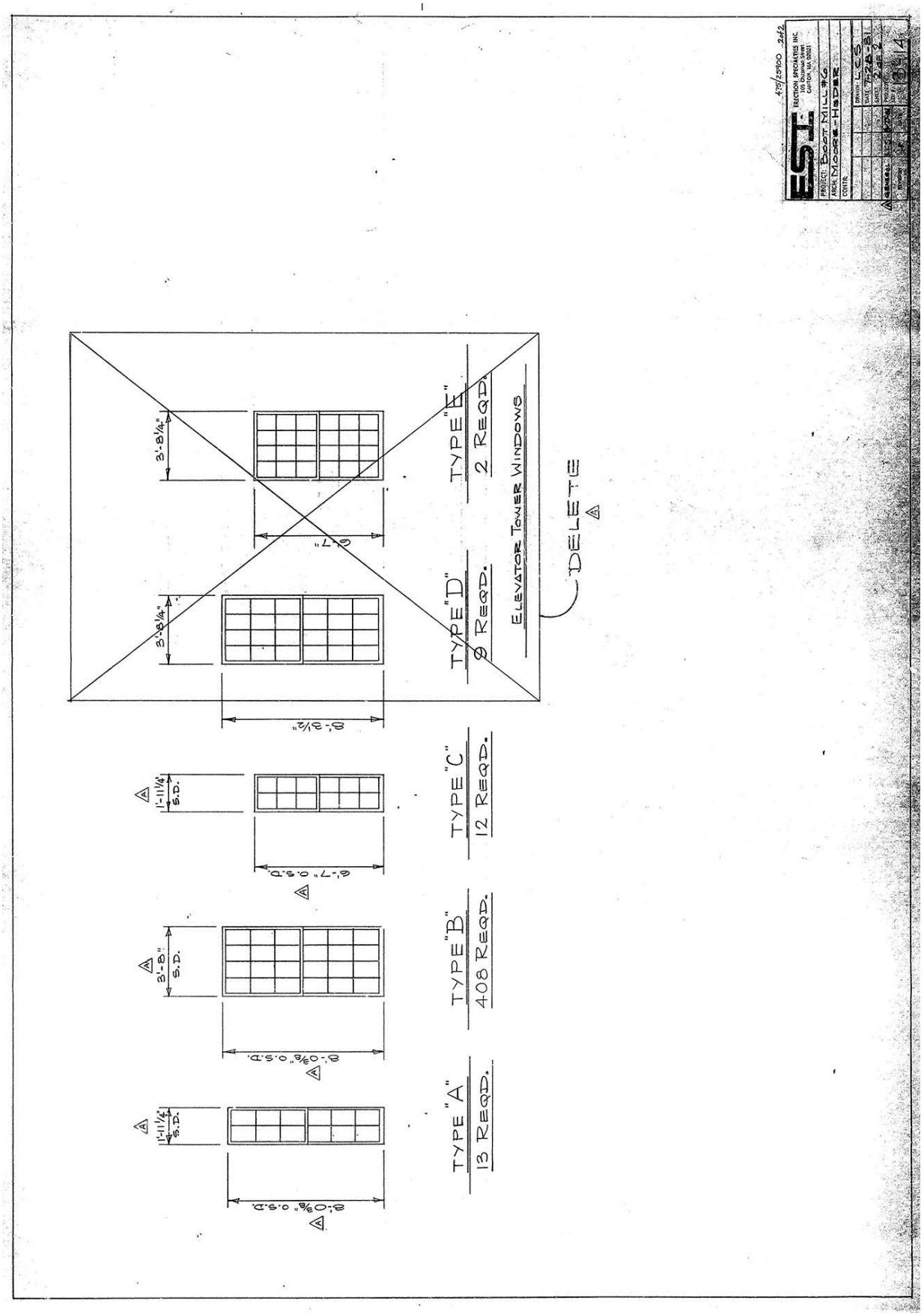


Figure 90A. Window Details, 1981
Source: Drawing 2 of 2, Boott Mill No. 6, ESI & Moore-Heder, 7/28/1981. LOWE_475_25900_[id19242] - DSC Archives

elevator tower was retained in these repairs and so was the bay of bricked up windows directly north of it. Other repairs apparent on the west façade included the reconstructed cornice on the west wall of Mill 6, adjacent to the Counting House. This cornice had been removed some time earlier at an unknown date and replaced with a short parapet. The parapet was removed and the cornice was reconstructed in 1981 to match the historic design elsewhere on the building. Another unfortunate change that had occurred on the west façade post 1956 was the loss of the ornamental wood hood and brackets over the entrance at the east octagonal tower. The arched opening had been poorly reconstructed with a flat profile, the opening was infilled and a single door installed in it to provide access. The west tower entrance was in appreciably better condition. While the arched opening and bracketed hood were still intact, the double doors were gone and had been replaced with an infill with a single modern door. The 1981 repairs did not include any work at these areas.

1984-1993:

After repairs that were undertaken at Mill 6 in 1981 as part of a collaboration between the then owners Wang Corporation and the LHPC, the building remained unoccupied for a couple years and was sold to the Lowell National Historical Park in 1984. By this time, the Park had determined that it planned to use Mill 6 for an interpretive use, and reuse the building in conjunction with the adjoining Counting House to accommodate a textile history museum, offices for the Park staff and educational activity areas. Conceptual design plans for both buildings had begun to be drawn up as early as 1983. The design ideas were further developed in a 'Comprehensive Design' set prepared by Earl R. Flansburgh & Associates, Inc. and dated 2/28/1986. It was decided that the project will be executed in two phases- the first phase included core and shell improvements to Mill 6, and the second phase included interior fit-out and additional shell improvements to Mill 6 and both core and shell and interior fit-out of the Counting House. Phase I was completed in 1989 and Phase II in 1993, as suggested by two sets of as-built drawings prepared by Flansburgh Associates corresponding to these dates. Apart from the interior partitions inserted at each floor to accommodate the new program, the other major change to the interior during these renovations, was the insertion of new building systems- most noticeably large mechanical ductwork that was left largely exposed and unpainted in the majority of spaces, thus allowing unhindered view of the original ceiling and cast iron column caps.

Mill 6 had already received a number of repairs to its façade and the roof during the Wang repairs of 1981. The intent of the additional facade work completed in 1989 was to continue those repairs and

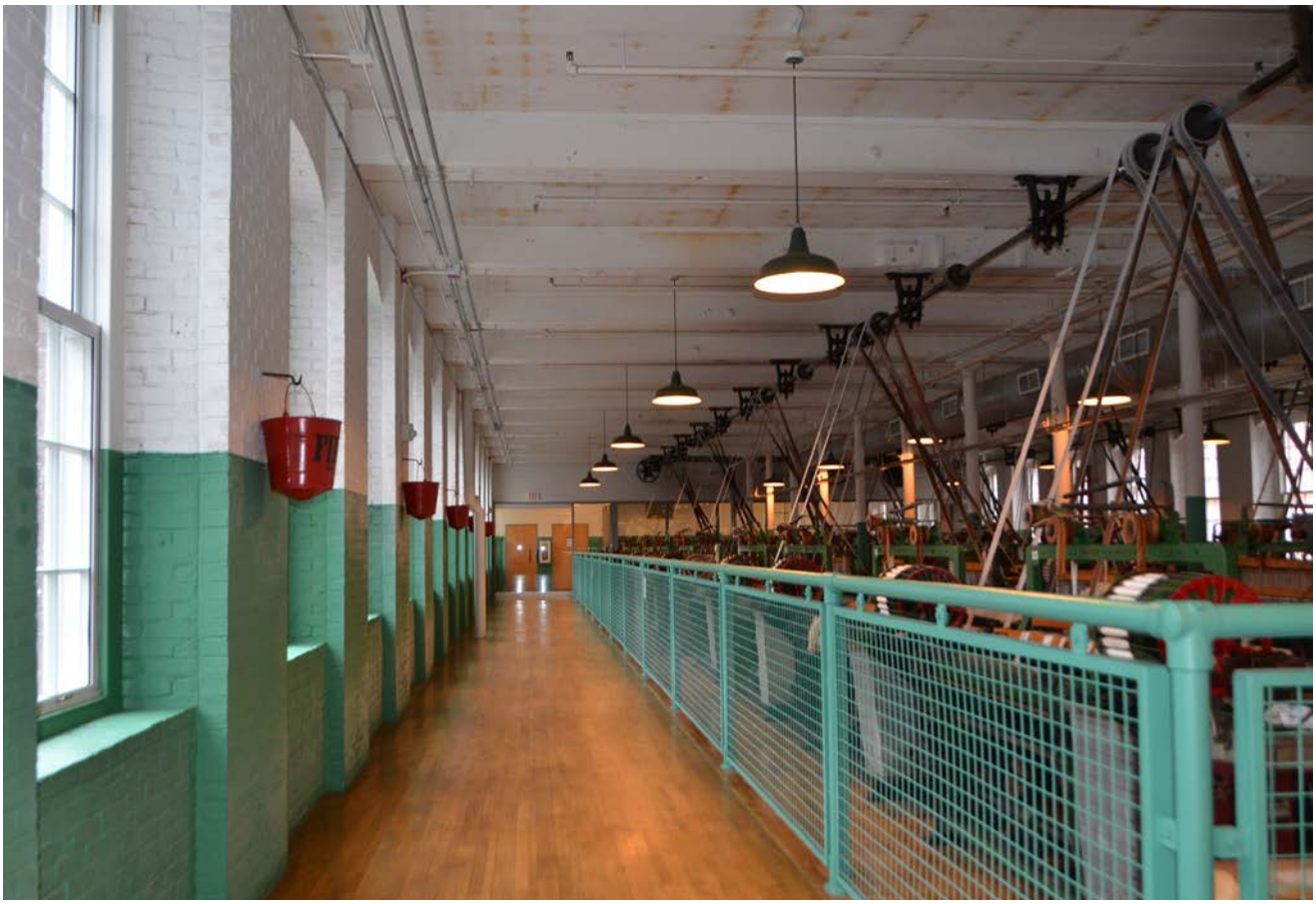


Photo 75. View of Weave Room at first floor of Mill 6, 2016. Note 1-wythe thick brick pilasters/piers added to the exterior wall between window openings in 1989.
Source: EYP

make other changes as needed to retrofit the building for its new proposed use. Following is a summary of the changes that were completed in 1989 and 1993.

First Floor:

Scope completed 1989:

The entire first floor slab was demolished and replaced with a new 6" concrete slab on steel form deck. The new slab was supported by new concrete beams that rested on existing granite piers in the crawl space below. Additional concrete walls and mat slabs were also laid in locations of the new building elevators (in the center of the east part). The floor slab at the two stair towers and the vaulted historic shop area in the west part was retained as existing. In addition, concrete was not poured over a section of the floor slab in the north half of the west part closer to the inside corner of the L-shaped plan.

In the west part of Mill 6, brick pier 'extensions' or pilasters were added to the inside of the exterior brick wall between the windows

on the first floor. These pilasters were connected to the existing brick walls with new anchors. Existing and original paired timber beams existed in this space. Framing the second floor deck, they were originally pocketed into the existing brick wall and anchored with tie rods featuring the distinctive and original diamond shaped plates on the outside. This entire structural arrangement was retained, albeit strengthened by the addition of new steel plates, brick and non-shrink grout in each beam pocket. Where damaged or missing, the existing tie rods to the outside of the exterior wall were also replaced. The existing cast iron columns were retained.

At this time, the 1973 elevator tower was demolished and the brick infill at the original windows was removed. The 1917 elevator tower was retained but the elevator car and all related equipment was removed from it. The space was intended to be used as programmable space on each floor, and therefore a new concrete slab was poured here at each level.

The 1973 interior masonry partition that subdivided the shop area into two sections was retained. At the original arched masonry partition that separated the east part of Mill 6 from the west part, replacement tie rods were provided at each of the existing arched openings. A new services and circulation core was constructed in the north half of the east part of the building. This included two elevator shafts, multi-stall toilets for men and women, a number of rooms for electrical, mechanical, plumbing and fire-protection equipment and a new staircase that served floors 1 through 5. The floor around the new stair opening was framed with new wood beams.

An existing ramp at the first floor that connected with the coal pocket area to the east was replaced with new steps and a door. Another door was added on the north wall of the east part, from the fire pump room directly to the exterior.

At the west octagonal stair tower, the existing infill and single door was removed to be replaced by a double door with six-panels on each leaf, reminiscent of the historic double doors that originally existed at this opening. The west stairway itself was proposed to be restored. While some of the items originally planned were executed, others were left out. For example, the vertical metal support channels that were existing and were probably added at the stair pre-1955 were initially called for removal, were left in place and still exist at the building. Other repairs included installation of plywood under each tread from floors 1-2 and expansion bolts at every alternate tread to the wall from floors 1-2. The 1914 pipe railings were retained and repaired in place.



Photo 76. View of east tower entrance, 2016. Note new wood hood and paneled double door based on historic design, constructed in 1989.
Source: EYP



Photo 77. View of arched masonry partition at first floor, 2016. Note new tie-rods installed (in place of existing) in 1989.
Source: EYP

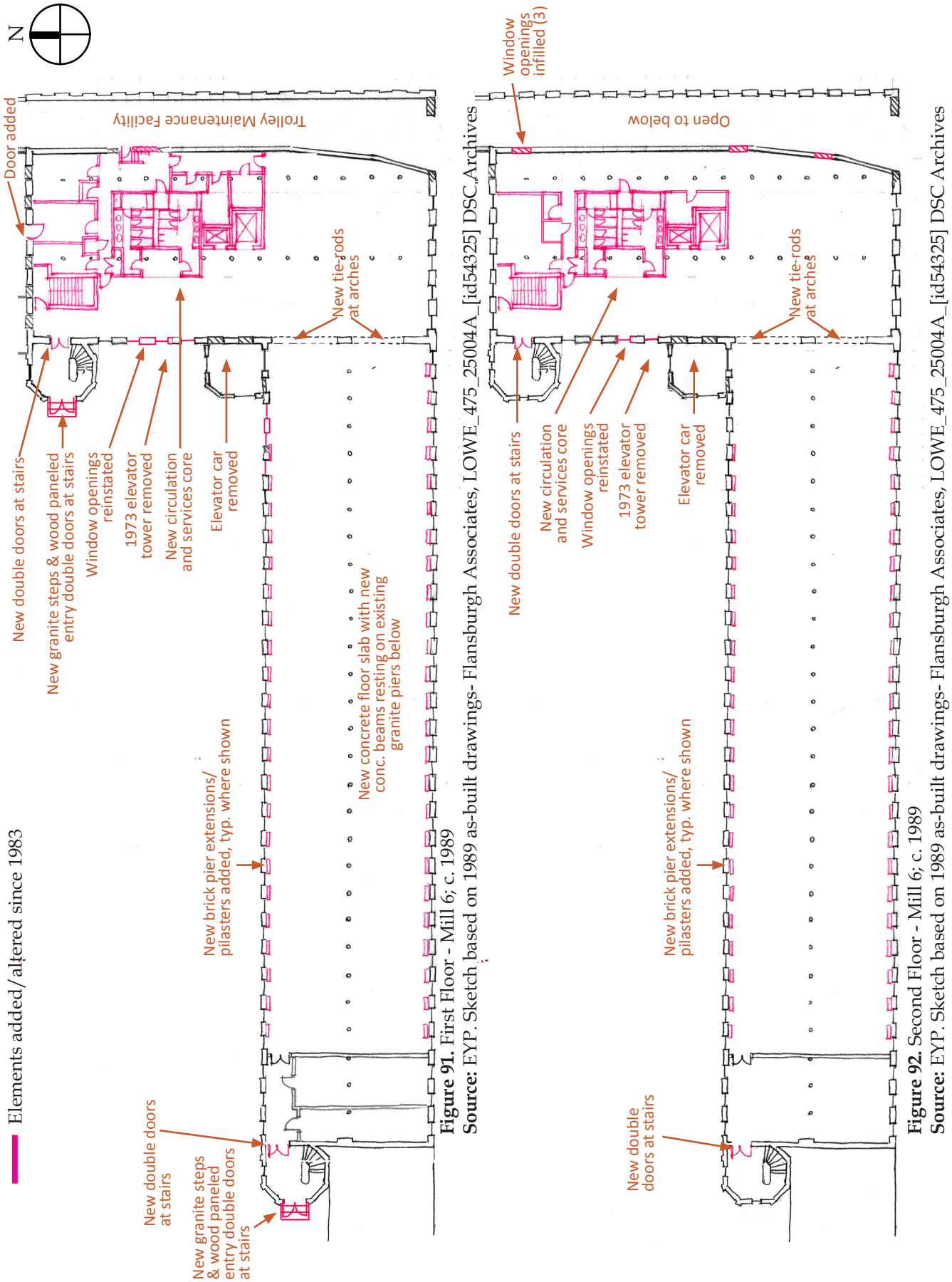


Figure 91. First Floor - Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC_Archives

