The Textile Factory in Pre-Civil War Rhode Island

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Introduction

On the night of December 24, 1822, Zachariah Allen wrote in his diary:

> Christmas eve — The church bell is now ringing a merry peal. To me it is rather melancholy — as it recalls days long since past, when I hailed the return of Christmas as one of the happiest days of my life . . . Now more anxious thoughts, & deeper laid schemes of future aggrandizement engross my mind—[1]

What could have inspired such solemn reflection, this somber Dickensian passage? Allen was tried; he had just spend over eight months building a small textile mill on the east bank of the Woonasquatucket River in Allendale (now called Centerdale), Rhode Island, and it is clear that this was uppermost in his mind at the time. He had begun spinning woolen yarn during the first week of December, and the entry continues: "I shall be compelled to go out to my mill tomorrow."[2]

The building of a textile factory at this time was not in itself remarkable. Indeed, Allen had proceeded cautiously into manufacturing, spending several years thinking about it, and visiting factories throughout the region, carefully writing down all the technical information he could acquire on water power, textile machinery and business practices.[3] What *was* remarkable was the very *ease* with which he could build and equip a textile mill once he had made up his mind to do so.

Less than thirty-five years earlier the project would have been impossible on this side of the Atlantic. And in England, where the modern factory was invented, its history can only be dated back as far as the first years of the 18th century.[4] In 1702, what is now considered to be the first factory, a silk mill, was built on the Derwent River at Derby by Thomas Cotchett. It was a simple 3-story brick structure, measuring approximately 62 feet in length by 28 feet in width. Portions survive today in what is now a technological museum on the site.[5] But factories did not appear in large numbers in England until after the middle of the 18th century when, as a result of a series of mechanical inventions, textile spinning and weaving were transformed from handicrafts to fully mechanized operations. And it was not until the late 1760s that the new spinning machines were brought together by Richard Arkwright and others into a completely integrated system of production, housed within a single structure.[6]

We call this structure a factory, which Andrew Ure defined in 1835 as the locus of: "the combined operation of many orders of work-people, adult and young in tending with assiduous skill a system of productive machines continuously impelled by a central power."[7] What we are confronted with in the factory, then, is the emergence of a totally new building type reflecting this technological development. It is the first important building type to appear in Western Europe since the Renaissance, and the one which repre-

sents the momentous shift in Western European and American civilization from a pre-industrial to an industrial society.

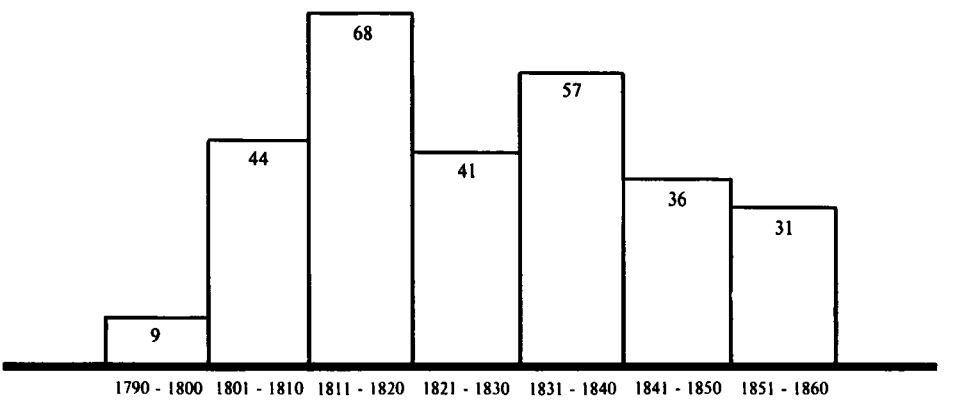
For the United States, the story of the textile factory's origin and development begins in the Rhode Island textile industry in the early 1790s and ends with the Civil War. In 1793, the firm of Almy, Brown and Slater constructed a spinning mill, on the west bank of the Blackstone River at Pawtucket Falls. It was located a short distance upstream from an old fulling mill where Samuel Slater's improved spinning machines, based on Richard Arkwright's patents, had been initially set up in 1790.[8] This modest structure was the first successful textile factory in North America.[9]