Figure 92. Second Floor - Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

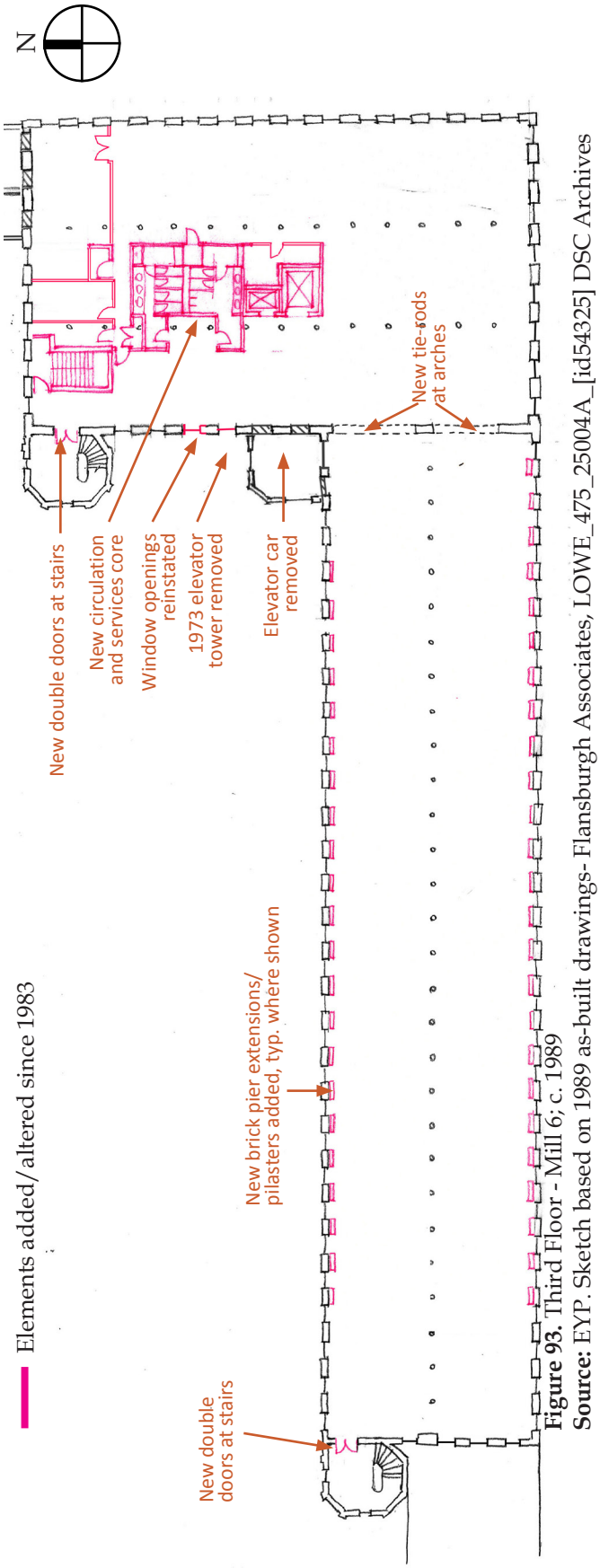


Figure 93. Third Floor - Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

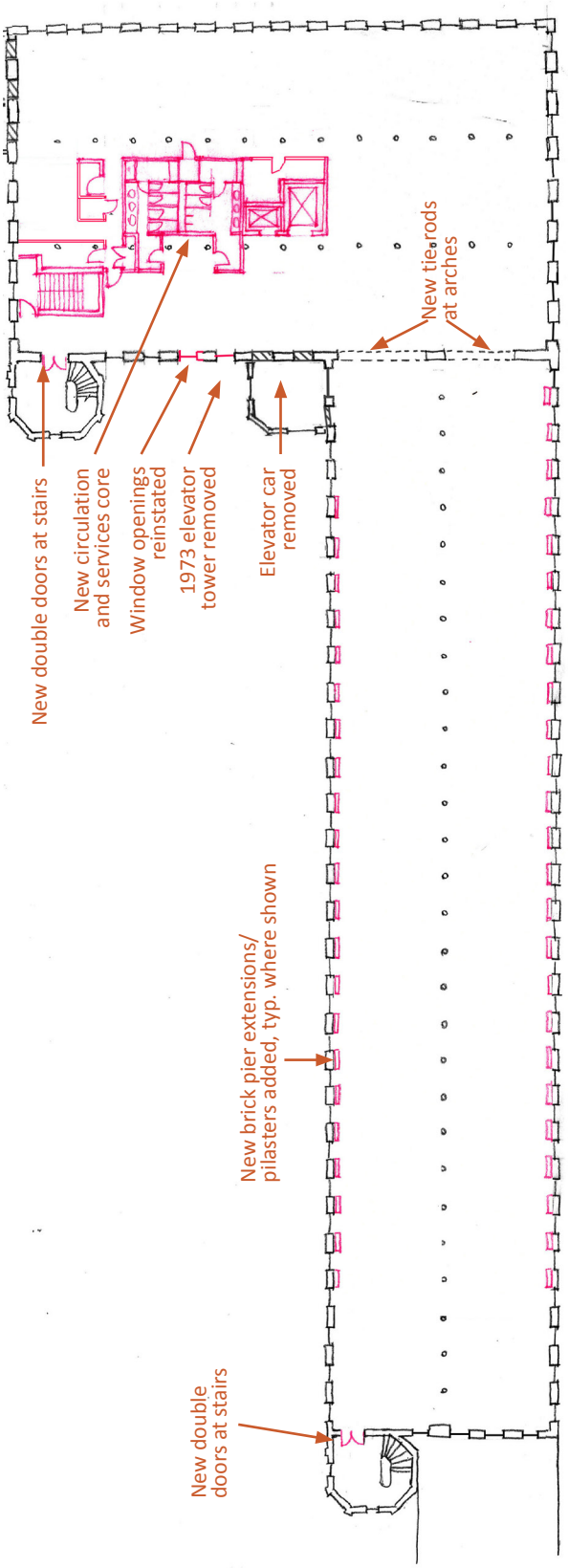


Figure 94. Fourth Floor - Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

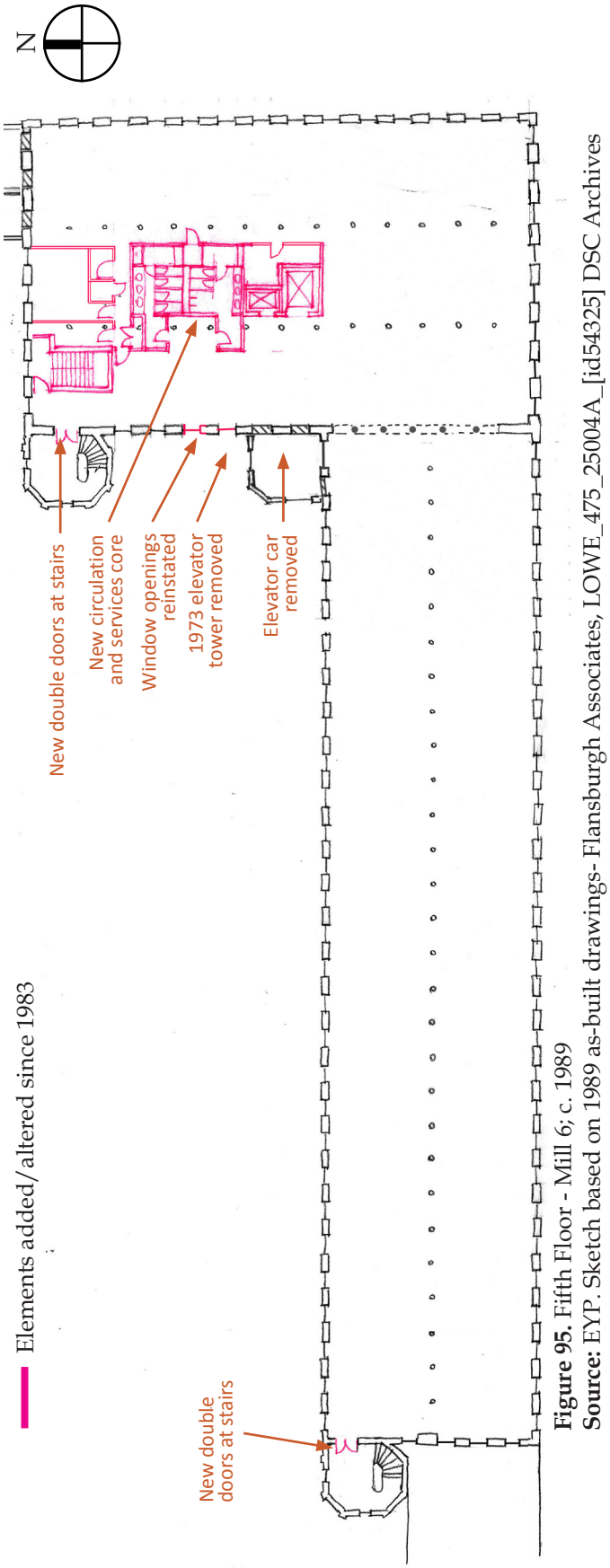


Figure 95. Fifth Floor - Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

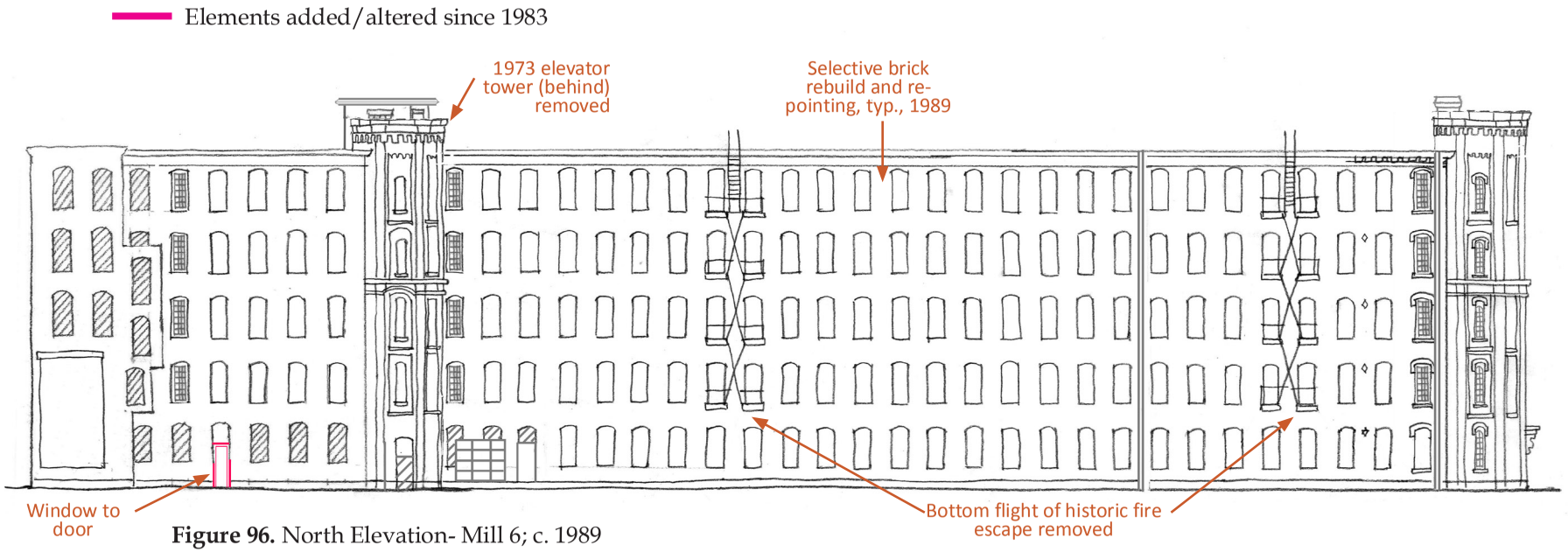


Figure 96. North Elevation- Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

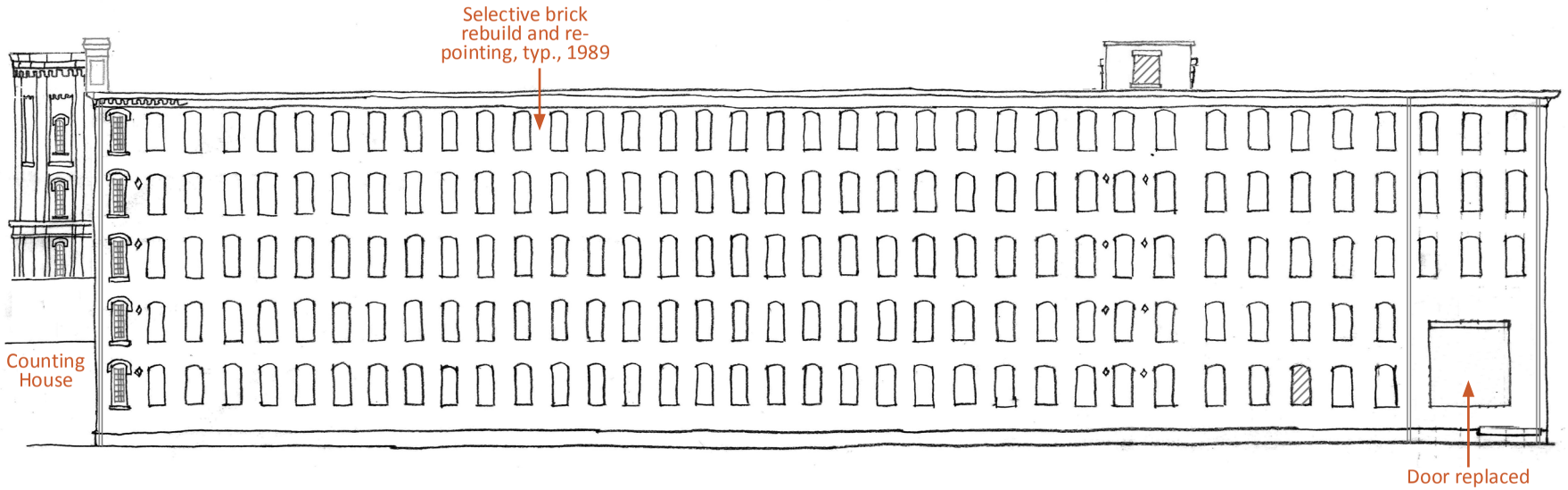


Figure 97. South Elevation- Mill 6; c. 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

Elements added/altered since 1955

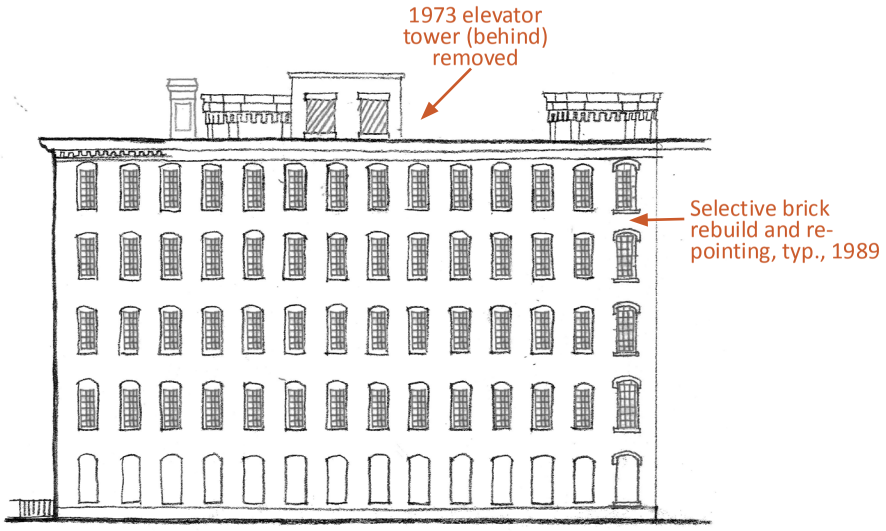


Figure 98. East Elevation- Mill 6; 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

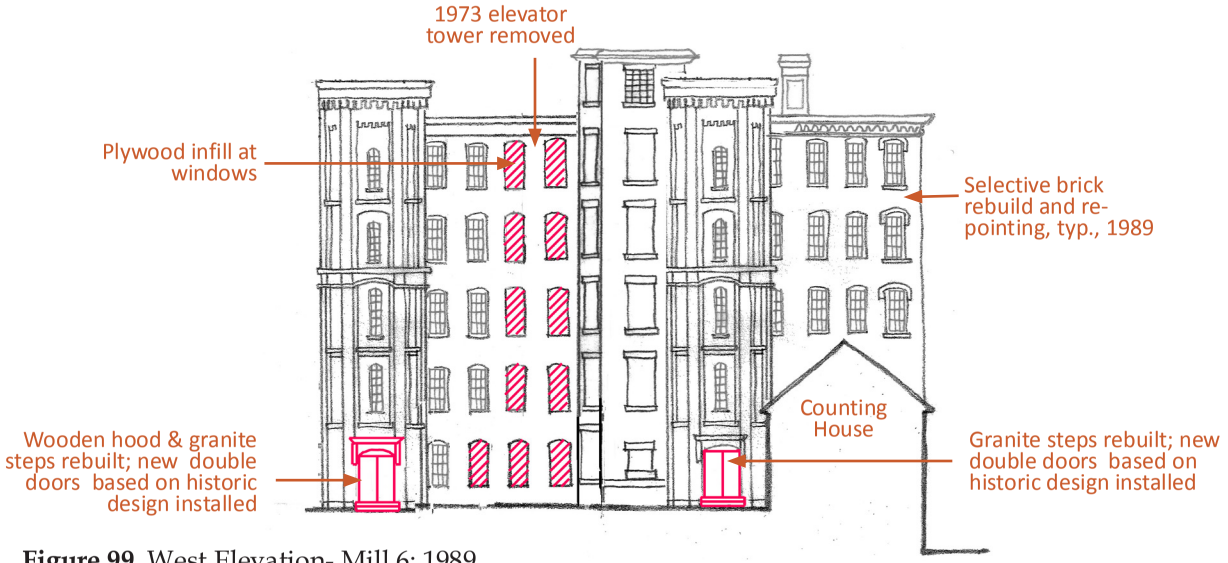


Figure 99. West Elevation- Mill 6; 1989
Source: EYP. Sketch based on 1989 as-built drawings- Flansburgh Associates, LOWE_475_25004A_[id54325] DSC Archives

Similar repairs were not called out for the east octagonal stair, probably because it was decided that the new stair built across from it to the east was designed to handle most of the traffic. Nonetheless, the entrance to the east stair tower from the exterior was rebuilt with a new wooden hood and brackets to match the extant version at the west tower with new double paneled wood doors.



Photo 78. Entry ramp and steps built in 1993 at the historic 1917 elevator tower, photo taken 2016
Source: EYP

Scope completed 1993:

Phase II included interior fit out of all floors of Mill 6. Since most of the east part was taken up by the core completed in Phase I, the majority of the program areas found space in the west part. At the first floor was a 'Weave Room'. This was envisioned as a working exhibit of a typical mill floor. Weaving looms were brought in from other textile mills in the country and installed in this space. Design drawings for this work were prepared by Flansburgh Associates in November, 1986, and they show the location and installation details for the various machines. The majority of the interior fit out scope is documented on a set of record drawings prepared by Flansburgh Associates and dated March 1993. This set shows that the first floor was meant to have two entrances – one at the west octagonal stair tower and the other at the 1917 elevator tower further east. New doors were provided at the 1917 elevator tower to create a new entry vestibule at the first floor leading directly into the elevator lobby. An exterior accessible ramp and set of stairs built in granite and brick were also added at this entrance. At the other end, the west tower entrance led to a reception/ orientation space in the historic blacksmith shop area (with the brick vaulted ceilings above). A new stair was added directly east of this space. Connecting floors 1 through 3 this stair was likely added to accommodate the larger occupancy on the first three floors of the building. The orientation area led to an observation space which provided access to the

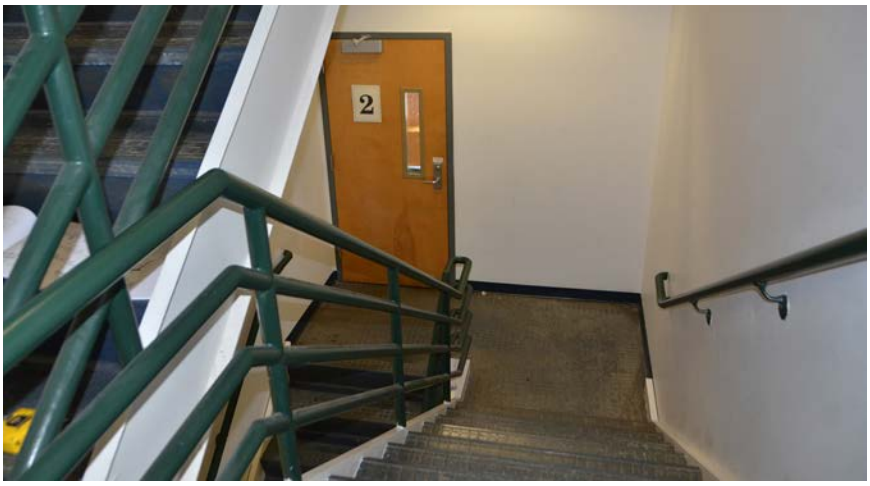


Photo 79. View of new internal stair from floors 1-3 inserted in west part of Mill 6 in 1989, Photo taken 2016
Source: EYP



Photo 80. Weave Room at first floor of Mill 6 , c. 1993
Source: Flansburgh Architects, http://flansburgh.com/projects/boott-cotton-mills-museum/



Photo 81. Curved stair connecting floors 1 and 2 of the museum located directly east of the arched masonry partition added in 1989, photo taken 2016.
Source: EYP

weave room through an aisle with railings on both sides. The entire floor was provided with a new wood floor over the concrete slab on concrete beams over crawl space. At the other end of the weave room was a new curved stair going up to the second floor directly east of the arched masonry partition. The space behind this was finished for exhibit gallery use and was accessed both from the weave room and the main building lobby.

In terms of interior finishes care was taken as much as possible to avoid covering of historic surfaces with new materials. New partitions were held away from the exterior walls and interior columns as much as possible. The un-plastered brick surface at the inside face of the exterior walls was retained and simply painted, as it had been historically. A bi-color scheme was chosen for the first and second floor, with the divide between the two colors happening roughly at the wainscot level. The upper half of the walls was always white. Walls at floors 3-5 were painted all white. The brick window jambs and stools, the cast iron columns, the underside of the floor deck above and the exposed timber beams were all painted white. All new pipes and conduits along the ceiling were also painted white with the exception of the round mechanical ducts that have a silver/gray metallic finish.



Photo 82. Theater located on floor 2 of the museum, added in 1989; photo taken 2016.
Source: EYP



Photo 83. View of corridor along exterior wall on floor 2 of the museum, built in 1989; photo taken 2016. Note the brick piers between windows, the bi-color wall paint scheme and the dark painted ceilings and systems above.
Source: EYP



Photo 84. Exhibit space at west end of Mill 6 on floor 2, built in 1989; photo taken 2016. Note the vaulted ceiling and cast iron columns.
Source: EYP



Photo 85. Exhibit space directly east of the space in Photo 80, at west end of Mill 6 on floor 2, built in 1989; photo taken 2016. Note the dropped ceiling and cast iron columns.
Source: EYP

Second, Third and Fourth Floors:

Scope completed 1989:

At the second, third and fourth floors, common changes in the work completed in 1989 included the addition of brick pier extensions at the exterior walls between the windows in the west part, selected replacement of decayed/ damaged wood beams, strengthening of the arched masonry openings in the partition wall and the creation of a new core similar to the one at the first floor. New metal double doors were also provided at the openings connecting the two historic octagonal stair towers to the floors at each level. At the



Photo 86. View from lobby looking west at west wing of Mill 6 on floor 3, general layout from 1989; photo taken 2016.
Source: EYP



Photo 87. Lunch room on floor 4, built in 1989; photo taken 2016. Note the dropped ceiling and cast iron columns.
Source: EYP



Photo 88. View of third floor looking south , c. 1993. Note arched masonry partition on right with one arch infilled; double-height opening created in the floor above and new connecting stair between floor 3 and 4 added in 1993.
Source: Flansburgh Architects, http://flansburgh.com/projects/boott-cotton-mills-museum/



Photo 89. View of third floor looking north , c. 1993. Note double-height opening created in the floor above and new connecting stair between floor 3 and 4 added in 1993.
Source: Flansburgh Architects, http://flansburgh.com/projects/boott-cotton-mills-museum/

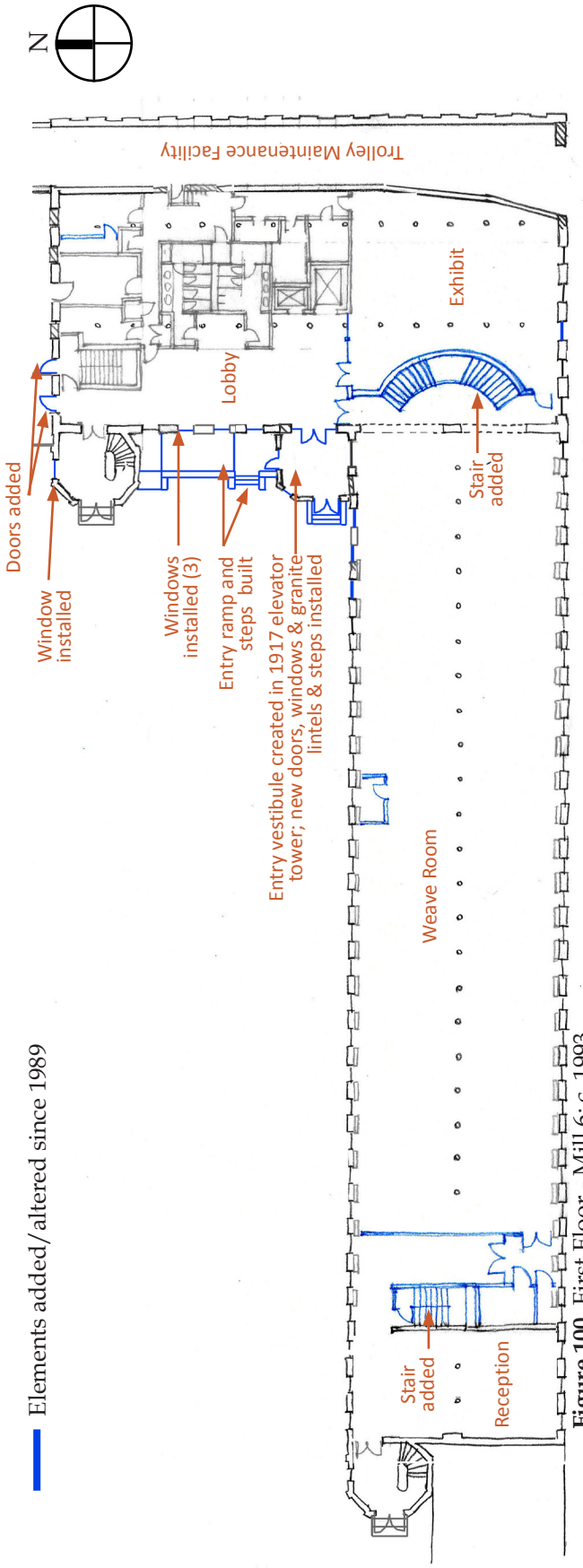


Figure 100. First Floor - Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

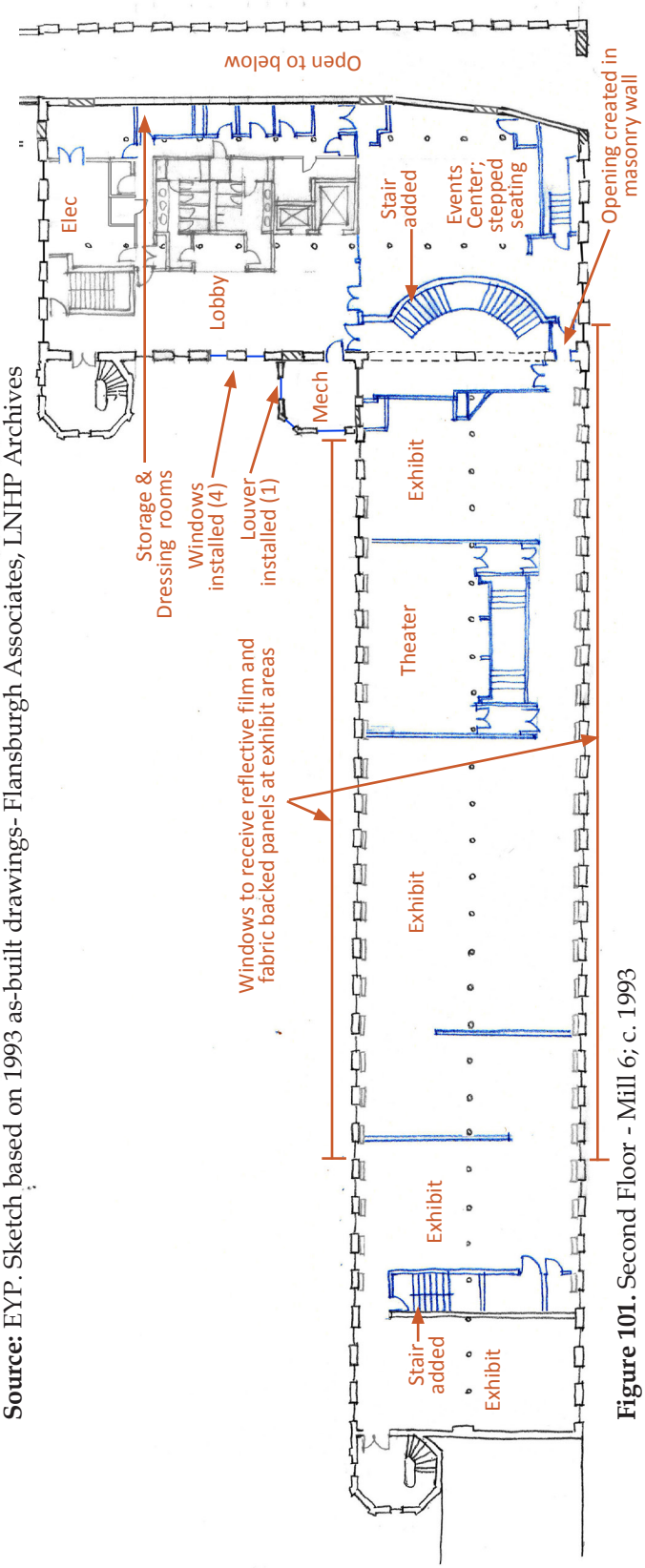


Figure 101. Second Floor - Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

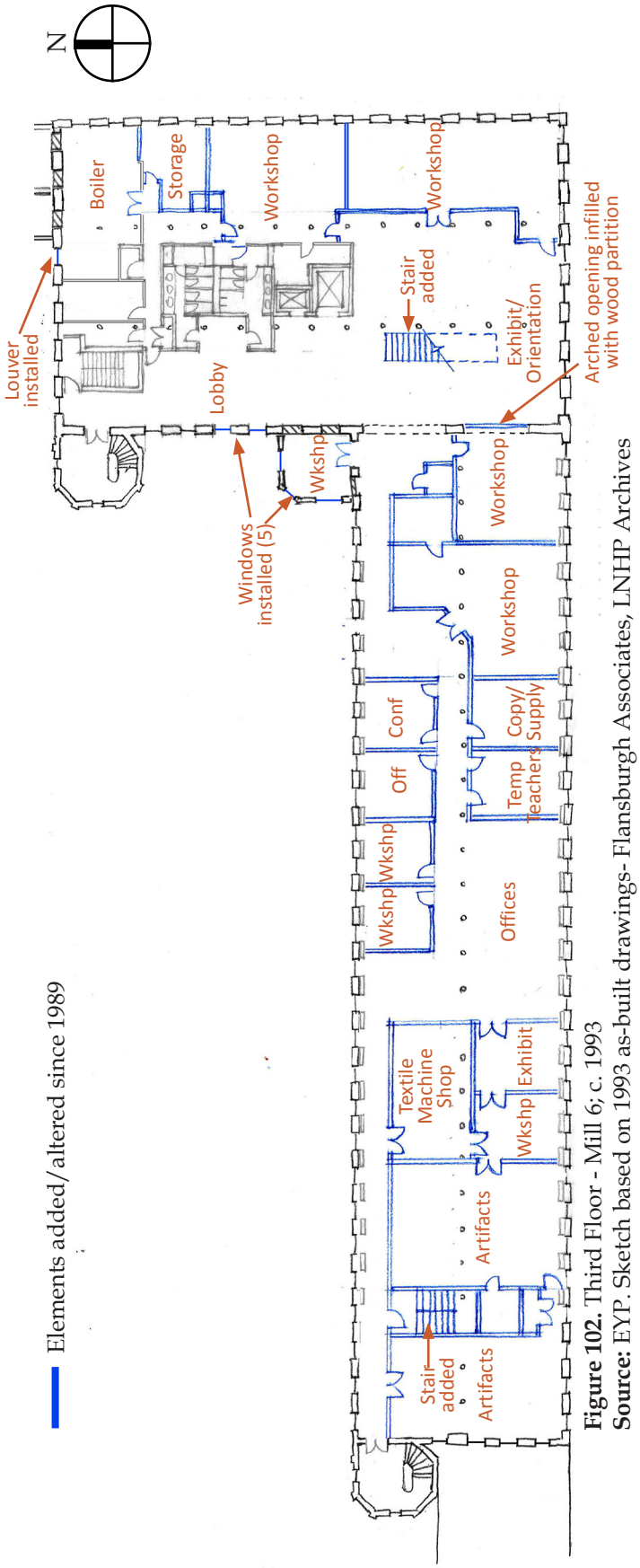


Figure 102. Third Floor - Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

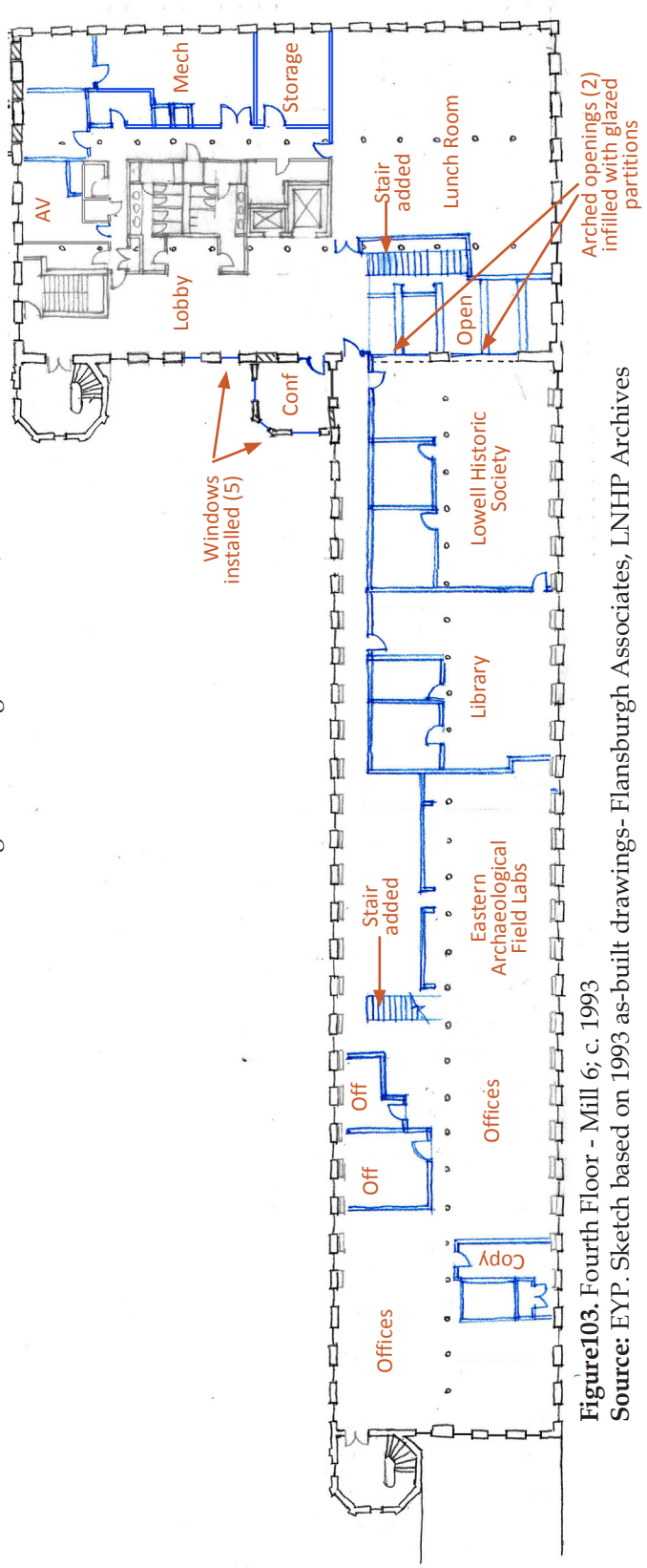


Figure103. Fourth Floor - Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

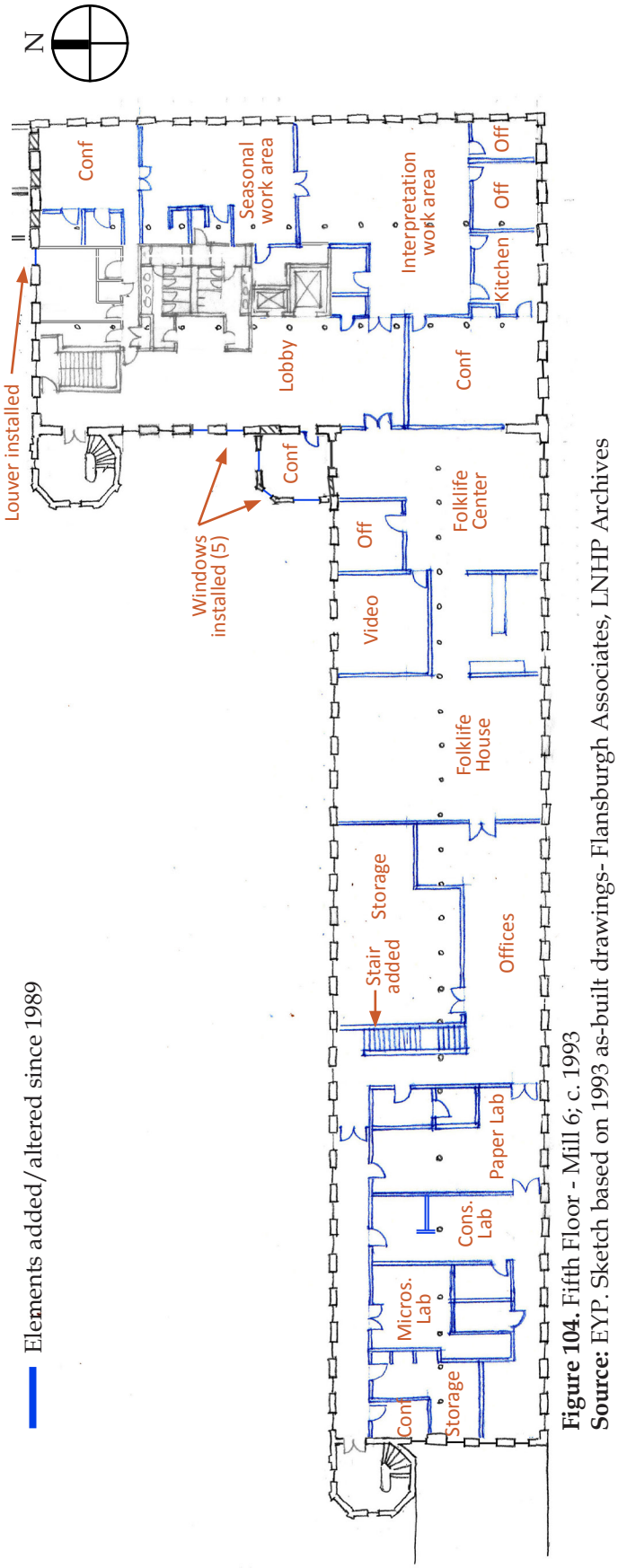


Figure 104. Fifth Floor - Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

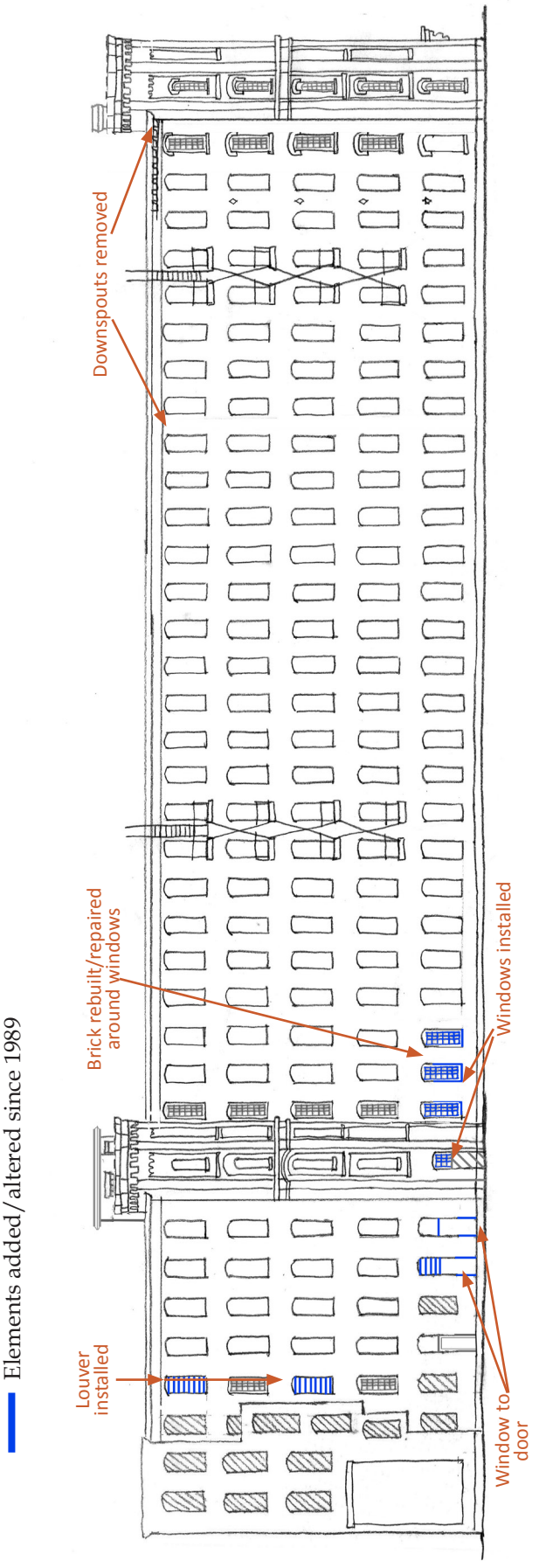


Figure 105. North Elevation- Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

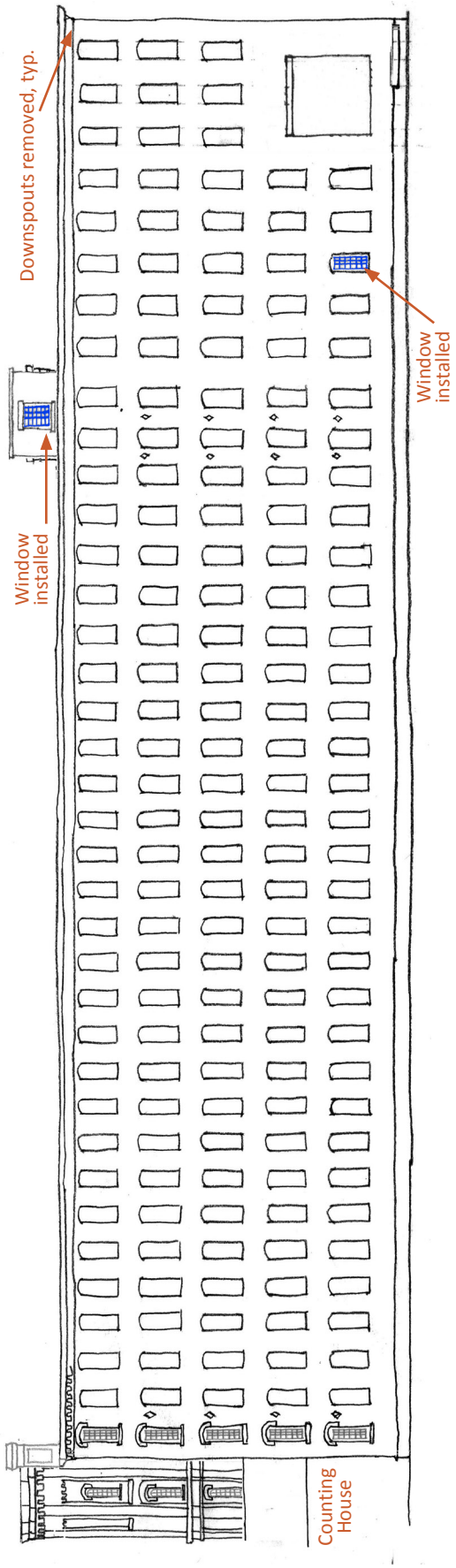


Figure 106. South Elevation- Mill 6; c. 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

Elements added/altered since 1955

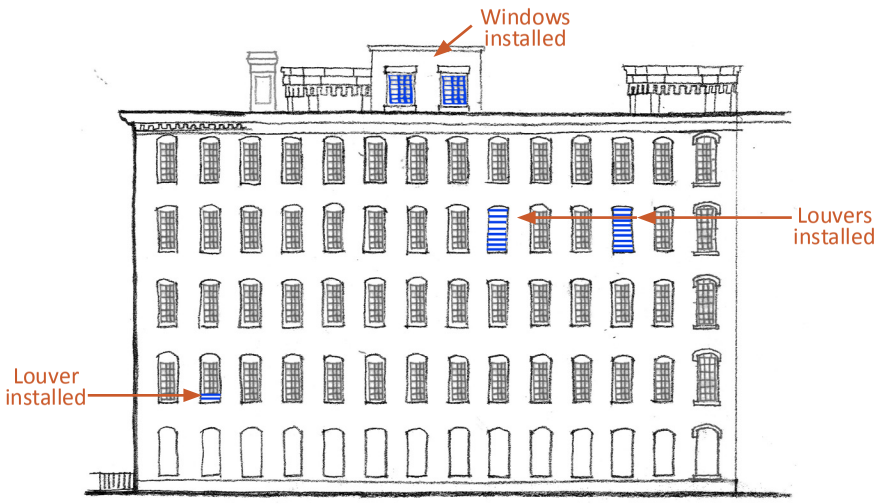


Figure 107. East Elevation- Mill 6; 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

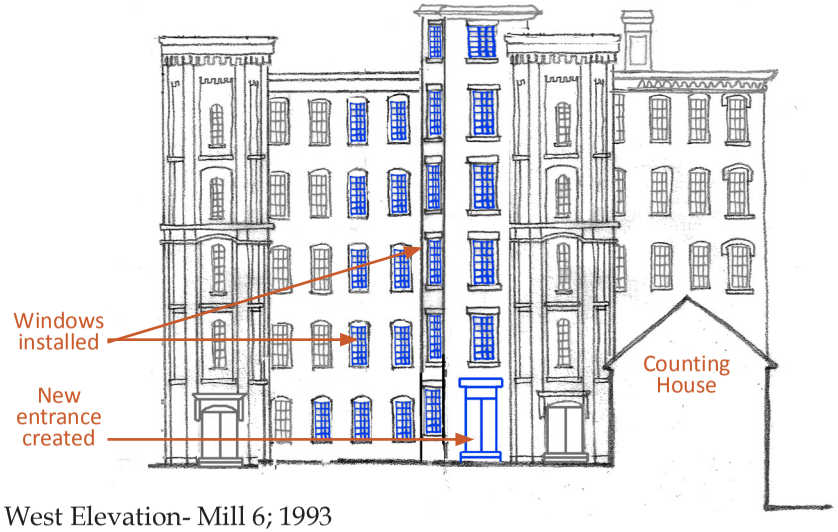


Figure 108. West Elevation- Mill 6; 1993
Source: EYP. Sketch based on 1993 as-built drawings- Flansburgh Associates, LNHP Archives

second floor, three openings in the easternmost wall looking into the coal pocket area, were infilled with masonry.

Scope completed 1993:

The second floor housed additional museum exhibit space with a small theater in a portion of it. Since natural light needed to be blocked in the auditorium and exhibit area, fabric wrapped panels (grey on the inside, black to the outside) are attached to all the window frames. All the ceilings and equipment attached to it was painted black in this area. There are two spaces on the second floor that have dropped ceilings with 2x2 acoustic tiles –a portion of the auditorium and a portion of the exhibit gallery directly east of the internal west egress stair that extends from floor 1 to floor 3. An events center with stepped seating was created behind the new curved stair on the second floor.

The third floor was designed to have space for ephemera storage on the west end while the rest of the floorplate accommodated spaces for the Tsongas Industrial History Center (TIHC) - an educational program for school children designed around the industrial history of Lowell. This comprised of various workshops/classrooms, exhibit areas and staff offices. A new straight-run stair was inserted in the east part and communicated with a lunch room on the fourth floor. Two historic timber beams were cut to make way for the stair. Directly to the west of this new stair, the floor was removed from the first five bays north of the south wall creating a double height space in this area.

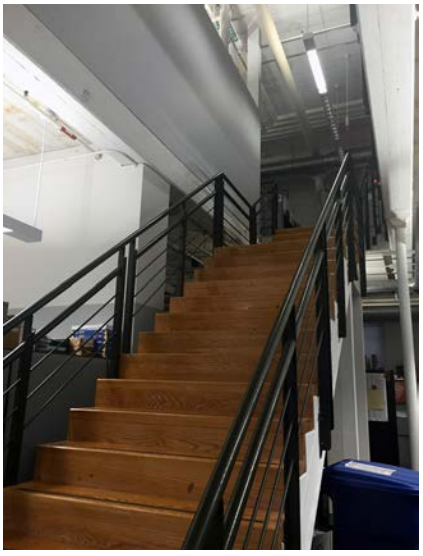
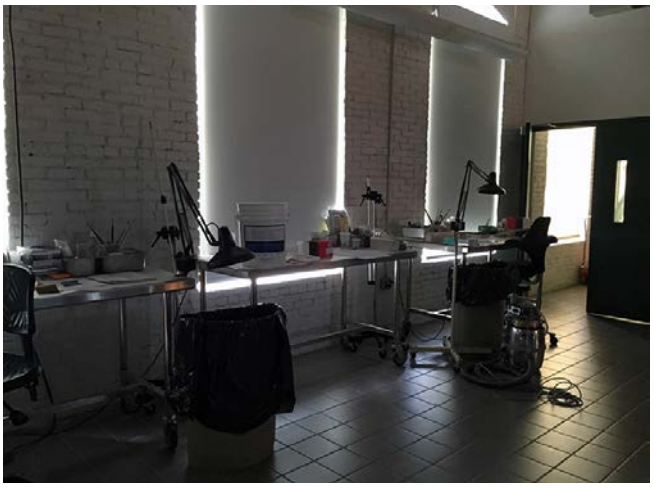


Photo 90. View of connecting stair between floors 4 and 5, constructed 1993, photo taken 2016.
Source: EYP





Photos 91 & 92. View of material conservation labs at floor 5 of Mill 6, constructed 1993, photo taken 2016.
Source: EYP

The fourth floor housed a lunch room for students in the education program, in the corner of the L-shaped floor plan. This was directly east of the new connecting stair and the double height opening creating in the floor, spanning five structural bays and extending west from the stair up to the arched masonry wall. The arched openings were in-filled with glazed partitions. The space directly west was occupied by the Lowell Historical Society. The remainder of the floorplan was utilized as offices, field labs and a library for the regional NPS archaeology department. A connecting stair between the fourth and fifth floors was located in the west part. The stair was designed to fit within a column bay, thus avoiding any major structural modifications.

Fifth Floor:

Scope completed 1989:

The1989 repairs at the fifth floor differed from those at the lower levels in that no brick pier extensions were added here. Also, the arched masonry openings at the brick partition wall had already been modified earlier in 1929 by the removal of the intervening brick pier and the addition of an I-beam supported by metal columns. This condition was retained in the 1989 work with repairs to the brick and structure.

Scope completed 1993:

The 1993 fit-out created a conference room and offices for seasonal Park staff adjacent to the lobby core area. The space at the corner of the L-shaped plan was occupied by additional offices for the LNHP Interpretation staff, with a large conference room directly west of it. The west wing of Mill 6 was taken up by two entities- east part housed the folk-life center and related offices and equipment rooms; while the west part was occupied by NPS regional staff connected to the fourth floor by the new connecting stair inserted in this area. This area housed offices and labs for material conservation and related equipment rooms.



Photos 93. View of north facade of Mill 6, 2016.
Source: EYP

Roof:

Scope completed 1989:

Although the roof had been completely replaced in 1981, it was removed again in order to make structural improvements to the deck and structural members and to accommodate new penetrations necessitated by the new systems. New insulation and single ply roofing membrane was installed once the structural

repairs were done. Downspouts from the façade were removed to enable brick work around and were not re-installed. The exterior leaders were either not reinstalled in 89 or 93. By 1993 at the latest (and probably by 89) the roof drainage had been changed to a new system that collected the runoff by wing at the ceiling and routed it horizontally to two interior leaders; the east wing at the southeast corner of the building and the west wing about midway down its length against the south wall. Apparently they drain directly into the Eastern Canal beneath the 1st floor. No work was done at the roofs of the two stair towers and the 1917 elevator tower.



Photos 94. View of north facade of east wing of Mill 6, 2016. Note the three doors that were added at floor 1 between 1989-1993.
Source: EYP

Scope completed 1993:

The work completed in 1993 was limited to flashing around new vents and mechanical equipment that was added post 1989.

North Elevation:

Scope completed 1989:

The elevations had already been partially restored in 1981- additional work was completed by 1989. This included partial repointing of areas of the façade, removal of some remaining mechanical flues, electrical conduits and other non-historic hardware/ devices from the brick walls. The area on the first floor directly west of the 1917 elevator tower which had been modified with an overhead door was called out for restoration in Phase I but it appears that this work was actually completed in 1993 as part of Phase II. Once the 1973 elevator tower was removed, window infills at the north façade of the 1917 tower were removed and closed with temporary board infill in anticipation of new windows in Phase II. The two metal fire escapes on this façade were retained as historic ornamental features, and those portions of them between ground level and the second floor level were removed to prevent exterior access.. A new door was added in an existing window opening at the north wall of the east wing.