During the next 67 years textile mill sites proliferated throughout the state, exploiting the better locations along available water resources by about 1840. Graph 1 depicts the number of new sites established each decade during this period.[10]

Defining the Rhode Island textile factory's architectural development is somewhat more complicated. In tracing the emergence of a new building type, particularly one outside the mainstream of conventional architecture, an extraordinarily rare analytical opportunity is provided. We are not dealing with the work of professional architects or gifted amateurs preoccupied with, or guided by, fundamentally stylistic and formalistic concerns, but with pragmatically-motivated millwrights and business-minded entrepreneurs, seeking practical answers to crucial technical and economic questions. This allows us to see more clearly than is usually the case with self-consciously artistically-motivated architecture, the technological, economic and social forces present in all architecture. These forces exert sometimes direct, sometimes subtle influences. All too frequently these important factors have been ignored in favor of the artistic aspect alone.

It has therefore seemed best for understanding its growth to treat the Rhode Island textile factory under four discrete categories. For each we will attempt to find the principal causes underlying its change during the pre-Civil War period. The categories, which in this instance I

GRAPH 1. VOLUME OF SITE DEVELOPMENT BY DECADE. (Data from 286 sites)



consider to be the major architectural variables, are: *Volume, Structure, Configuration* and *Decorative Style.*[11] For the latter, the topic lends itself to more general examination and discussion will broaden well beyond the borders of Rhode Island.

Since some of the best surviving examples of the early Rhode Island type textile mills are in outlying parts of other New England states, I have chosen to use them where they better illustrate a point than extant Rhode Island buildings. Indeed, many of the statements made for the Rhode Island textile mill's structure and configuration, as well as decorative style, can be applied, with slight modification, to the lower capitalized textile factories in other areas of New England as well.

Volume

Turning to the buildings themselves, let us begin by examining their dimensions and how these change over time. Not surprisingly, plan size tends to increase as the industry develops.

Table 1[12] reveals a general tendency for plan dimensions to become larger. The ratio of width to length also changes. Thus, not only do textile factories become wider and longer, they become progressively narrower, or more attenuated, in proportion as well. In general, height tends to remain relatively uniform throughout the period. Rhode Island mills were usually 3 or 4 stories.[13]

The Rhode Island textile factories of the 1790s were small buildings (Figure 1). For example, the Almy, Brown and Slater Mill of 1793 was only 29 feet wide and 47 feet long, 2 stories high, with a useable attic above.[14] What does this mean in comparison with other sections of the eastern United States, where textile manufacturing was also taking hold?

We have an indication from records kept by an English clothier named Henry Wansey, who travelled the eastern seaboard from Nova Scotia to Philadelphia in the spring and summer of 1794.[15] Among his entries are brief descriptions of at least two textile mills visited, and mention of a third. One factory was located about three miles from New Haven, manufactured wool and cotton yarn, and measured 100 by 38 feet. It was 4 stories

TABLE 1. Volume. (Data from 214 sites)

Decade	Length			Width			Ratio: W/L			Height	
	Range	Mean	Median	Range	Mean	Median	Mean	Median	Range	Mean	Median
1790 - 1800	33-47	39	40	26-30	28	28	1:1.4	1:1.4	2-3	2.75	3
1801 - 1810	38-108	73	80	30-43	36	40	1:2	1:2	2-5	3.55	3
1811 - 1820	36-125	64	56	18-50	33	32	1:1.9	1:1.8	1-5	3.25	3
1821 - 1830	28-165	80	80	15-80	39	40	1:2.1	1:2	1-6	3.80	4
1831 - 1840	40-175	95	82	25-50	37	40	1:2.6	1:2.1	2-6	3.60	3
1841 - 1850	36-300	130	102	20-58	42	44	1:3.1	1:2.4	2-7	4.05	4
1851 - 1860	40-410	158	148	30-72	49	44	1:3.2	1:3.4	2-5	3.60	3