Scope completed 1993:

Spot repointing, brick cleaning and minor brick repairs were completed in some additional areas by 1993 including rebuilding of the three window openings directly west of the 1917 elevator tower. Two windows, on the third and fifth floors on the north wall of the east wing (as indicated on Fig. 105), were replaced with metal louvers. Windows that were provided with temporary infills in Phase I (at the 1917 elevator tower) were fitted with new wood windows. Two additional windows on the north wall of the east wing at the first floor were converted to door openings.



Photos 95. View of east facade of Mill 6, 2016. Note the window openings converted to louvers in 1993.
Source: EYP

South Elevation:

Scope completed 1989:

Repairs at the south façade were similar to those on the north with regards to repointing and repair of brickwork. The roll-up door at the previous coal pocket and future trolley maintenance area was replaced.

Scope completed 1993:

Spot repointing, brick cleaning and minor brick repairs were completed in some additional areas by 1993. A blocked up window (third from the east on the first floor) was provided with new wood frame and sash.

East Elevation:

Scope completed 1989:

In addition to masonry repairs, another change at the east elevation was the removal of grafiitti from the first floor.

Scope completed 1993:

Spot repointing, brick cleaning and minor brick repairs were completed in some additional areas by 1993. Double doors were installed at the roof level at the two window openings in the east wall of the 1917 elevator tower to provide access to the building roof.

Two windows, as indicated on Fig. 107, at the fourth floor were entirely removed to be replaced with metal louvers, and at the second window from the south on the second floor, some of the panes were removed to install a small louver.



Photos 96. New entry at 1917 elevator tower created in 1993, photo taken 2016.
Source: EYP

West Elevation:

Scope completed 1989:

The west elevation saw a major improvement in appearance at the end of Phase I in 1989, owing to the removal of the 1973 elevator tower and machine room. The window openings obscured by it were restored and provided with a temporary infill. The entry on the west face of the east stair was restored by the construction of a new wood hood and brackets that matched the extant historic version on the west tower. Double doors were installed at both the tower entrances in a paneled design that was more sympathetic to their historic appearance. New granite steps were provided at both stair tower entrances.

Scope completed 1993:

Spot repointing, brick cleaning and minor brick repairs were completed in some additional areas by 1993. New windows were installed in the openings that had been fitted with temporary infills in Phase I at the location of the removed 1973 elevator tower and at all openings of the 1917 elevator tower. A new entry vestibule was created at the first floor of the 1917 tower by enlarging and installing new doors with new granite lintels in existing window opening locations.

System Improvements:

A large part of the 1989 and 1993 renovation was the complete replacement of all building systems- mechanical, electrical, plumbing, fire protection and telecommunications. Most of the mechanical ductwork in Mill 6 was left exposed other than at locations indicated in the narrative above. The ductwork was left unpainted (with a silver/sheet metal finish) except on the second floor of the museum exhibit area where it was painted black similar to the ceiling and all other systems in this area. Other visible impacts of the new system improvements were fire sprinklers, fire alarms, light fixtures, electrical outlets and plumbing pipes and vents. The 1989 and 1993 as-built drawings by Flansburgh Associates, filed at both DSC and the LNHP should be referenced for more details of the systems design and layout.



Photos 97. Bookstore at first floor of Mill 6 - relocated to this space in 2007. Prior location was the second floor of the Counting House.
Source: EYP

1994-2016:

The exterior and interior of Mill 6 has not changed appreciably since the 1993 renovation. The majority of changes have focused on interior re-organization of programmatic functions, addition and/ or alteration of mechanical, electrical and IT systems, structural repairs to the penstock under Mill 6 and the more recent phased replacement of the deteriorated 1981 windows.

Following is a summary of changes that have happened since 1993.

First Floor:

The first floor has remained largely unchanged, with the weave room exhibit still occupying the majority of the floorplate as designed in 1993. The bookstore/ museum store was relocated from the second floor of the Counting House in early 2007 to the west end of the first floor of Mill 6. This space was earlier used as



Photos 98. Typical 1981 wood window at Mill 6
Source: EYP



Photos 99. Typical 2013-2016 custom replacement aluminum window with true divided lights and integral storm panel, at Mill 6
Source: EYP

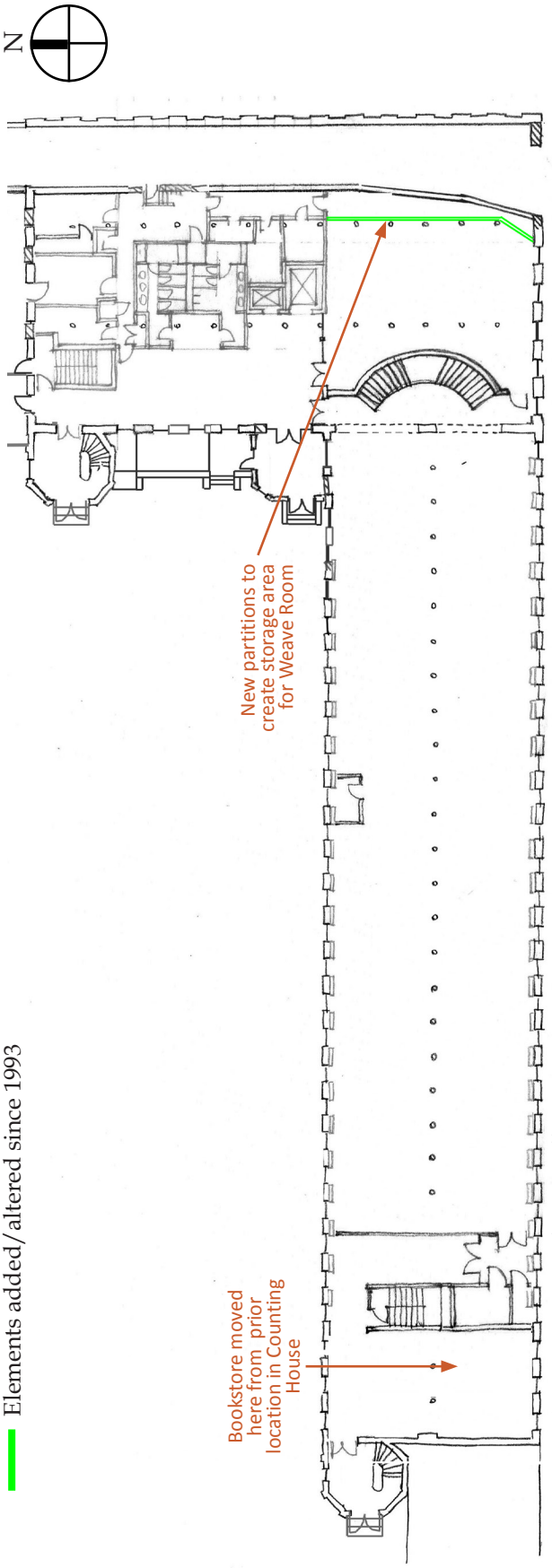


Figure 109. First Floor - Mill 6; 2016
Source: EYP.

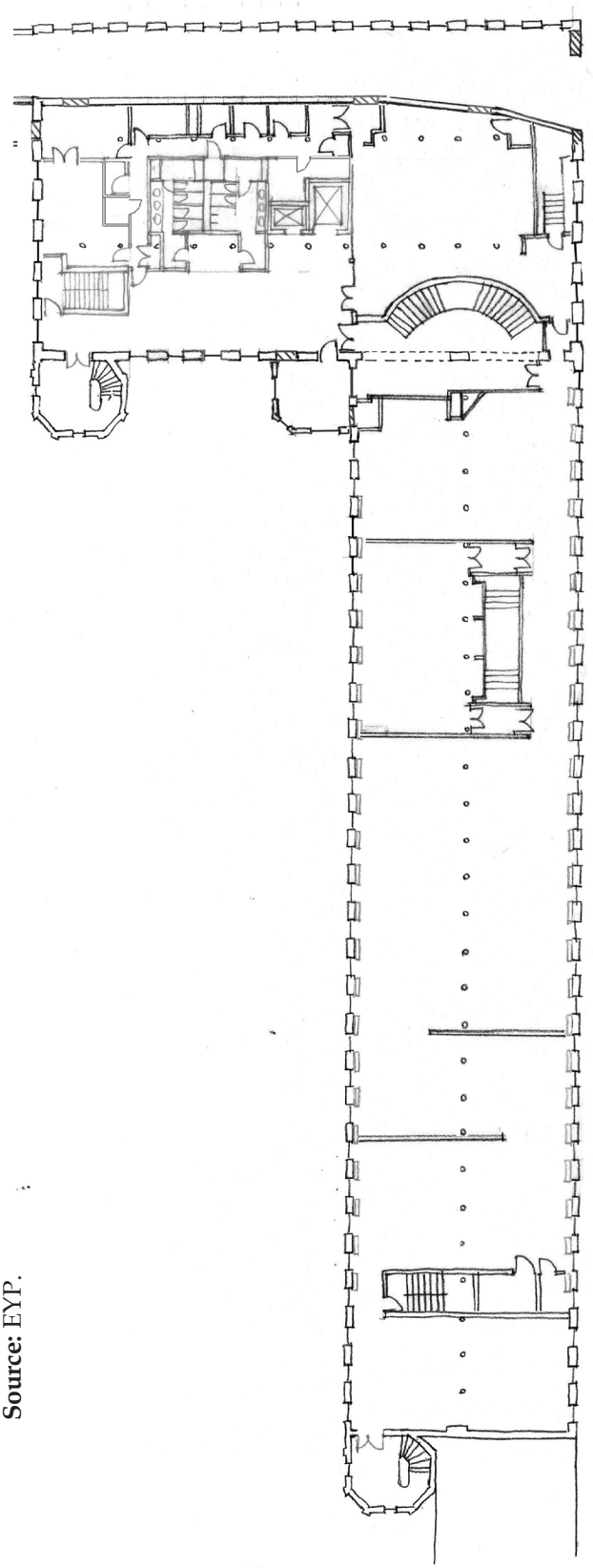


Figure 110. Second Floor - Mill 6; 2016
Source: EYP.

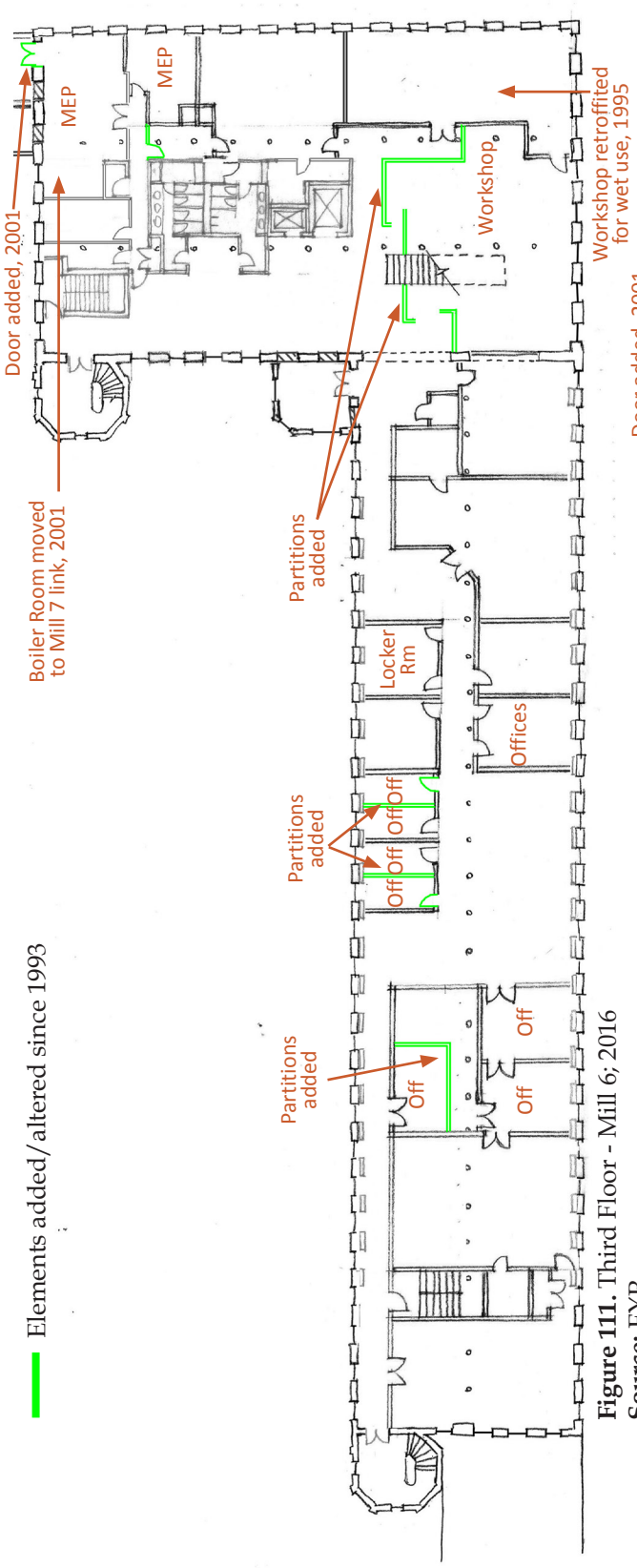


Figure 111. Third Floor - Mill 6; 2016
Source: EYP.

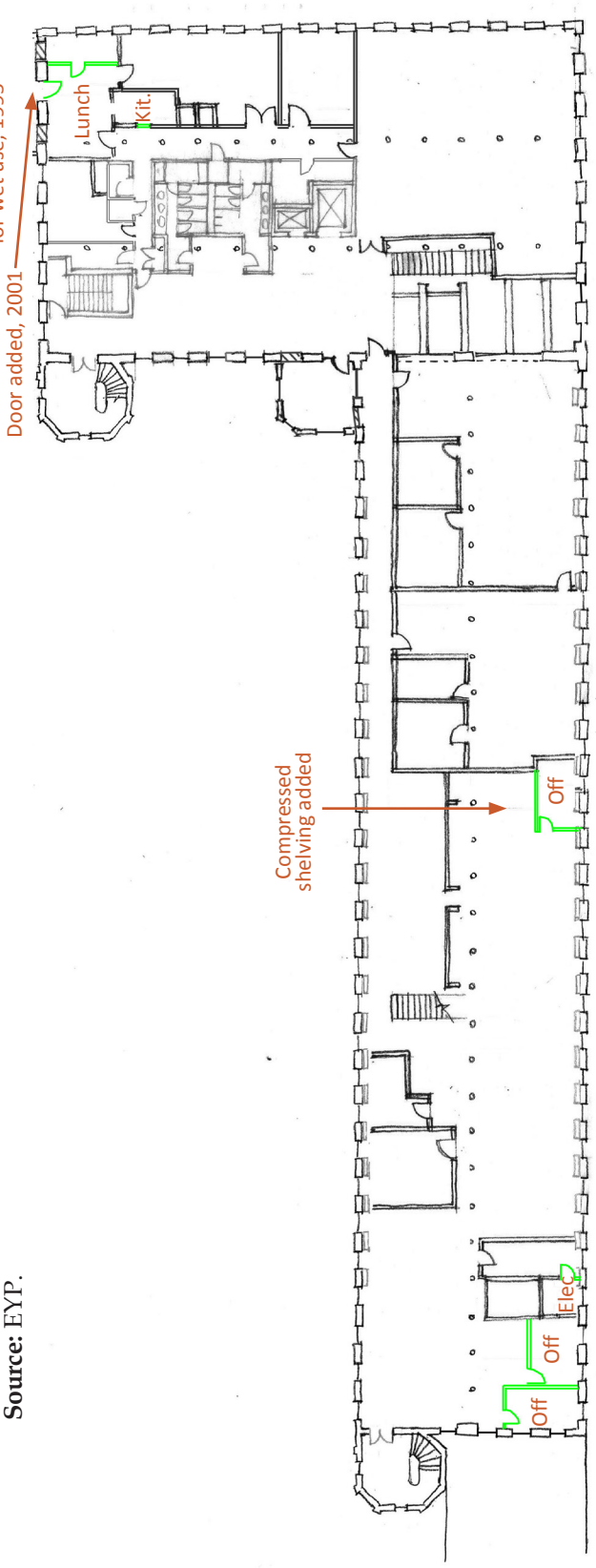


Figure 112. Fourth Floor - Mill 6; 2016
Source: EYP.

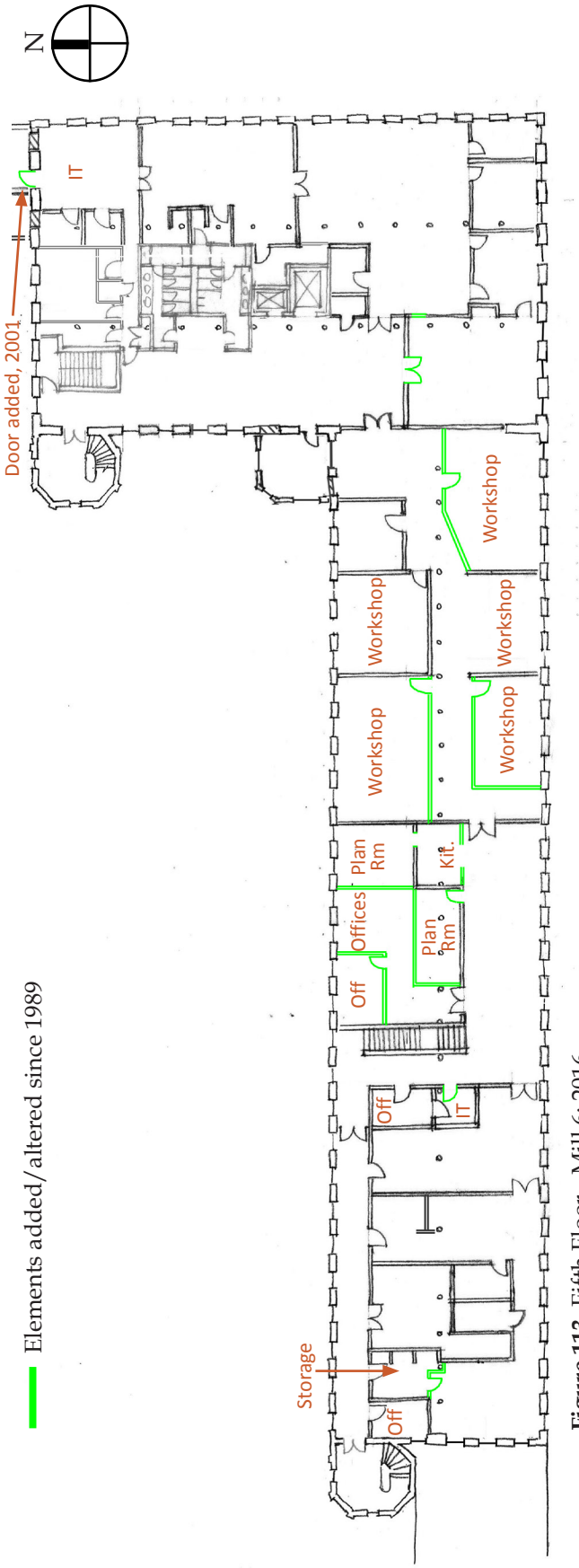


Figure 113. Fifth Floor - Mill 6; 2016
Source: EYP.

Elements added/altered since 1993

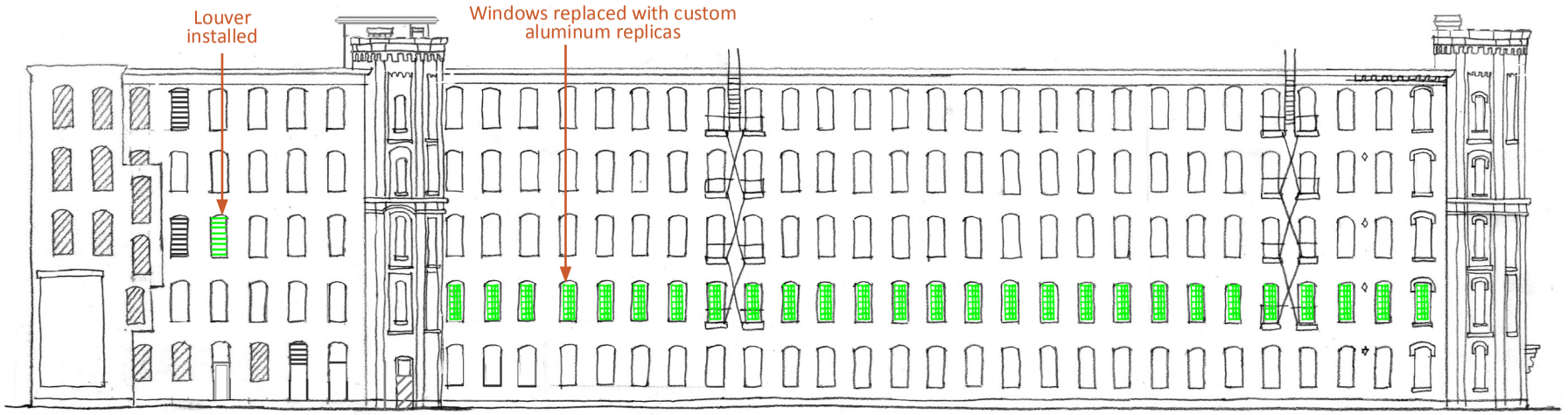


Figure 114. North Elevation- Mill 6; 2016
Source: EYP.



Figure 115. South Elevation- Mill 6; 2016
Source: EYP.

Elements added/altered since 1955

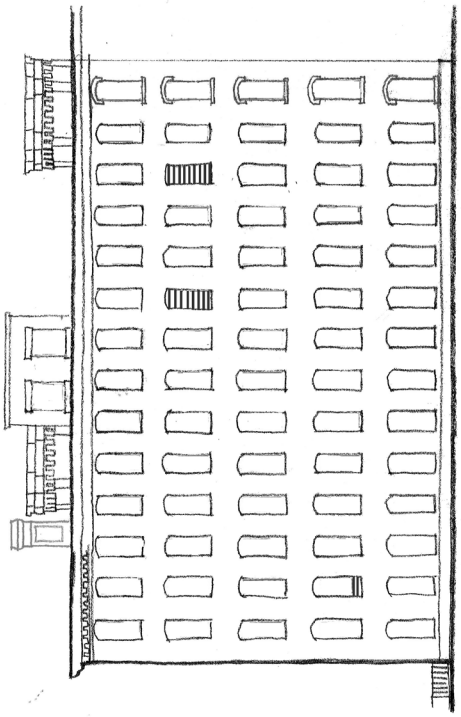


Figure 116. East Elevation- Mill 6; 2016
Source: EYP.

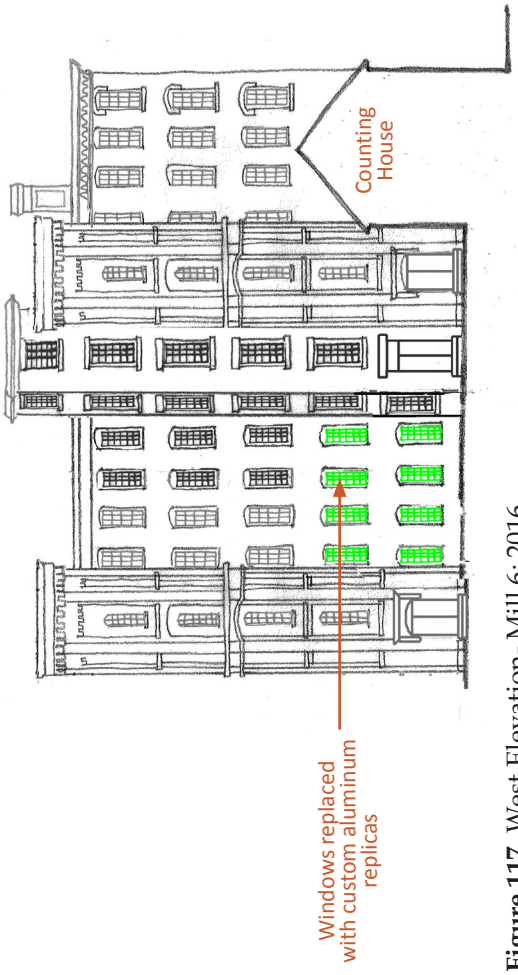


Figure 117. West Elevation- Mill 6; 2016
Source: EYP.

a reception/ orientation area. Another minor change includes the addition of partitions to create a storage room at the exhibit room on the east end of Mill 6 (east of the curved stair to floor 2). The first floor windows on the south and west facade have recently been replaced with custom aluminum true-divided light replications with an integrated storm panel. These are designed to closely match the original wood windows at Mill 6 and the 1981 replications. This window replacement is being executed as part of a phased project- the first phase was completed in 2013 and involved replacement of 62 windows; the second phase is expected to be completed in 2016 and involves replacement of 42 additional windows. All of these are the typical 12/12 windows at Mill 6.



Photos 100. Room 340 - Workshop converted to wet use in 1995. Photo taken 2016
Source: EYP

Second Floor:

While the second floor has not seen any major changes in physical layout, there appear to have been some changes in mechanical distribution and equipment, in and around Room 228 (the mechanical room housed in the historic 1917 elevator tower). The north, south and west facade windows on the second floor (as indicated on Figs 114-117) have been replaced with aluminum versions as described in the discussion on the first floor, as part of a phased project executed in 2013 and 2016.

Third Floor:

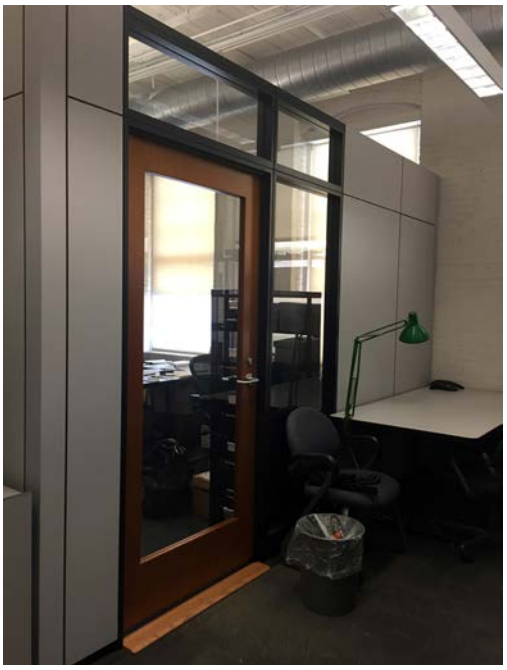
In 1995, one of the workshops/classrooms (Room 340) on the third floor was fitted with a wet floor and sinks to better accommodate the

new program activities. In 1997 additional mechanical ventilation was provided to spaces on the third, fourth and fifth floors. This involved installing new roof-top equipment and some new ductwork at each floor. Joists were cut where required to enable new duct penetrations.

Mill #7 Link Building:

In 1995, the five story link building between the north wing of Mill #6 and Mill #7, which encompassed the northern end of the coal pocket was acquired by the Park from the then owners of the rest of the Boott Mill complex, Historic Boott Mills, Inc. The Park continued the use of the Link building portion of the coal pocket as part of the trolley maintenance facility and then extended its occupancy to the three floors above the coal pocket and began using those spaces for storage and maintenance functions supporting the uses of Boott #6 and other Park programs In 2001, the boiler room from Room 345 in Mill 6 was relocated to the link space. A fire escape stair was also added at this time in the Mill 7 link, internally on floors 3, 4 and 5, and externally on floors 1 and 2 (to avoid the trolley barn facility). Connecting doors to the Mill 7 link were added in the north wall of Mill 6 at floors 3, 4 and 5.

Sometime during this period, the area directly east of the curatorial space and identified as 'Textile Machine Shop' on the 1993 plans was reprogrammed to be used as offices by the curatorial staff - some partitions were added to create additional private offices.





Photos 101 and 102. Enclosed offices added on fourth floor post 1993.
Source: EYP

Two TIHC workshops lining the north wall of Mill 6 were subdivided by insertion of partitions are re-used as private offices. Low-height partitions were also added in the space directly south of the elevator lobby to enable use as an additional workshop area.

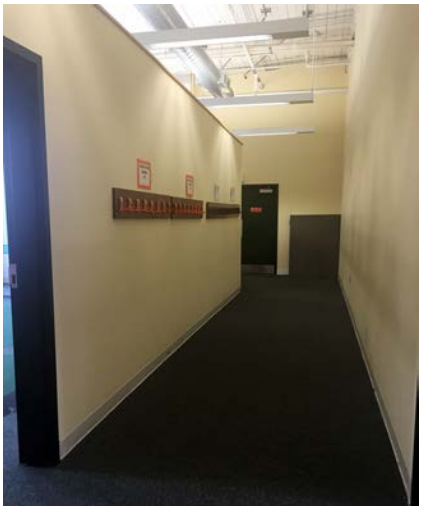


Photo 103. New partition (not extending all the way to underside of structure) at left of picture, added post 1993 at fifth floor to create new TIHC workshops; photo taken 2016.
Source: EYP

Fourth Floor:

The changes on the fourth floor are largely at the open office areas of the NPS regional staff. Three enclosed offices were added, along with new open office workstations at various locations. Compressed shelving was installed at the east end of the NPS regional office space (roughly in the middle of the west wing floorplate of Mill 6). None of the new partitions extend all the way up to the underside of slab to avoid interference with existing systems. A partition was added at the north end of the building to create a new lunch room and staff kitchen, along with the addition of a door to the Mill 7 link space.

Fifth Floor:

Changes on the fifth floor have also been limited to programmatic switches and addition of partitions. The Tsongas Industrial History



Photo 104. PV arrays and solar hydronic system added at roof of Mill 6 in 2007 and 2010 ; photo taken 2016.
Source: EYP

Center expanded to include workshop/classroom space on the fifth floor at the location of the earlier Folklife Center. Partitions were added in this space to create five new workshops. Similar to the fourth floor, none of the new partitions extend all the way up to the underside of slab to avoid interference with existing systems. A large storage room at the east end of the NPS regional office space was subdivided with new partitions to create some office space, a staff kitchen and storage areas.

Roof:

In 1997, two changes impacted the roof at Mill 6. First, a completely new single-ply membrane roof was installed to replace the existing membrane roof; and second, new roof-top mechanical equipment was installed to provide additional ventilation to floors 3, 4 and 5 of Mill 6. The roof replacement project included replacement of all existing flashing but did not impact the existing cornice or the roof structure.

In 2007, a 96-panel photo-voltaic system was added to the roof, providing 22 KW power on four circuits. The system provides direct current electrical power for lighting at Mill 6. In 2010, A solar array hydronic system was also installed on the roof, providing 350,000 Btu. This system supplements the main heating and cooling absorption chiller operation. At this writing, the system is non-functioning due to mechanical failure. Both the 2007 and 2010 installations are not visible from the ground except for the southerly row of the solar hydronic array, which does not become visible south of the building until about 250 feet from the façade.

Other changes:

In 2004, major structural distress was noted in the penstock gallery under the south wall of Mill 6 at the canal, with evidence of failed granite piers and brick piers caused by scour eroded soil and subsequent settlement of foundation blocks subsided footings. Another concrete column was displaying significant erosion at the head. The proposed design suggested insertion of new concrete footings, galvanized steel column replacement of failed granite posts, repair of the eroded concrete pier and reconstruction of the fallen brick piers. The work was actually executed in 2006 and also included insertion of by the canal owner of a new steel trashrack over the penstock gallery entrance.

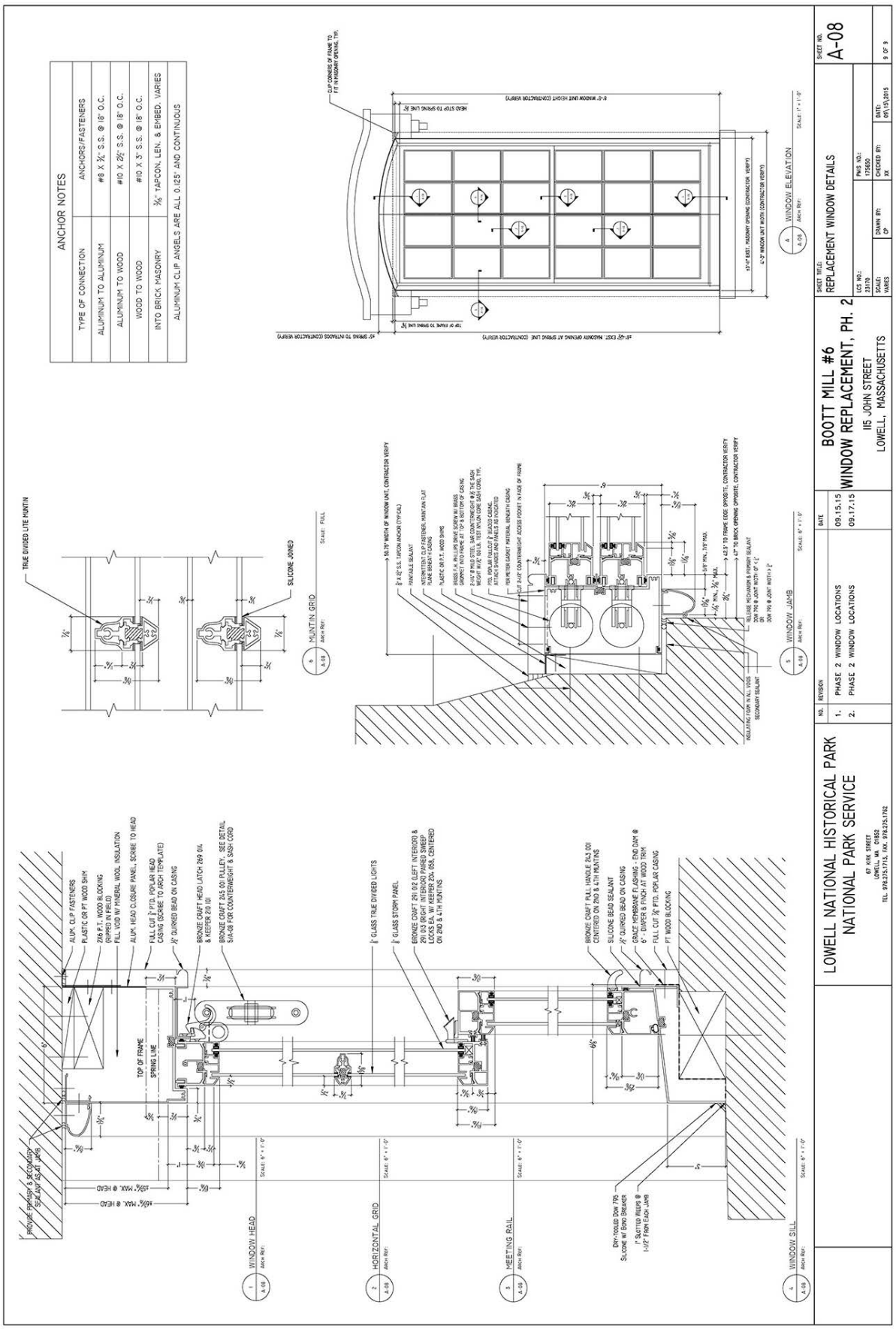


Figure 118. Details of aluminum window used for Phase I and Phase II of the Window Replacement Project at Mill 6, drawing dated 9/15/2015
Source: LNHP

II. Tabulated Building Chronology

Year	Event	Bldg.	Description	Source/Note
1810	Lowell visits England		Francis Cabot Lowell visited England, observed their factories & machinery	HSR, p.7
1813	Mill in Waltham		Lowell teamed up with engineer Paul Moody & founded the Boston Manufacturing Company (BMC) and built the first integrated textile factory in Waltham.	HSR, p.7
1821	Pawtucket Falls		Paul Moody discovered the Pawtucket Falls of the Merrimack River in East Chelmsford.	HSR, p.9
1826	Birth of Lowell		Town of Lowell was incorporated	HSR, p.43
1835	Founding of Boott Mills		Boott Cotton Mills founded by John Amory Lowell, Abbott Lawrence, Nathan Appleton and other Boston investors. Named in honor of Kirk Boott, the first agent of the Merrimack Manufacturing Company and of the Proprietors of the Locks and Canals.	HSR, p.11
1835	Lowell Railroad		Initiation of service by the Boston and Lowell Railroad	HSR, p.49
1836	Eastern Canal		Eastern Canal, built for Boott Cotton Mills was completed.	HSR, p.46
1836	Mills 1 and 2		Mills 1 & 2 were built	HSR, p.56
1836-1839	Counting House built	CH	Counting House or office of the Boott Cotton Mills was built, concurrently with the first four mill structures, and most likely in 1836, so that it would be operrative when Mills 1 & 2 went into production that June.	HSR, p.77
1836-1839	Boott Mills housing		First unit of Boott Mill housing constructed	HSR, p.58
1837	Kirk Boott		Kirk Boott dies	HSR, p.11
1839	Penstock built		Boott penstock constructed to improve flow of water	HSR, p.46
1839	Mills 3 and 4		Mills 3 & 4 were constructed	HSR, p.56
1847-48	Mill 5		Mill 5 was constructed	HSR, p.58
1849	Gas lighting		Lowell Gas Company was established, providing mill agents the opportunity to convert from oil lamps to wall mounted or suspended gas lighting.	HSR, p.53
1850s	Bituminous materials		Introduction of modern bituminous materials makes shallow pitched roofs practical for mills	HSR, p.34
1857	Turbine power		Four original Boott Mills were converted to turbine power	HSR, p.61
1871-1904	Early changes to CH	CH	No documented changes to the CH- due to file at Locks & Canals being misplaced.	HSR, p.162
1871-72	M6	M6	Mill 6 was built	HSR, p.60
1871	CH windows blocked	CH	The 2 easternmost windows on the north façade were infilled with brick due to construction of Mill 6 stair tower directly north of it	
1873	Steam power introduced		Steam power was introduced to supplement the water powered turbine	HSR, p.62

Year	Event	Bldg.	Description	Source/Note
1876-78	Mill 7 and connector	M6	Mill 7 was built & connector b/w 6 & 7 was built. This connector was 2 stories high & access was limited to a door(s) at the second level, since passage to the coal pocket ran through the lower level. All eveidence of this was lost in the coal pocket expansion of 1927-28.	HSR, p. 60, p.189
1882	Connectors	M6	Second, third & fourth floors of the mill (at north wall -east section) were connected by a connector to 'dressing mill' & Boiler House beyond. There were 'tinned' doors at this location. Two window openings in the easternmost bay of the north wall were converted to doors to serve the connector @ 3rd & 4th floors.	HSR, p. 189
1886	Connector expansion	M6	Connector b/w Mill 6 & 7 raised to five stories from 2 stories (original)	HSR, p. 60
1889-1911	Enclosed bridges	M6	Sometime during this period, enclosed bridges were added to the west side of the 5-story connector b/w 6 & 7. To facilitate access, windows in the 3rd bay west of Bridge street on the 2nd, 3rd & 4th floors were converted to doors.	HSR, p. 189
1889-1928	CH roof skylights	CH	Four flat skylights were installed at the front edge of the south roof just west of Mill 6	HSR, p. 312
1897	Insurance Dwg	CH,M6	Provides a bird's eye illustration of the complex,includes information about building levels and materials.	DSC file-LOWE_475_25910_[id9907]
1901	Insurance Dwg	CH,M6	Provides a bird's eye illustration of the complex,includes information about building levels and materials.	DSC files: LOWE_475_25911_[id38975] LOWE_475_25911_[id38988]
1905	Boott Cotton Mills to Boott Mills	CH, M6	Boott *Cotton* Mills closed & the company was reorganized as 'Boott Mills' - producing 'coarse' goods- toweling, corduroy; Frederick A. Flather began as treasurer at Boott	DSC file-LOWE_475_129153_[id34816]
1905-1954	Flather appointed Treasurer		Flather family overtakes operation of Boott Mills	HSR, p. 197
1906-1907	Consultant report	M6, CH	Lockwood Greene & Company, inspected the mill buildings & machinery & presented a very scathing report- old, narrow buildings not suited for a 'modern' mill.	HSR, p.201
1906	Machinery Plans	M6	Plans showing location/ type of machinery (as running before 1906)	DSC file-LOWE_475_25913_[id64571]
1906	Machinery Plans	M6	Proposed motor driven machinery plans	DSC file-LOWE_475_25914_[id143986]
1906	Shops moved	M6	The Carpenter, Blacksmith, Paint & Machine & Wood shops were moved from Mill 6 to other locations in the Boott complex	HSR, p. 229

Year	Event	Bldg.	Description	Source/Note
1906	M6 production	M6	Mill 6 started the process of becoming a Fine Mill producing the lighter weight yarns & fabrics, including corduroy.	HSR, p. 229
1906	CH rooms	CH	Improvements to office space with introduction of a cotton sample room to the Counting House	HSR, p. 311
1907	Humidifiers	M6	Humidifiers from the American Moistening Company were installed in 6	HSR, p. 231
1908	Lighting	M6	Use of gas lighting (supplemented by electric) continues at Mill 6	HSR, p.185
1910-1930	New programmatic layout	M6	Mill 6: 5th floor-Ring Spinning 4th floor- Ring & mule spinning 3rd floor- mule spinning & weaving 2nd- recreation room abutted counting house 1st- repair shop next to CH & coal pocket CH: Vacant attic 2nd- office rooms 1st- Supplies & belt shop	HSR, p. 203
1912	Steam heating replaced		Steam heating system was replaced	HSR, p. 324
1914	Handrails installed	M6	Metal pipe railings were added in the octagonal stairs	HSR p. 323
1916	Consultant report	M6	Another audit was performed by Valentine. Buildings in poor condition- dim lighting. Machines arranged such that they blocked the windows. Artificial lighting hung too high/low & with inadequate shades as to cause glare.	HSR p. 245
1916	Hoists removed	M6	Hoists in the octagonal stairway existed only in one of the staircases by this time (most probably east stair). It was removed and all the wall openings reduced to 5'-6" and by installation of a steel lintel, and the wall bricked in, flush with the tower side, indented at the mill side 12".	HSR, p. 323
1917	Electrification	M6, CH	Boott Mills electrification was completed.	HSR, p. 327
1917	Elevator tower	M6	Construction of 6 story freight elevator tower. Led to blocking of all windows in the two southernmost bays of the east wing and the two eastern bays of the west wing. Access from exterior was provided by an overhead Door in the west wall that slid on vertical tracks. Door was served by a concrete loading dock.	HSR, p. 314; 318
1920	Fire escape on north façade	M6	West Wing--2nd floor, seventh bay from west--window was converted to door and led down a fire escape on the outside of the building to the ground below. This used to be a textile lab & display room.	HSR, p. 314
1922	CH footbridge	CH	Footbridge to Counting House repaired	HSR, p. 332
1924	CH footbridge	CH	Footbridge to Counting House re-built	HSR, p. 332
1925	Cracks in west tower	M6	C.T. Main Co. in their structural assessment note that the west tower continues to show cracks which open up after each pointing & painting.	HSR, p. 313

Year	Event	Bldg.	Description	Source/Note
1926	Structural report & repairs	M6	Due to reported 'vibrations' in Building 6, Charles T. Main & Company Engineers was asked to prepare a survey of structural conditions. Their report cites the need for repointing, replacement of a stone lintel and the need for underpinning of part of the wall along the canal. Based on this, concrete piers & lally columns were placed below lintels in the penstock.	HSR, p. 313
c. 1927	Downspouts installed	M6	Exterior downspouts installed to supplement interior drainage system.	
1927	Structural re-inspection	M6	Still some vibration reported in Mill 6	HSR, p. 313
1927	Trolley tracks		Trolley tracks were present in the yard atleast up to 1927, maybe even a little later	HSR, p. 225
1927-1928	Coal Pocket enlarged	M6	Coal Pocket entrance at Mill 6 was widened to the west to 14' and raised to a height of 23'4". This required the elimination of a window in the first floor and three windows at the second floor. Rolling steel door was installed at entrance	HSR, p. 60; p. 316
pre-1928	Shutters removed	CH	Wooden lovuvered shutters from second floor south elevation were removed	Historic photos
pre-1929	Window openings added	CH	Two window openings, one each at first and second floor of the Couting House were added	Historic photos; 1936 elevations
1928	Shipping Shed'	M6	25' x 16' concrete block shipping shed was appended to the west wall of the 1917 elevator tower. It had a shallow shed roof pitched toward Building #6, with upper section of west & north walls consisting of steel industrial sash. Roof was surmounted by a single sawtooth monitor on an east west axis.	HSR, p. 331
1928	Structural study	M6	Study by John A. Stevens, & repairs based on study included bolting, stiffening and strengthening steel plates on wooden beams.	HSR, p. 314
1928	Towers repair	M6	Upper deck of the towers was stated to be rapidly deteriorating. West Tower: New tie rods were installed at S wall, 3 & 4 floors. East Tower: New tie rods at S & SW walls, 1, 2, & 3 floors. Also, large 8" x 16" plates to secure additional ties were placed at 5th floor window heads.	HSR, p. 317
1929	Repair of arched interior masonry wall	M6	Stevens expressed concern about this wall- there were some cracks at various levels. Repairs were subsequently done at the fifth floor- this involved removal of a brick pier & tie rods & replacement with a pair of 12" I-beams, supported by 5 5/8" lally columns.	HSR, p. 322
1929	structural repairs	M6	West wing- 5th floor: Application of plates and angle irons to brace all columns where they were connected with roof beams.	HSR, p. 320
1930	CH entrance at bridge	CH	Pre-1930 this entrance was protected with a flared metal hood and had a wood door with a single glass upper panel. In 1930, the hood was removed, opening altered and new door installed	HSR, p.311

Year	Event	Bldg.	Description	Source/Note
1930	Footbridge to Mill 7 built	CH	3rd floor-Northmost wall-3rd window from east-changed from window to door to provide access to a footbridge built alongside the #6-#7 connector	HSR, p. 321
1932	Power source		Combined use of steam & water power continued till this time	HSR, p.62
1935	Structural study	M6	Another study of M6 conducted by CT Main & Co., reported 'bulges' in the canal-side (south) wall of Mill 6. Deflection of almost 6-1/8" from plumb was documented by the dwgs accompanying the report.	HSR, p. 403
1936	Flood	CH	Water entered first floor of Counting House	HSR, p. 342
1936	CH renovation	CH	Un-executed plans from 1936 for renovation	HSR, p. 400; Fig. 22
1937	CH renovation	CH	Complete renovation based on plans drawn up in 1937; new partitions and stairs added	HSR, p. 401; Fig. 23
1937	Door/windows altered	CH	North elevation first floor -one window converted to door; 2 door openings converted to windows. West elevation first floor- window added; door converted to window	HSR, p. 401; Fig. 23
pre-1937	Structural braces	CH	Structural braces were added below the cornice on north and south façade of CH; new circular/star anchor plates on first floor south façade	1937 drawings
pre-1937	Window sash replaced	CH	Second floor north façade- sash on four easternmost windows changed from 6/6 to 1/1 on three windows and 2/2 on one window	1938 drawings
1938	Hurricane	CH,M6	A hurricane in 1938 damaged portions of the buildings & subsequent repairs were made. These included - repair, painting & new flashings at the cornices, tie-rods at the CH & M6 and bracing of roof beams and columns in both east & west wings on the fifth floor.	HSR, p. 405
1938	War production		Mill started transition to war production	HSR, p. 342
1942	Skylights removed	CH	Four skylights in the CH roof were removed	HSR, p. 402
1944	Reinforcement	CH	CH walls & floors were reinforced (especially at the canal wall, where tie rods were added).	HSR, p. 402
1949	Stair reinforcement	M6	The spiral stairs in the towers were reinforced due to sagging.	HSR, p. 408
c.1949	Steel supports in stairs	M6	steel supports were added in stairs	undated
1950	Stair reinforcement	M6	Cement floors laid under all stairs	HSR, p. 408
1945	Track	M6	Trestle and track filled in to facilitate oil truck deliveries. Steel diamond plate installed in track area. Rolling door at entrance replaced	HSR, p. 408
pre-1950	Chimney removed	M6	Brick chimney at west end of Mill 6 removed	Historic photos
1950	Towers upper floor removed	M6	The Treasurer announced the removal of the sixth floor of the two stair towers at M6. "to prevent vibration and sway."	HSR, p. 403
pre-1955	Hoods at CH entrance	CH	Simple wood hoods were added to the CH four doors along the yard side	HSR, p. 403
1954, Dec-10	Mill sold	CH,M6	(ODC). All equipment was appraised & sold- it is estimated that everything in Mill #6 went for scrap.	HSR, p. 361; p. 415
1955, June-15	Mill sold	CH,M6	ODC sold the complex to the Massachusetts Mohair Plush Company.	HSR, p. 415

Year	Event	Bldg.	Description	Source/Note
1955, June-13	Windows bricked in	M6	In anticipation of 3 new transformers to be installed in the yard between Mill 1 & Mill 6 , all first floor windows in the north wall of the east wing were bricked in.	HSR, p. 417
1955, July-Aug	Repairs in prep of sale	M6	Conveyor holes in floors were closed up, all machinery was removed and the doorways between mill 6 & adjoining buildings were closed off, CH first floor-- ramped opening to M6 blocked.	HSR, p. 416
1955, July-22	Mill sold	M6	A new ownership group was incorporated under the name Northern Textiles of Lowell, and they again sold Mill 6 to the Lowell Realty Corporation	HSR, p. 415
1956-1984	Doors at stairs	M6	Many of the interior doors were replaced with fire-rated metal clad doors	HSR, p. 422
1956-1976	Tower entries	M6	East stair tower- hood, door and steps removed, West stair tower- door removed, opening partially infilled	Historic photos
1960	CH-Int renovations	CH	Counting House occupied as offices of Locks and canal: First Floor- employment office and rooms along canal wall removed, concrete block fireproof vault added. Connection b/w CH & M6 at first floor re-opened, ramp removed; new stairs and new door added here. Second floor- entirely re-arranged, especially at the east end where a series of offices, rest rooms and a conference room were located. Stair to second floor of Mill 6 remained but door was blocked off.	HSR, p. 415, 419
1960-mid	Tsongas		Paul Tsongas returned to the city in mid 1960s and was elected to the Lowell City Council.	MP, p. 26
1966	Federal Model Cities Program		Federal Model Cities Program for urban redevelopment was established. Model cities had a five-year plan (1968-1972)	MP, p.xix
1966-1978	Mogan campaign		Dr. Patrick J. Mogan campaigned for a revival of Lowell. Reconceived Lowell as a city-scale lifelong learning laboratory.	MP, p.19
1971	HSC		Mogan & his collaborators formed the Human Services Corporation (HSC) to keep federal funds flowing after the conclusion of the Model Cities time frame. HSC became the primary vehicle for developing plans for what was being called an urban cultural park. From 1972 to 1974, HSC advanced the Park idea.	
1972	Bldg sale		Mill 6 sold to the Capehart Corporation	HSR, p. 415
1973	Boiler installation	M6	Boiler was installed in the original blacksmith shop at the first floor of M6	HSR, p. 418
1973	New freight elevator	M6	New freight elevator tower (12' x 13') was added on the exterior adjacent to the outmoded 1917 elevator. It extended 6" above the roof line & was built with a combination of CMU & . Led to bricking in of the 3rd and 4th bays of the west wall of east wing. A one-story machine room was built to the north of the tower- 8'9" side with a flat roof, concrete block walls and a modern flush door	HSR, p. 418, 420

Year	Event	Bldg.	Description	Source/Note
1973	New masonry partition; boiler room	M6	An 8" masonry wall was built in the fireproof (vaulted) section of M6 on first floor to sub-divide into 2 spaces; westernmost room housed boiler	LOWE_475_25003_[id40295]
1973	Door b/w CH & M6	CH, M6	Door between these spaces at first floor was blocked off.	LOWE_475_25003_[id40295]
1973	First Historic District		Lowell's first historic district was created – the Locks and Canals Historic District.	MP, p. 44
1975	LDFC formed		Another entity was formed: a quasi-public banking entity called the Lowell Development & Financial Corporation (LDFC), through which local banks pooled funds to make low-rate loans for local projects.	MP, p. 27
1974	Lowell Historic Canal District Commission		Senate passed the bill establishing the Lowell Historic Canal District Commission with a budget of $150,000 to determine whether Lowell warranted being a park.	MP, p.46
1974	New access from loading dock/yard	M6	A new masonry opening was created in the west wing, north wall (west of the 1917 elevator) at first floor to receive a 10' wide (9' high) overhead door. A pedestrian fire-proof door was also installed west of this overhead door.	HSR, p. 419
1974	New overhead door to coal pocket	M6	Another new opening with a fire-proof door was created in the west wall of the coal pocket (providing access from M6)	HSR, p. 420
mid-1970s	Gas explosion in Mill 6	M6	Mill 6 damaged in gas explosion with resulting loss of 455 windows.	LHPC Briefing Paper, March 18, 1983
1975	Brown Book		US Congress created a federal commission to study Lowell's prospect for inclusion in the national park system. Commission's report known as the 'Brown Book' for the color of the cover	
1975	Univ of Lowell		Lowell State College & Lowell Technological Institute merged in 1975, forming the University of Lowell (now U Mass Lowell)	
1977	LNHP bill		Congressman Tsongas put forward a bill to establish Lowell National Historical Park.	
1978-June	LNHP formed		President Jimmy Carter signed the LNHP legislation. The park represented a $40 million initial investment by the federal government.	MP, p. 22
	LHPC formed		Lowell Historic Preservation Commission formed with Fred Faust as first Executive Director	MP, p. 22
1978	Window	M6	West Wing--2nd floor, seventh bay from west--door converted back to window.	HSR, p. 314
1979	M6 sold to Wang	M6	Mill 6 sold to the Wang Corporation	HSR, p. 415
1979	Lowell Plan, Inc. formed		Lowell Plan, Inc., a roundtable of business, govt and community leaders was formed	MP, p. 27
1979	NPS expresses interest in Boott Mills	CH,M6	In late 1979, the NPS and LHPC staff forged an agreement that they would develop a portion of the Boott Cotton Mills in the heart of the downtown for a high-profile use to be identified later	MP, p. 58
1980	Wang buys M6	M6	LHPC & city of Lowell urged Wang Laboratories to purchase Mill #6 from bankrupt Capehart Corporation	LHPC Briefing Paper, March 18, 1983

Year	Event	Bldg.	Description	Source/Note
1980	Restoration-Dwgs-1980	M6	Design drawings for partial renovation of Mill 6---roof demo & replacement- entirely new elastomeric roof, insulation added, new flashing ; spot repointing; new windows, frame repair and replacement (7 sheets)	LOWE_475_25902_[id14563]
1981	Window replacement & repairs		Dwgs showing new wood window sash for Mill #6, with storm panel & spiral balance system (2 sheets)	LOWE_475_25900_[id19242]
1981	Wang Corporation repairs to Mill 6		Replacement of 400 window sash & repair of window frames and sills. Window openings were weatherstripped and jambs rabetted for storm windows that were installed later; Windows painted based on historic paint analysis	As-built drawings, Moore-Heder, 1981, LNHP Archives; HSR, p. 422
			Selective brick masonry re-building and repointing based on historic preservation guidelines	
			New roof and insulation, metal and brick cornice rebuilt at west wall, historic chimney rebuilt at west end, new downspouts installed	
1982	CBA formed		Community action group- The Coalition for a Better Acre (CBA) formed in 1982 gave traction to LNHP creation	MP, p. 27
1983	Early sketches		Shows area around the Counting House and Mill 6. The footbridge is shown elevated with double doors at the passageway.	LOWE_475_40014_[id36299]
1983	Lowell Historic Board		Lowell Historic Board was established	MP, p. 117
1983	Mill 6 sold to Park		Wang Labs sold Mill #6 to the LHNP for $200,000- price reflecting the actual capital costs Wang incurred on the building.	LHPC Briefing Paper, March 18, 1983; LNHP Archives
1983	Structural Study		Concept drawings were done for stabilising the structure of Mill 6 for shear loads- new shear walls proposed, new connections at beams, roofs and building perimeter.	1983 drawings, LNHP Archives
1983-Oct	Concept Sketch		Early perspective sketches of the proposed reuse show landscape improvements along the north and south façade of the Counting House. The south footbridge is shown elevated with double doors at the passageway on both the north and south facades.	Sketch, DSC Archives
1984	HAER Documentation	CH	Existing Conditions set (27 sheets)	LOWE_475_25007_[id40632]
1984	HAER Documentation	M6	Existing Conditions set (73 sheets)	LOWE_475_25003_[id40295]
1984	Penstock & Bridge Assessment	CH	Assessment and recommendations for repair of Counting House sub-structure	LOWE_475_D49_[id39685]
1984	Walters becomes Superintendent		In late 1984, Sandy Walters replaced Burchill as Superintendent- oversaw renovation of Boott Mill No. 6, the signature building of the park	MP, p. 59
1985	Paint & Mortar Analysis	CH	161 pg. report. Concurrent effort with preparation of 1984 HSR. 307 exterior & interior paint samples & 36 exterior & interior mortar samples from the Counting House were analyzed.	LOWE_475_D50_[id41410]

Year	Event	Bldg.	Description	Source/Note
1985	Cultural development plan		The city was changing in other ways. Local artists, business chiefs, museum directors, patrons and others joined forces in 1985 to write the state's first comprehensive plan for cultural development.	MP, p. 32
1986	Design drawings	CH, M6	Comprehensive Design Set- CH & #6 (64 sheets)	LOWE_475_25011_[id4 4995]
1986	Design drawings	M6	Comprehensive Design Set- LG series dwgs (6 sheets)- machine layout	LOWE_475_41011_[id4 7104]
1986	Design drawings	Ch, M6	Comprehensive Design Set- CH & Mill 6 (64 sheets)	LOWE_475_25011_[id4 4995]
c. 1986	Tower reconstruction explored	M6	Concept sketches prepared for reconstruction of stair towers- not pursued	LOWE_475_25016_[id1 38687]
1987	Lowell folk festival		First Lowell Folk Festival held	MP, p. 60
1987	Congress Group acquires Boott Complex (Bldgs other than M6, CH & M7 link)		Congress Group Properties of Boston acquired other mills within Boott with plans for offices, technology companies and shops. Congress Group announced that it would spend $50 million to renovate the complex. Unfortunately, Congress Group's progress at the Boott stalled out in the recession of 1991.	MP, p. 66
1988	Trolley	M6	Historic trolley line expansion	MP, p. 60
1989	Phase I Renovation complete	M6	Included structural repairs and core and shell renovation of Mill 6.	LOWE_475_25004A_[id 54325]
1989	MCC		Mogan Cultural Center established	MP, p. 60
1990	Boardinghouse Park		Boardinghouse Park built	MP, p. 60
1990	Lowell hailed as success		Historic Preservation magazine praised Lowell as "the premier rehabilitation model for gritty cities worldwide."	MP, p. 32
1991	Congress Group		Recession stalls Congress Group's plan to renovate Boott Complex (mills other than M6 and CH)	MP, p. 66
1992	Wang bankrupt		In 1992 Wang Laboratories declared bankruptcy.	MP, p. 24
1992	Boott Mills Museum	M6	Boott Mills Museum in Mill 6 opened	MP, p. 60
1993	Phase II Renovation complete	CH, M6	Included exterior and interior renovation of CH, interior fit-out of Mill 6 and various repairs and improvements to create a multi-use LNHP complex.	LNHP
post-1993	CH first floor restrooms	CH	Restrooms expanded on first floor	LNHP/ current conditions
1994	M6 Ice Storage system	M6	Mill 6 ice storage system (now abandoned) was added in basement of Mill 1, in space leased by NPS.	LNHP
1995	Historic Landscape Report	CH,M6	Historic Landscape Assessment for Eastern Mill Yard , Boott Cotton Mill No. 6' was completed by Olmsted Center for Landscape Preservation	LNHP
1995	TIHC classroom fitted for wet-room use	M6	Room 340 (third floor, corner of L-shaped plan) was converted to wet-use - 'Power to Production' workshop; new flooring and drainage added.	LNHP, File G00257
1997	Additional ventilation added	M6	New roof top equipment was added to provide additional mechanical ventilation to spaces on the 3rd, 4th and 5th floors; joists were cut where required for duct penetrations in the floors.	LNHP

Year	Event	Bldg.	Description	Source/Note
1997	Roof replacement	M6	The entire single-ply roof at Mill 6 was replaced with new single-ply roof and new insulation to match existing. New flashings were provided at all penetrations. Downspouts on north face were removed.	LNHP
2000	LHP formed		the Lowell Heritage Partnership (LHP) was formed	MP, p. 73
2001	Boiler room re-located	M6	Boiler Room 345 converted to MEP room and boilers moved to Room 345C - at north end of Mill 7 link on the 3rd floor	LNHP
2001	Fire escape in Mill 7 link	M6	Fire escape stair added in Mill 7 link space (functional part of Mill 6) internally on floors 3, 4 and 5, externally on floors 1 and 2 to avoid trolley barn facility.	LNHP
2004	Administrative history LNHP		Administrative history of LNHP completed by George O'Har & Gray Fitzsimons	LNHP
2006	Penstock stabilization	M6	Turbines 3,4,5 penstock entrance under Mill 6 received structural repairs to the canal wall and column replacement	LNHP
2007	PV electrical power system	M6	A 96-panel photo-voltaic system was added to the roof, providing 22 KW power on four circuits. The system provides direct current electrical power for lighting.	LNHP
2007	Museum store relocated	CH,M6	The museum store was relocated from the second floor of the Counting House to the west end of the first floor of Mill 6 (in the earlier reception/orientation space).	LNHP
2010	PV hydronic system added	M6	A solar array hydronic system was installed on the roof, providing 350,000 Btu. The system supplements the main heating and cooling absorption chiller operation. At this writing, the system is non-functioning due to mechanical failure.	LNHP
2013	Window Replacement Phase I	M6	62 of the typical 12/12 windows on the south and north façade at first and second floor of Mill 6 were replaced with custom true-divided light aluminum windows with integral storm panel.	LNHP
2014	CH-kitchen	CH	New kitchen built in west portion of CH at first floor	LNHP/ current conditions
2015	Penstock under CH	CH	The substructure under the CH which forms entrance to penstock 1 was investigated for structural stability-preliminary recommendations include partial rebuilding of the easternmost arch that is displaying movement, rebuilding the failed brick vault and replacement of deteriorated brick piers with new granite columns.	EYP; PMIS # 162632-Project A
2016	Window Replacement Phase II	M6	42 of the typical 12/12 windows on the south, north and west façade at first and second floor of Mill 6 were replaced with custom true-divided light aluminum windows with integral storm panel.	LNHP

Key:

CH= Counting House
M6= Boott Mill 6
HSR= 1984 Historic Structures Report, Archived copy at LNHP. Reproduced as Chapter 1.2 of this document. Page numbers refer to the archived printed copy at LNHP.
MP=Marion, Paul. Mill Power: The Origin and Impact of Lowell National Historical Park. Lanham: Rowman and Littlefield, 2014.
LOWE= Sources preceded by LOWE refer to the document name/id at the Denver Service Center of the National Park Service
LNHP= Lowell National Historical Park Archives, 3rd Floor, 115 John St, Lowell, MA 01852

CHAPTER 1.5

Current Physical Description

1.5 Current Physical Description

This chapter provides a brief description of the current exterior and interior features and spaces of the Counting House and Mill 6 at the Boott Mills Complex in Lowell National Historical Park. The two adjoining structures are located at 115 John St, Lowell, MA 01852. Please refer to Appendix 1 for plans (with room numbers) and elevations of the two buildings.

I. COUNTING HOUSE

The Counting House is a rectangular, 2-story masonry building, roughly 100' x 30'. It is situated along the north edge of the Eastern Canal, at the east side of the John Street bridge that serves the Boott Mill complex. Mill 6 abuts the building directly to the east. To the north of the building lies the Boott mill-yard with an asphalt sidewalk and concrete paving between the building edge and the grassy sections in the middle of the yard.

Exterior Elements

Foundation/Substructure

The Counting House is built partially on the canal penstock (Penstock No. 1) entrance underneath. The penstock entrance at this location comprises of three barrel vaulted channels with galleries on either side. The vaults appear to be constructed of double wythe brick masonry and are supported on the short ends by granite



Photo 105. Canal penstock substructure under south wall of Counting House visible during canal dewatering, 2015.
Source: EYP



Photo 106. Easternmost arch at the canal penstock entrance (visible on the left of photo 105), directly under west end of Counting House,visible during canal dewatering, 2015.
Source: EYP



Photo 107. View of eastern gallery under south wall of Counting House, visible during canal dewatering, 2015.
Source: EYP

arches and along the long ends by granite walls. The walls between the vaults are rough-cut ashlar while the retaining wall that forms the back and sides of the penstock/ gallery area is random rubble. The Counting House sits directly on top of the easternmost vaulted channel and the east gallery.

The east gallery is a roughly 11' wide space extending the length of the Counting House along the canal and features trabeated construction with solid granite beams and columns. Two columns are constructed of brick and a third is cast in concrete. A composite steel deck with concrete slab forms the first floor slab of the Counting House. This slab ties into the exterior brick walls of the structure and rests on the granite penstock substructure below.

North of the retaining wall, the first floor slab sits directly on grade There are interior concrete column footings, and existing masonry footings supporting the exterior walls.

Exterior Walls

The 2-story structure is composed of multi-wythe load bearing brick walls roughly 10-1/2" thick. The molded red brick is laid in common bond with a header course after every seven stretcher courses. Mortar joints are struck flush. The brick walls are punctuated by window and door openings on the north, south and west facades. Some variation in brick color and texture from the rest of the building can be seen around the passageway opening on the north facade.



Photo 108. North wall of Counting House, 2015.
Source: EYP

A row of circular anchor plates (with an embossed star shaped pattern) marks the structural ties at the second floor level on the north and south facades. The south wall has some additional ties between the window openings and at the first floor slab level. One example each of the original diamond anchor plates and the subsequent circle anchor plates can be seen on the north and south facade. Other items on the brick walls include linear structural braces directly underneath the roof cornice on both the north and south elevation. These exist (from the west), over the second and third windows, over the fifth window and over the seventh, eighth and ninth windows on the south facade. At the north facade, these braces exist (from the west) over the third and fourth windows, over the sixth window and over the eighth, ninth and tenth windows. Three metal downspouts are present - all on the north facade.

The west side of the building has a semi-enclosed passageway that was created inside the original building shell. This unconditioned two-story space features the original gabled exterior west wall of the Counting House on the west, and one bay of the north and south facades. A relatively newer brick wall on the east separates the passageway from the interior conditioned building volume. While most of the original joist/ beam pockets of the second floor slab in this space have been filled in, a section has been left exposed as a reminder of the slab that existed here. Also visible are the concrete columns that were added at the exterior wall for stabilizing the building.



Photo 109. Double-height pedestrian passageway at west end of Counting House, created inside the building shell in 1993, photo taken 2015.
Source: EYP

Windows

The building facade is punctuated by windows on the north, south and west facades. The west facade windows (and one bay of the north facade) are at the semi-enclosed unconditioned entry



Photo 110. South facade of Counting House, 2015.
Source: EYP



Photo 111. Detail of windows at south facade, 2015.
Source: EYP



Photo 112. Windows at north wall of Counting House, 2015.
Source: EYP

passageway, so they are not windows in the traditional sense, but their appearance is similar to the other windows on the building. The fenestration pattern at both the long elevations, north and south is not completely regular - windows do not always line up on the first and second floors and there is variation in opening sizes and light patterns.

On the south facade, all but two of the eleven windows are 6/6 wood double hung windows. The westernmost window is a 12-light single-sash window and the seventh window from the west is a smaller 9-light single-sash window. The second floor windows are of three different heights, yet all are 1/1 wood double hung. All windows on this facade feature exposed granite lintels and sills.

On the north facade, the most typical windows are 9/9 wood double hung windows. There are deviations from this rule though- on the first floor the fourth window from the west is a 2/2 double hung window and features a brick row-lock sill and the third window from the west has a brick lintel. On the second floor, the second and third window from the west are 1/1, and the fourth window from the west is a 2/2. All windows (other than those mentioned above with brick sill and lintel) have an exposed granite lintel and sill.

Doorways



Photo 113. Typical doorway at north wall of Counting House, 2015.
Source: EYP

The pedestrian passageway entry on the west end of the north and south facade is a simple masonry opening with a granite lintel and no doors. There is a light fixture on either side of it with signage over the south entry. On the north facade, there are three identical entry doorways into the Counting House. Each opening is framed by a granite lintel and protected by a projecting canopy. The canopy consists of a gabled wood framed construction with metal flashing on the slopes, at the edges of the wood fascia and at the brick wall interface. Simple wood brackets support the canopy and are attached to the brick wall. There are small light fixtures on either side of each opening. The door itself is a metal door with six glazed lights. There are granite thresholds at each doorway entrance.

Roof

The building has a gable roof with slate tiles and a boxed wood cornice. A wood gutter is attached to the cornice, only on the north facade. The roof is punctuated by two pipe vents, one each on the north and south slopes, and an elevator vent on the ridge line at the east end. There is a continuous snow-guard on the north facade- on the south facade the snow-guard extends only above the pedestrian passageway entry.



Photo 114. West and south facade of Counting House, 2015. Note the slate roof and wood cornice.
Source: EYP

Interior Elements

First Floor

The rectangular floor-plate of the first floor is accessed by three doorways on the north facade. These lead into a two-story lobby space that features a stair to the second floor on the west side and five exposed wood beams to the east. This floor opening allows a view to the second floor of the Counting House which is separated from this two-story space by a metal railing. The open stair features a similar metal railing and wood steps.



(Reprinted) Photo 54. Open stair to second floor in Counting House lobby, 2016
Source: EYP

A continuous row of cylindrical metal columns (roughly 10'-6" from the outside of the north exterior wall) support the second floor above and are visible in the open lobby at the first floor. Other spaces on the first floor include a kitchen on the west end, a store and toilets along the south wall and an elevator to the second floor on the east end. There are also a set of three steps leading up to the first floor of Mill 6 through an opening in the east wall of the Counting House.

The inside face of the exterior walls is painted white. There are numerous concrete and brick pilasters at the north and south walls that are remnants from various interior arrangements and stabilizing efforts at the Counting House. These are also painted white. The window openings do not feature any casings or stools on the interior. Other features on the wall include various light

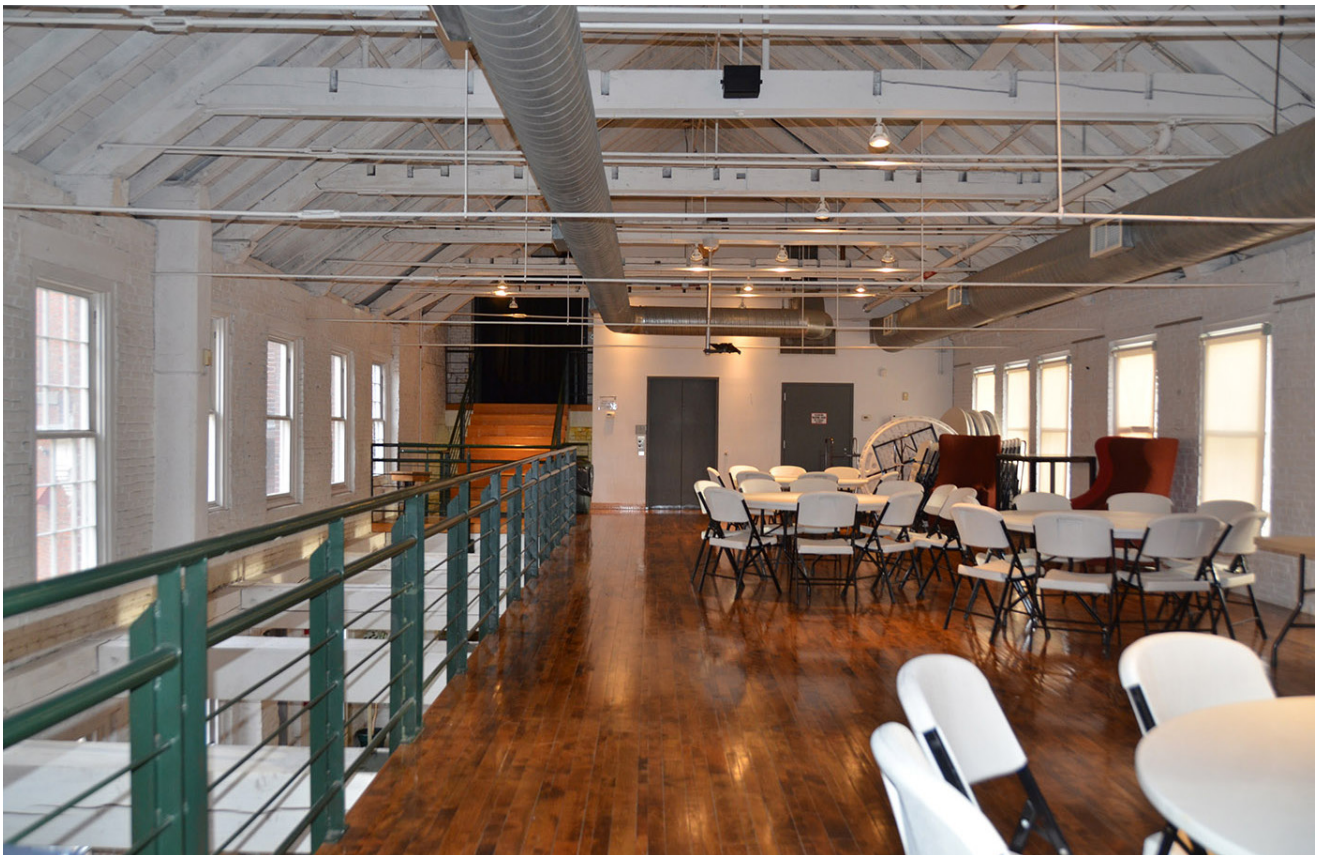


(Reprinted) Photo 53. Entrance lobby at first floor of Counting House, 2016. Note the double height space created in 1993 by removing a section of the second floor slab and re-framing the area with new beams and columns.
Source: EYP

fixtures, signs, conduits, and equipment boxes. Most of these items are also painted white. The lobby features a brick floor- other areas vary from linoleum to tiles. All interior partitions are faced with painted gypsum board.

Second Floor

The second floor of the Counting House is primarily one open space that is accessed via the stair from the first floor at the west end. It looks down onto the first floor via the floor opening along the north facade and features a continuous metal railing along the slab edge. An elevator and machine room are situated along the east wall, along with a set of steps leading up to the second floor of Mill 6. The second floor space functions as a large milt-purpose events room. There is a wood counter at the southwest corner, some wall shelving and movable furniture in this space. The flooring is wood , and the ceiling is exposed underside of the roof truss. All the structure and underside of the roof deck is painted white, and so are all the conduits and pipes attached to the roof. Two large round mechanical ducts run along the length of the second floor space - these are left unpainted.



(Reprinted) Photo 61. Multi-purpose events space at second floor of Counting House, 2016
Source: EYP

II. MILL 6

Mill 6 is a roughly L-shaped five-story structure located along the north edge of the Eastern Canal. It abuts the 2-story Counting House to the west, is bounded by Bridge Street on the west and faces the Boott millyard on its north. For ease of description, the longer part of the L-shaped plan that extends along the canal will be referred to as the west wing and the shorter portion that extends along Bridge Street will be referred to as the east wing. It is connected to Mill 7 on the north via a five story masonry connector. The building features 2 octagonal stair towers- one each at the northwest corner of its west and east wings. A third, three-sided, six-story tower, (built later in 1917), is present at the inside corner of the L-shaped plan, facing the mill yard.

Exterior Elements

Foundation/Substructure

The foundations at the east, north and west walls of Mill 6 are constructed of solid granite blocks. The south foundation of the building sits on the north wall of the Eastern Canal, bearing on a series of granite capped brick barrel vaults resting on solid granite walls that enclose the penstocks running under Mill 6, from the third bay from the west end through the nineteenth bay. Individual square granite piers support the first floor framing. Additional concrete foundations and tie beams were added in 1989-1993 to support the new elevator and two interior stairs. There is a small crawl space between the first floor framing and the top of grade under Mill 6. The entire first floor (with the exception of some areas) has a concrete slab on metal deck that rests on the foundation structure described above. In 2006, repairs were made to the structure supporting the penstock under Mill 6. This included replacement of columns and repairs to the canal wall.

Exterior Walls

The exterior load bearing masonry walls are laid in common or American bond, 7:1 (stretchers to header course) using salmon to dark red brick. Mortar joints are struck flush. A roughly 15" tall granite foundation band is visible above grade on most elevations. Based on archival info noted in the 1984 HSR and field measurement taken in the 1980's wall thicknesses are 20" at the first two floors, and 16" for the third through fifth floors at the west wing; and 23" for the first two floors, 20" at the third, and 16" for the fourth and fifth in the east wing. The walls are solid multi-wythe masonry. The north and south face of the west wing features diamond shaped



Photo 115. West (left) and north (right) facade of Mill 6, 2015. Photo taken from mill yard. Note the octagonal east stair tower on the left of the photo and the 1917 elevator tower at the inside corner of the L-shaped Mill 6, at center of photo.
Source: EYP

cast iron anchor plates between each window at the second through the fifth floor slab. These mark the location on the inside where the timber beams supporting the floor are secured by tie bolts through the wall. Similar ties and anchor bolts exist at the east wing on the east and west face from the second through the fifth floor. Note that due to the presence of the two story historic coal pocket space along the east facade, the second floor ties are present on the coal pocket wall where the beams terminate, and not at the exterior wall.



Photo 116. Detail of diamond shaped anchor plate at Mill 6, 2015.
Source: EYP

At the roof level, the masonry walls are topped by a six course corbeled continuous projecting brick cornice with pendant like brackets that terminate at a two-course projecting brick stringcourse. There are two historic metal fire-escapes attached to the north facade. These are purely decorative and non-functional.

Stair Towers

Both the octagonal stair towers that are situated at the northwest corners of the east and west wing were built at the same time as Mill 6 and their exteriors are almost identical in design. The towers



Photo 117. East stair tower at Mill 6., 2015
Source: EYP



Photo 118. West stair tower at Mill 6, 2015
Source: EYP

feature similar molded red brick as Mill 6 with similar mortar joints, however, their coursing varies from 7:1 to 9:1. The towers have five stories and their top extends above the roof of Mill 6 by roughly 6'. Each tower has six exterior faces- north, south, west, northwest and southwest. Windows occur in the north, south and west wall of each tower, the northwest and southwest facades are blind. Each corner has a one-wythe thick pilaster that extends along the height of the tower and is punctuated only by a brick stringcourse and granite band at the fourth floor slab level.

Floors two through five feature recessed panels at each face. At the north, west and south faces, the panel at the second floor is rectangular with two-course corbel at the top edge, while the panels at the third and fourth floors are segmental with a four-course corbeled top with pendants. The fifth floor panel is also rectangular with four-course deep pendants set flush with the outer wall surface. Each recessed panel has a granite band as its lower edge. The fourth floor panel has a continuous granite band that extends beyond the panels, swells over the corner pilasters and continues all around the tower. Directly below this band is a two-course brick stringcourse that forms the top of the segmental recessed panel at this floor and that too extends all around the tower. There is another similar granite band at the top, right below the tower roof. Right below this band is a continuous band of seven-course deep brick pendant brackets. At the northwest and southwest angled wall surfaces, the recessed panels stay rectangular at all floors and there is no corbeling at the top of the fourth floor panel.

As mentioned previously, windows occur in the north, south and west wall of each tower. Each tower window opening is detailed similarly to the windows at the regular Mill 6 facades, except that they are significantly narrower in proportion, resulting in 6/6 sash as opposed to 12/12 in the mill proper. Each window opening has a projecting segmental brick arch that creates a hood; the sills are rock-faced granite. See the discussion on 'Windows' for greater detail about the hood design.

At the west face of each tower on the first floor is an entrance door. A set of three granite steps leads up to the door. The door opening itself features a segmental brick arch with a projecting wooden hood above. The hood has metal flashing on top and is supported by ornamental brackets that drop down on either side of the opening. The doors are double leaf, with six recessed panels on each leaf. The east stair tower has granite side walls at the steps leading up to the entrance along with a simple metal pipe handrail. The side walls and railing are not present at the west stair tower.

1917 Elevator Tower

This three-sided tower is present at the inside corner of the L-shaped Mill 6 plan and faces the mill yard. It was constructed in 1917 as a freight elevator tower, but was converted in 1993 to be used as programmable interior space. Therefore, it was provided with a new concrete floor at each level . This tower has roughly 12" thick loadbearing exterior brick walls, laid in common bond with 7:1 (stretchers to header course) and mortar joints struck flush. The walls rest on a granite foundation at the same level as the foundation of the mill itself. The two exposed tower corners (where the northwest wall meets with the north and west wall) feature an interesting detail, where the last brick at each alternating course is not cut to create a flush mitred corner, but rather left empty for more relief.



Photo 119. 1917 elevator tower at Mill 6, 2015
Source: EYP

There are no beltcourses or pilasters on this tower. The largely monolithic brick walls extend for six stories culminating in a projecting metal cornice. Window openings are at each floor on all three facades and feature 12/12 double hung wood sash. Each opening is rectangular with an exposed honed granite head (set flush) and projecting granite sill.

The first floor of this tower forms the entry vestibule for entry to the main elevator lobby of Mill 6. To enable this use, door openings exist in the west and north face. The west opening has three granite steps with side walls and metal handrails leading up to a double door with six glazed lights in each leaf. The opening is framed by an exposed honed granite lintel set flush with the brick wall. The north opening is accessed off of a brick paved landing that leads to an exterior ramp and set of three steps. This opening is also framed by an exposed honed granite lintel set flush with the brick wall and has a single door with six glazed lights along with a glazed side light and transom.



(Reprinted) Photo 96. Entry at west face of 1917 elevator tower, photo taken 2016.
Source: EYP

Windows

Mill 6 features a very rhythmic and symmetrical fenestration pattern with one window opening between each structural bay lined up vertically on all five floors. While there are minor variations in window size and type at certain locations owing to function or change over time, the typical window consists of an approximately 4'-0" x 8'-7" segmental arched opening. Each opening has a three-course projecting brick hood with pendants that drop three courses below the lower chord of the segmental hood. A full stretcher in width, the pendants terminate with a centered header over a queen closer. The hoods at the second and fourth floors were visually accented by having only each alternating brick project out in the second brick course. This led to a dentil-like appearance and



(Reprinted) Photo 98. Typical 1981 wood window at Mill 6
Source: EYP



(Reprinted) Photo 99. Typical 2013-2016 custom replacement aluminum window with true divided lights and integral storm panel, at Mill 6
Source: EYP

provided more ornamental relief to the brick hoods. Each projecting window hood has a metal flashing on its top curved surface that bends over slightly to cover a portion of the front face of the top course. The sills are all rock-faced granite and project out slightly from the brick wall surface.

The windows themselves are mostly 12/12 wood double hung with an integral storm panel on the inside of each sash and date to the 1981-1993 renovations. In 2016, the first and second floor windows on the south facade and the second floor windows on the north facade of the west wing were replaced with custom true-divided light aluminum replication windows that closely mimic the appearance of the 1981-1993 windows. These too have an integrated storm panel on the inside.

The first floor windows at the east facade are blind- this is believed to be an original condition, owing to the location of the coal pocket along this wall, and as affirmed by early photographs. The blind openings are the same size as first windows in other parts of the east wing on the first floor with the typical corbeled brick hoods and rock faced sills. The brick infill is recessed roughly 4" from the face of the exterior wall.

At the north face of the east wing, three windows on the first floor have brick infill and two windows on the third floor and one window on the fifth floor have a metal louver. At the east elevation, two windows on the fourth floor have metal louvers, while one window on the second floor has a partial metal louver. For a discussion of windows at the octagonal stair towers and the 1917 elevator tower, refer to the sections above on those elements.

Doorways

The entrance doorways located at the stair towers and at the 1917 elevator tower have been described above under the respective headings. Other than those, three doors are located on the first floor at the north face of the east wing. All of these are metal doors. Two of these have a solid infill above the door height and one of them has a metal louver above the door.

Roof

Mill 6 has a single ply membrane roof which was last installed in 1997. Drawings from this effort indicate rigid insulation underneath the membrane roof which rests on a wooden roof deck. The cornice is made out of metal and is comprised of five interlocking pieces. It extends out roughly 2'-3" from the face of the brick cornice below and hides metal brackets that tie the cornice back to exterior brick



(Reprinted) Photo 104. PV arrays and solar hydronic system added at roof of Mill 6 in 2007 and 2010 ; photo taken 2011.
Source: EYP



Photo 120. Chimney at west end of Mill 6, 2015
Source: EYP

wall. Below the metal cornice is a corbeled brick cornice described in the section on exterior walls.

The west wing roof has both an electric photo-voltaic array system as well as a hydronic solar array installed in a portion of it. There is some other additional mechanical equipment, various vents, exhausts, hatches and drains on the roof.

Chimney

There is one chimney on the roof of Mill 6 situated at the west end. This is a non-functioning, ornamental chimney that was constructed in 1981 as a reconstruction of the historical chimney that existed at this location and was removed prior to 1950. It is constructed of brick and features recessed panels on all four sides. There is a simple corbeled brick cornice at the top with a dark grey metal cap.

Interior Elements

First Floor

The first two floors of Mill 6 are primarily used for the Boott Mill Museum and related exhibit purposes. The primary entrances into the building are through the west stair tower, and the vestibule at the 1917 elevator tower (at the inside corner of the L-shaped plan). The door at the east stair tower is used as an exit. Visitors can also get access to the Museum through the Counting House via an opening in the west wall of Mill 6. The 1917 elevator tower



Photo 121. Entry vestibule at first floor of 1917 elevator tower at Mill 6, 2015
Source: EYP

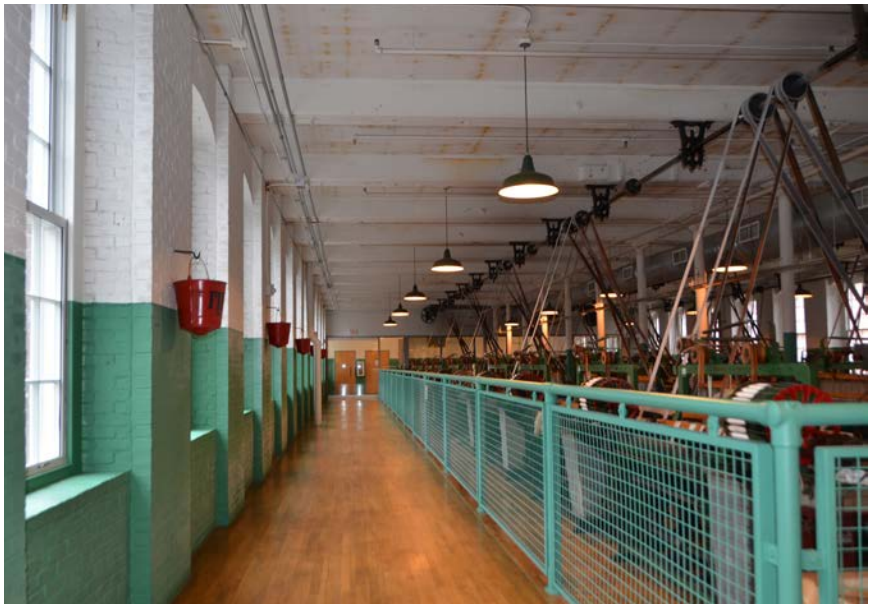


Photo 122. Elevator lobby at first floor of Mill 6, 2015
Source: EYP

provides access to the main elevator lobby and is used by staff and visitors to the upper floors of the building. The entrance through the Counting House and the west stair tower lead into the Museum bookstore and are more specific access points to the Museum. The bookstore occupies the west end of Mill 6 and has a brick vaulted ceiling. Directly to the east is a stair tower that connects floors 1-3. Further east is an observation lobby with a glazed partition that provides a view of the Weave Room that occupies almost the rest of the floor plate of the west wing. The Weave Room features various looms that have been brought here from other mills to re-create



Photo 123. Typical bricked in wall opening at historic hoist access at west wall of east wing, 2015
Source: EYP



(Reprinted) Photo 75. View of Weave Room at first floor of Mill 6, 2016. Note 1-wythe thick brick pilasters/piers added to the exterior wall between window openings in 1989.
Source: EYP

a functional 19th century mill floor. Timber beams roughly 8' o.c. span from north to south between each window. At the mid point of each beam is an approximately 5-1/2" dia. cast iron column. An aisle cuts through the looms to lead visitors to the east end where the arched masonry wall between the east and west wings of Mill 6 marks the end of the Weave Room. There are one wythe thick brick pilasters between each window in this room, that were added in 1989 as a means to structurally strengthen the building. The walls are painted in a bi-color scheme with the divide happening roughly at the vertical mid-point of the walls, the lower half is green and the upper half is painted white. The ceiling and all exposed structure-beams and columns are also painted white. Exposed mechanical ductwork added in 1989-1993 is left unpainted (therefore has a silver/grey metallic finish)



(Reprinted) Photo 81. Curved stair connecting floors 1 and 2 of the museum located directly east of the arched masonry partition added in 1989, photo taken 2016.
Source: EYP

Directly east of this masonry wall is a curved stair, added in 1993, that leads up to more exhibits on the second floor. A door to the north of the weave room provides access to the elevator lobby with toilets and various utility and storage rooms. East of the curved stair is another exhibit room with a narrow storage room carved at its east end. The remainder of the east wing is taken by the building lobby and utility rooms mentioned above. The east wing has timber beams that run east to west and each beam is supported by two cast iron columns, each at roughly the 1/3 rd point of the span. All these columns are present, the partitions added in 1993 work around them to create the various rooms and spaces. At the north end of the east wing is another internal stair that connects floors 1-5. Across the hall from this stair is the historic east stair tower. The east end of the building at floors 1 and 2 houses the trolley maintenance facility in the historic coal pocket area.



Photo 124. Spiral stair at octagonal stair tower, 2015
Source: EYP

The interior of the historic octagonal stair towers is similar and each features a wooden spiral staircase. Doorways connecting the stair to the floor are located on the east wall of each tower. Directly north of this door opening, originally there used to be an arched opening for hoists that connected the various floors. These were removed in 1916 and the openings infilled with brick However, once can still see the profile of the brick arch and the opening recess on the floor side of the wall. Each flight of stair has 21 risers and 20 treads. The treads are protected with cast iron plates, with 'Boott Cotton Mills' cast into the face. These plates are presumed to be original to the building's construction. A metal pipe handrail with metal posts, most likely dating to 1914 are present in both stairs.



Photo 125. Metal plate at each tread of the spiral stairs with the letters 'Boott Cotton Mill' stamped on them, 2015
Source: EYP

Second Floor

Most Museum visitors get access to the second floor by taking the curved stair from the first floor and continue their tour to the west. This leads them through various exhibit rooms with floor and wall



(Reprinted) Photo 82. Theater located on floor 2 of the museum, added in 1989; photo taken 2016.
Source: EYP



(Reprinted) Photo 83. View of corridor along exterior wall on floor 2 of the museum, built in 1989; photo taken 2016. Note the brick piers between windows, the bi-color wall paint scheme and the dark painted ceilings and systems above.
Source: EYP



(Reprinted) Photo 84. Exhibit space at west end of Mill 6 on floor 2, built in 1989; photo taken 2016. Note the vaulted ceiling and cast iron columns.
Source: EYP



(Reprinted) Photo 85. Exhibit space directly east of the space in Photo 80, at west end of Mill 6 on floor 2, built in 1989; photo taken 2016. Note the dropped ceiling and cast iron columns.
Source: EYP

displays. A small theater is also situated in the west wing, closer to the east end. All windows in the exhibit areas and theater on this floor are covered with fabric backed panels to block daylight. The ceilings and some of the pipes and ductwork at the ceiling are also painted black to not detract from the exhibits. The exhibit room on the west end, directly east of the stair from floors 1-3, has an acoustic ceiling with 2'x 2' tiles laid in a metal grid. The false ceiling is fairly close to the structural floor and does not come down far enough to conceal the timber beams. Directly east of this room is the stair that

connects floors 1-3 and further east is an additional exhibit room that features the vaulted brick ceiling similar to this location on the floor below that houses the Museum bookstore. Walls at the second floor also feature a bi-color scheme- in addition to green/white, they also include rooms with a white/yellow scheme. The 1917 elevator tower space at the second floor is used as a mechanical room. To the east of the curved stair from floor 1, is a room with stepped seating that functions as a workshop/ events center.



Photo 126. Event Center at second floor of Mill 6, 2016
Source: EYP

Third Floor

The third floor is occupied by workshops and offices of the Tsongas Industrial History Center (TIHC) in the east and majority of the west wing. The west end of the west wing is occupied by the curatorial department. The elevator lobby and services core occupies the north half of the east wing just like on all other floors. A mechanical room in the northeast corner connects internally to additional maintenance and mechanical space in the Mill 7 link building, which is a functional part of Mill 6.



Photo 127. TIHC classroom at third floor of Mill 6, 2015
Source: EYP

All the interior spaces are created by metal partitions faced with gypsum board, wood and glazing -- most of these were installed in 1993. There have been minor additions and alterations, as documented in Chapter 1.4- Chronology of Development. The inside face of the exterior walls is painted white as well as all exposed columns, beams and ceilings. The southern arch in the masonry wall that divides the east wing from the west is in-filled with a wood partition, while the north arch is left open and provides access to the west wing of the third floor. An open staircase is located east



Photo 128. View from third floor looking up through opening in fourth floor slab, 2015. Note fourth floor arched opening with glazed partition.
Source: EYP

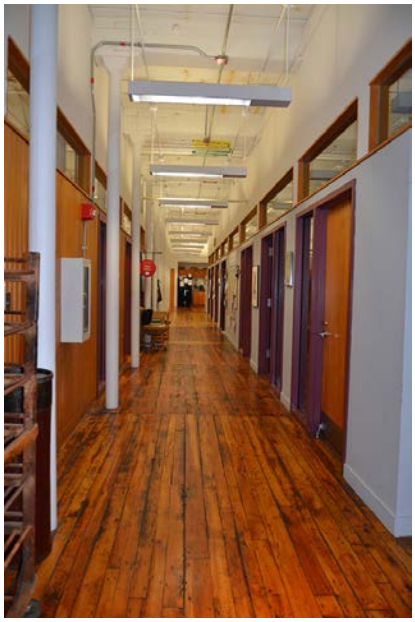


Photo 129. Corridor at third floor of Mill 6, 2015
Source: EYP

of this arched masonry partition and connects the third floor to the fourth. To insert this stair and create a visual connection between the two floors a portion of the fourth floor slab was removed (in 1993) in this area. The floor opening spans five structural bays and extends west from the stair all the way to the arched masonry wall. Two timber beams were also cut to allow the stair to extend up. The 1917 elevator tower space at the third floor is used as a library/ conference room.



Photo 130. Curatorial space at west end of third floor, 2015
Source: EYP

Fourth Floor

The fourth floor has mix of functions- the north end of the east wing has the lobby and elevator core as on lower floors. In the northeast corner is a lunch room and small kitchen area that connects to the maintenance shop in the Mill 7 link space. At the southeast corner of the building is a large lunch room used by school groups attending classes at the TIHC. Directly west is the connecting stair to the third floor. To the west of the arched masonry partition a corridor runs along the north exterior wall for roughly half of the west wing and provides access to office/ storage space occupied by the Lowell Historical Society. Directly east are libraries for the LNHP and the NPS Northeast Regional Office (NERO). The remainder of the west wing, west of the library, is used for NERO offices. This includes some private offices, open office workstations, enclosed copy rooms and an area of compact shelving. There is a connecting stair that leads up to additional NERO space on the fifth floor. The 1917 elevator tower space at the fourth floor is used as a conference/ small lunch room.



(Reprinted) Photo 87. Lunch room on floor 4, built in 1989; photo taken 2016. Note the dropped ceiling and cast iron columns.
Source: EYP

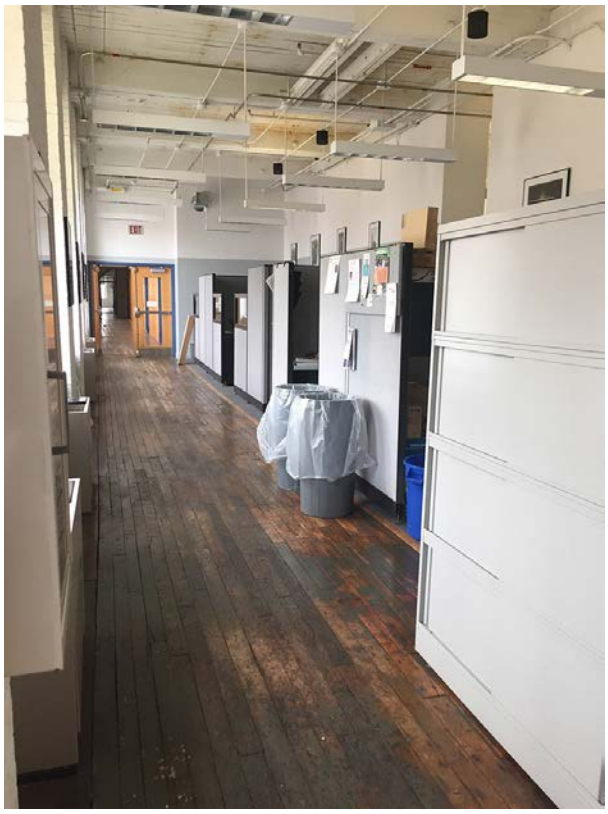
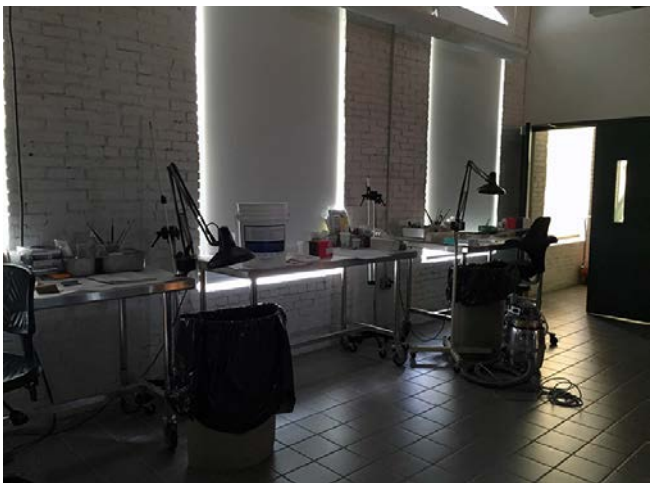


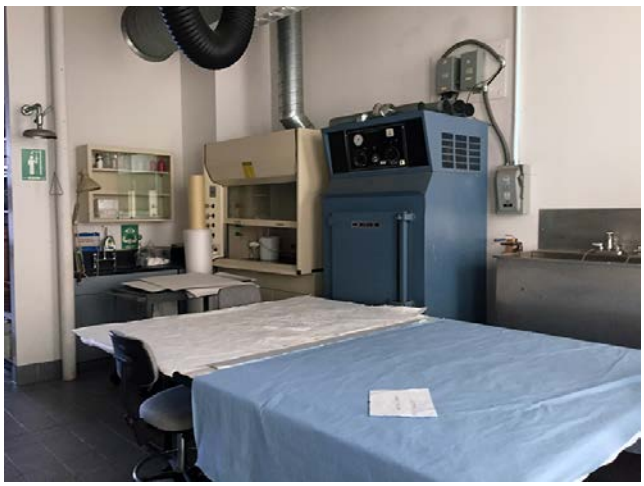
Photo 131. Corridor along north exterior wall on fourth floor of Mill 6, view of NERO office space on the right, 2015.
Source: EYP

Fifth Floor

The fifth floor also has a mix of functions - at the northeast corner of the east wing is an area occupied by the Information Technology (IT) Department. This has a door leading to additional curatorial storage in the Mill 7 link space at this floor. South of the IT area, and directly east of the toilet/ elevator lobby, extending all the way to the south facade of Mill 6, the space is occupied by the LNHP Interpretation and Education Department. This comprises of some enclosed offices, storage rooms and open workstations. Directly west is a conference room along the south wall that is accessed from the main elevator lobby. Across the lobby from this room is the 1917 elevator tower space at the fifth floor that is used as a smaller video-conference room. From the lobby a set of double doors lead to a small open exhibit area that continues to a central corridor with rooms on either side - one of these is an unused office and the remainder function as TIHC classrooms. Another set of double doors leads further west to NERO office spaces that terminate at the connecting stair to the fourth floor. West of this stair are material conservation labs used by the NERO staff. These include rooms

for microscopy, mortar analysis, archaeological artifacts, paper treatment and paint samples along with various storage rooms. The labs are all arranged along the south wall with a corridor that runs along the north wall to the west stair tower.





(Reprinted) Photos 91 & 92. View of material conservation labs at floor 5 of Mill 6, constructed 1993, photo taken 2016.
Source: EYP

CHAPTER 1.6

Character Defining Features

1.6 Character Defining Features

Character-defining features are the visual aspects of a structure that help us to identify and understand its value as an historic resource. *Preservation Brief 17, Architectural Character - Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving their Character*, states the following:

"Character refers to all those visual aspects and physical features that comprise the appearance of every historic building. Character-defining elements include the overall shape of the building, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment."

The following features and elements should be taken into account during the planning process and preserved to the greatest extent possible. These visual and tangible features are what give the building its character and contribute to its significance.

I. COUNTING HOUSE

Exterior

* **Exposed granite foundation band**

  Portion of the Counting House substructure is part of the Eastern Canal penstock entrance, which comprises of granite arches, columns and brick vaults. Only the top lintel band of this substructure is visible above the canal water line on the south facade. This should be maintained as is. None of the foundation is visible on the west or north facades.

* **Load-bearing exposed red brick walls**

  Includes the color, texture, and size of the brick units, coursing pattern, mortar color, composition and flush joint profile.

* **Diamond shaped anchor plates**

  These were most likely the original plates for the metal tie rods visible on the exterior of the building. Only three representative examples were retained - one on the north

facade and two on the south facade. On the north facade, the plate exists west of the easternmost window head on the first floor. At the south elevation, the first plate exists east of the fourth window sill from the west at the first floor and another plate exists east of the seventh window head from the west on the first floor.

* **Circle shaped anchor plates**

These were most likely added pre-1955 and should not be confused with the circle plates that have an embossed star on them and were added in 1993. Only one representative example of the historic circle plates was retained on both the north and south facade. On the north facade, the plate exists west of the fourth window head from the east on the first floor. At the south elevation, the plate exists east of the fifth window head from the west at the first floor.

* **Linear metal braces**

These refer to the linear structural metal braces directly underneath the roof cornice on both the north and south elevation. These exist (from the west), over the second and third windows, over the fifth window and over the seventh, eighth and ninth windows on the south facade. At the north facade, these braces exist (from the west) over the third and fourth windows, over the sixth window and over the eighth, ninth and tenth windows.

* **Windows**

Predominantly rectangular but of different sizes. Irregularity in window opening size and placement is a character defining feature. South facade: Nine 6/6 double hung sash, one 12-light single-sash, one 9-light single sash on first floor. Eleven 1/1 double hung sash at second floor. North facade: Five 9/9 double hung sash, one 2/2 double hung sash, at first floor. Seven 9/9 double hung sash, one 2/2 double hung sash, two 1/1 double hung sash, at second floor. Exposed honed granite sill and lintel, typical - includes finish, size and color. Third window from east on north facade at first floor has a brick lintel, and fourth window from east on north facade at first floor has a brick sill. Both of these are not original to the building but pre-date 1955 and are considered character defining features.

* **Projecting door canopies**

Each of the three doors on the north facade have a gabled wood frame canopy with a metal roof. These date from 1993 but were reconstructed based on an existing design that dated from pre-1955. Character defining features include

the proportions and design of the canopy and not the materials themselves.

* **Roof**

The building originally had a slate roof which was removed pre-1955 (most likely in 1942, coinciding with removal of the skylights). Two brick chimneys which were likely original to the building were also removed sometime during this period. The current slate roof was installed in 1993. It is identified as a character defining feature for the Counting House. Since no historical remnants of the original slate roof exist, the current roof should be used for purposes of matching color, texture and size. The existing wood cornice also dates from 1993 and was built based on the existing cornice. Profile, material and finish of the cornice are character defining features.

INTERIOR

* **Inside face of exterior brick walls**

Includes the exposed, painted (white) brick walls, brick window jambs and brick stools. The paint is more recent but mimics the original 'whitewash' finish of the interior.

* **Concrete and brick pilasters**

Remnants of prior stabilization efforts at the Counting House. Includes brick and concrete pilasters on the inside on the north, south and west walls.

* **Wood roof truss**

Original wood roof truss with metal tie rods. The white paint is more recent but mimics the original 'whitewash' finish of the interior.

II. MILL 6

EXTERIOR

* **Exposed granite foundation band**

  Roughly 15" tall granite foundation band visible above grade on most elevations. Features gaps/ vents at joints to crawl space behind.

* **Load-bearing exposed red brick walls**

  Includes the color, texture, and size of the brick units, coursing pattern, mortar color, composition and flush joint profile. Walls taper in thickness at upper floors. Six course corbeled continuous projecting brick cornice with pendant like brackets that terminate at a two-course projecting brick stringcourse.

* **Diamond shaped anchor plates**

  The north and south face of the west wing feature diamond shaped cast iron anchor plates between each window at the second through the fifth floor slab. These mark the location on the inside where the timber beams supporting the floor are secured by tie bolts through the wall. Similar ties and anchor bolts exist at the east wing on the east and west face from the second through the fifth floor. Note that due to the presence of the two story historic coal pocket space along the east facade, the second floor ties are present on the coal pocket wall where the beams terminate, and not at the exterior wall. These are original to the building.

* **Historic 'octagonal' west and east stair tower**

  Includes overall profile, shape and footprint. Note that the towers were originally six stories tall. The top most story was removed in 1950. This sixth story has not been reconstructed. Note that brick coursing is different from mill proper. Pilasters at each corner; recessed brick panels with brick corbel and pendant detailing at top and granite bands at bottom. Granite bands and brick stringcourses at fourth floor and roof level that wrap around tower. Seven-course deep roof cornice with brick pendant brackets. Segmental arched window openings with 6/6 sash, rock-faced granite sills and corbeled arched brick heads with brick pendants on either side. Projecting wood entrance canopy at door opening in west face- note that canopy at west tower is original and the east is a reconstruction; granite steps at

entrance- both have been rebuilt based on historic design- west is closer to historic design.

* **1917 elevator tower**

Includes overall profile, shape and footprint. Originally built as freight elevator tower- now part of interior space at each floor with new concrete slab. Interlocking brick corner detail. Metal cornice at top is a reconstruction from 1981 based on historic design. 12/12 double hung wood sash in rectangular window openings with an exposed honed granite head (set flush) and projecting granite sill. Door openings at first floor on north and west face were created in 1993, with new granite lintels.

* **Windows**

Rhythmic and symmetrical fenestration pattern with one window opening between each structural bay lined up vertically on all five floors. Rectangular opening with segmental arched head. Three-course projecting brick hood with pendants on either side. Hoods at second and fourth floors visually accented by 'dentil' course in the hoods. Rock-faced projecting granite sills. 12/12 double hung windows- none of the windows are original - wood versions date from 1981-1993, aluminum versions date from 2013-2016. Character defining features include the number of lights, muntin and frame profiles and proportions. Recessed brick infill at first floor window openings on east facade.

* **Roof**

The building roof is non-historic and dates from 1995. Character defining features include the lack of a parapet, and an ornamental metal cornice all around. Brick chimney at west end- built in 1981 based on historic chimney that existed originally.

* **Fire escapes**

Two historic metal fire-escapes attached to the north facade.

INTERIOR

* **Inside face of exterior brick walls**

Includes the exposed, painted brick walls, brick window jambs and splayed brick stools. The paint is more recent but mimics the original 'whitewash' finish of the interior.

* **Paired timber beams 'pocketed' into the exterior walls**

  All beams are painted white- the paint is more recent but mimics the original 'whitewash' finish of the interior.

* **Cast Iron columns**

  Cylindrical columns with a foliated cushioned cap. Placed at midpoint of span at west wing and at 1/3rd span at east wing.

* **Wood plank flooring**

  Wood flooring at floors 2-5 is historic (Floor 1 is all new dating to 1993). It is likely that historic flooring at upper floors was also partially replaced rather regularly prior to 1955 owing to switching of machinery, etc.

* **Arched masonry partition wall**

  Between the east and west wings of the building at floors 1 through 4. Note that some openings at floors 3, 4 have wood/ glass infill.

* **Masonry partition wall**

  Located in the west part of the building on floor 1, 2 separating the historic shop area from the mill floor.

* **Vaulted ceiling**

  Brick vault floor slab construction at the historic shop area on floors 1, 2 at west end of building.

* **Spiral wood staircases with metal tread plates**

  Located in the octagonal stair towers with simple wooden balustrades and handrail, and heavy turned newel posts. Pipe handrails and posts added in 1914 are also character defining and so are the cast iron plates on each stair tread with the text 'Boott Cotton Mills' cast into it.

* Recessed brick infills at hoist openings

  Bricked-in arched openings at the wall between the stair tower and the mill floor, at location of original hoists, in-filled in 1916.

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APPENDIX 1- ANNOTATED LIST OF DRAWING SETS CONSULTED

1. Denver Service Center Digital Archives

The Denver Service Center has 29 digital PDF drawing files pertaining to Mill #6 and the Counting House. Below is a more detailed description of each file with a brief summary of its contents.

NPS File Name	Date	Author	Title	Bldgs(s)	Content Description
LOWE_475_25003_[id40295]	11/1984	HAER/NPS	Existing Conditions- Boott Mills Building #6	M6	Set of 73 dwgs. Same as that available on HAER website but more complete. Includes civil, arch, struc, FP/P & electrical pre 1984 renovation. Indicates physical conditions, some condition assessment.
LOWE_475_25003_[id40308]	Same file as above				
LOWE_475_25004A_[id54325]	3/1989	Trust Corp.	Mill #6 & Trolley Maintenance Facility	M6	Set of 137 as-built dwgs. Includes Demo, Arch, Struc, MEP/FP and civil. Comprehensive account of 1984 work. As built version of 1986 Flansburgh dwgs.
LOWE_475_25007_[id40632]	12/1984	HAER/NPS	Counting House- Existing Conditions	CH	Set of 27 dwgs. Includes civil, arch. Indicates physical conditions, some condition assessment.
LOWE_475_25009_[id31161] HAER	1983	HAER	Boott Cotton Mills	M6, CH	Boott Cotton Mills Recording Project- HABS. Set of 30 dwgs. Includes various mills.
LOWE_475_25011_[id44995]	2/1986	Flansburgh	Comprehensive Design- Building #6 & Counting House	M6, CH	Set of 64 dwgs. Includes civil, landscape, arch, struc, MEP/FP. Design dwgs showing proposed work.
LOWE_475_25016_[id138672]	undated	unknown	untitled	M6	1 sheet. Perspective sketch showing yard facing facade and corner of Mill #6.
LOWE_475_25016_[id138687]	Same file as above				
LOWE_475_25900_[id19242]	1/1981	ESI/ Moore & Heder	Boott Mill #6	M6	2 sheets. New window types and details.
LOWE_475_25901_[id138700]	undated	unknown	untitled	M6, CH	6 sheets. Existing floor plans of the entire mill complex. Does not include interior partitions. Notes floor elevations and floor-plate areas.
LOWE_475_25902_[id14563]	5/1980	Moore & Heder	Boott Mill #6- Repairs & Restoration	M6	Set of 7 dwgs. Roof and façade repairs to Mill #6 while owned by Wang Laboratories.
LOWE_475_25904_[id138715]	undated	unknown	Section I-J	M6	1 sheet. Seems to be part of a larger set. Line section through Mill #6 & #7 noting floor levels.

NPS File Name	Date	Author	Title	Bldgs(s)	Content Description
LOWE_475_25905_[id110786]	undated	unknown	untitled	M6, CH	3 sheets. Part of same set as above. Line sections through various mills noting floor levels. Includes key plan.
LOWE_475_25905_[id110801]	Same file as above				
LOWE_475_25910_[id9907]	5/1897	Associated Mutual Insurance Co.	Boott Cotton Mills Insurance Map	M6, CH	1 sheet. Contains plan, line section, aerial axonometric and construction type/material description of mill complex.
LOWE_475_25911_[id38975]	3/1901	Associated Mutual Insurance Co.	Boott Cotton Mills Insurance Map	M6, CH	1 sheet. Contains plan, line section, aerial axonometric and construction type/material description of mill complex.
LOWE_475_25911_[id38988]	Same file as above				
LOWE_475_25913_[id64571]	11/1906	Lockwood, Greene & Co.	Sketch Machinery Plans running previous to 2/1906	M6	Set of 36 dwgs. Contains existing machinery and proposed new 'main driving' at the mill complex. Coincides with switch from cotton production to coarse goods.
LOWE_475_25914_[id143986]	Undated; presumably 1906	Lockwood, Greene & Co.	Sketch Machinery Plans	M6	Set of 12 dwgs. Proposed motor driven operation.
LOWE_475_40014_[id36299]	10/1983	unknown	Preliminary Study of Boott Mills	M6, CH	6 sheets. Concept landscape sketches for courtyard and sidewalks at Mill #6 & Counting House.
LOWE_475_41011_[id47104]	11/1986	Flansburgh	Comprehensive Design-Building #6 – Weave Room Technical Design	M6	Set of 6 dwgs. Looms and shafting details for Weave Room.
LOWE_475_41012_[id144017]	undated	unknown	untitled	M6, CH	1 sheet. Cut-away perspective sketch showing museum, admin and TIHC program layout at various floors.
LOWE_475_80008A_[id4971]	undated	unknown	LNHP Boundary Map	M6, CH	1 sheet. Map showing LNHP and Preservation District boundary in Lowell.
LOWE_475_80008C_[id54333]	3/1989	unknown	LNHP Boundary Map Index	M6, CH	19 sheets. Enlarged maps showing LNHP and Preservation District boundary in Lowell.
LOWE_475_129153_[id34816]	9/2008	Northeast Museum Services	Finding Aid for the Boott Mills	M6, CH	35 pg. report that describes the content of the (mostly administrative) Boott Mills

NPS File Name	Date	Author	Title	Bldgs(s)	Content Description
		Center/NPS	Records, 1905-1989 (Bulk dates 1955-1985)		Records (bulk dates 1955-1985) that are housed at NMSC, Charlestown, MA. Related collections at NMSC include Lowell Industrial Company Records (bulk 1949-1951) & Proprietors of the Locks & Canals (bulk 1890-1970)
LOWE_475_D13_[id37688]	2/1984	NPS	Inventory of the Flather/Boott Mills Collection	M6, CH	Inventory of the Flather Collection (1836-1979) housed at the Center for Lowell History, UMass Lowell. 62 pgs inventory of the collection items.
LOWE_475_D49_[id39685]	9/1984	Flansburgh	Building #6 and Counting House: Penstock & Bridge Structural Investigation	M6, CH	56 pg. report containing text, dwgs, photos of the bridge & penstocks, including recommendations.
LOWE_475_D50_[id41410]	2/1985	NPS	Boott Mills Counting House-Paint & Mortar Analysis	CH	161 pg. report. Concurrent effort with preparation of 1985 HSR. 307 exterior & interior paint samples & 36 exterior & interior mortar samples from the Counting House were analyzed.
LOWE_475_D54_[id146640]	Undated (presumably 1983)	Brown, Rona Inc. Consulting Engineers	Untitled	M6	106 pg. structural report assessing feasibility of Mill #6 for adaptive reuse.

2. LNHP Archives

The material at LNHP is in two locations- Plan Room in the basement of 67 Kirk Street, Lowell MA which is the Park Headquarters building; and the Park Archives located at the 3rd floor of Boott Mill #6. All the drawing sets are located in the Plan Room at 67 Kirk Street while photos, documents etc are in Mill #6.

Title	Date	Author	Bldgs(s)	Content Description
Boott Mill #6 Repairs and Restoration	4/1980	Moore-Heder	M6	Set of 7 drawings. Detailing proposed roof and exterior work at Mill 6 when the building was owned by Wang Laboratories.
Boott Mill #6 Repairs and Restoration	5/6/1980 with 2/1981 annotations	Moore-Heder	M6	3 sheets scanned. Site visit notes on 1980 base drawing documenting the amount of exterior restoration work done and still remaining.
Concept Design Boott Mill #6	9/23/1983	Unknown	M6	Set of 3 sheets. Structural analysis regarding loading and shear at Mill 6.
Contract Documents-Bldg #6 and Counting House	1988	Unknown	M6, CH	Hand-written note on cover says 'As-Builts'. Scanned 40 sheets. Total set includes SK-1 through SK-20. Seems like a working set that was re-submitted as the 1989 as-builts by Trust Corporation. See file LOWE_475_25004A_[id54325] in DSC Archives.
Building No. 6 and Counting House	1993	L. Addison and Assoc. and Flansburgh Assoc.	M6, CH	Set of 193 drawings. As-constructed drawings for all disciplines.
Boott Mills Interior Details	1991	Various	M6	Scanned 10 sheets. Interior fit-out details for various rooms at Mill 6 like Events Center, Weave Room, TIHC classrooms, offices etc.
Boott Mills Wet Room	1995	R.C. Wright	M6	Interior details for TIHC classroom
Additional Ventilation-Boott Mills Museum	1997	Unknown	M6	New HVAC work on multiple floors in Mill 6.
Roof Replacement-Mill 6	1997	P. Wright	M6	2 sheets. Roof plan and details.
Structural Repairs beneath Boott Mill #6	2004	McGinley Kalsow & Assoc. with Structures North	M6	Drawings showing proposed repairs to penstock under Mill 6.
Boott Mill 6-Cooling Tower	2007	Johnson Engineering & Design	M6	Consulted sheets E2 & E3 that show new electrical work at floors 2 & 3 of Mill 6.
Solar Hot Water-As Built layout	2010	Scanned by Chuck Parrott, NPS	M6	Partial scanned sheet showing proposed layout of solar hot water panels at piping at roof of Mill 6.
Existing Conditions	2011	NPS, NERO	M6, CH	Existing plans of Mill 6 and Counting House with program areas identified.

Title	Date	Author	Bldgs(s)	Content Description
Boott Counting House Kitchen	2014	Unknown	CH	Renovation of kitchen at first floor of Counting House.
Boott Mill 6 Window Replacement Project	2015	Unknown	M6	First & Second Floor Plan showing locations of Phase 1 and 2 window replacements at Mill 6.

Appendix 2- Existing Floorplans