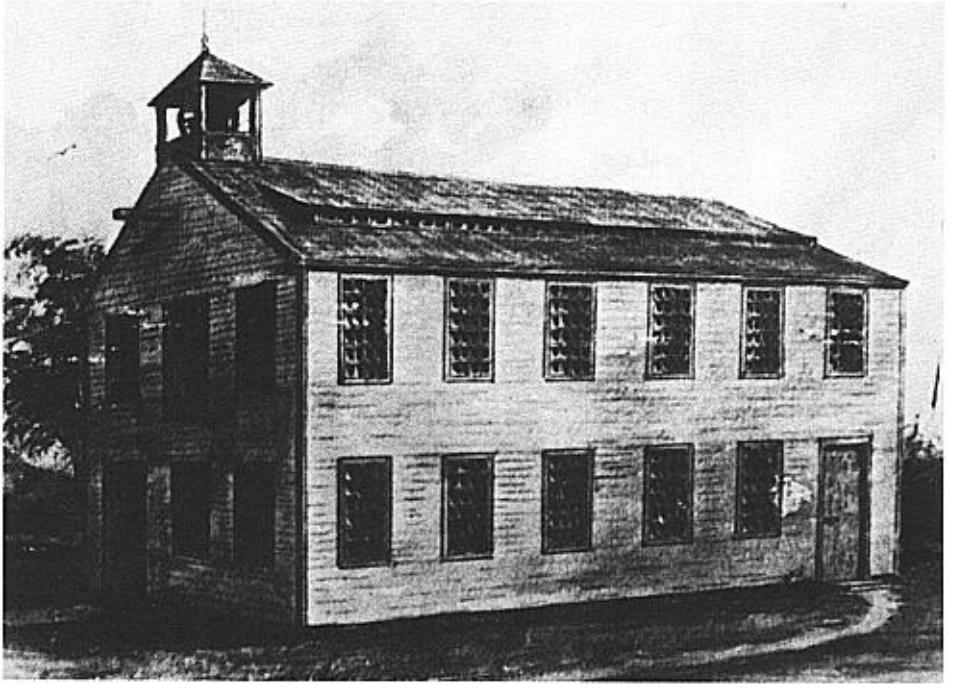


FIG. 1. CONJECTURAL DRAWING OF THE ALMY, BROWN AND SLATER MILL OF 1793, PAWTUCKET, RHODE ISLAND. (Courtesy of the Slater Mill Historic Site, Pawtucket, Rhode Island.)

in height.[16] The second site contained two identical buildings, 80 feet long and 4 stories tall, and was located at "Hell Gates" New York.[17] A third building referred to was a cotton mill at Paterson, New Jersey. From other sources we know it was 90 feet by 40 feet, 4 stories, and built of stone.[18] If Wansey's notes are accurate, and we have no reason to doubt them, the mills he saw far exceeded contemporary Rhode Island textile factories in plan size and height. Buildings of comparable size do not appear in the state until 1803 and later.[19] It is also of interest that the Paterson mill was built of stone. In Rhode Island the earliest use thus far uncovered of load-bearing stone walls for a textile factory dates from 1807.[20]

Were the Rhode Islanders backward compared to their neighbors? Not necessarily. We know, for instance, that Samuel Slater was thoroughly familiar with larger and more advanced structures than the 1793 Almy, Brown and Slater mill from his years in England. Through correspondence he kept abreast of the latest developments at home, such as William Strutt's Belper West Mill, begun in 1793 and the first multi-storied iron-framed incombustible building.[21] Rather, it seems the Rhode Islanders were just proceeding cautiously. This explanation has support from Wansey, who was critical of the textile enterprises he had seen: "The general error of all their large undertakings," he chided, "has been, their lay-

ing out their capital in large buildings and an unnecessary stock of machinery, etc. which brings a heavy mortgage on the concern, before they actually begin."[22]

Is it possible for us to identify what caused dimensional and volumetric changes in the Rhode Island textile factories? Obviously there is a relationship between the economic growth of the textile industry and its buildings. As the industry established itself, production demands increased and this was directly reflected in larger structures.[23]

Factory size is also related to power available. Water was the principal source in the early years. Samuel Slater began experiments with steam at Providence in 1827, but its use in the 1830s was confined to coastal locations where there was easy access to coal supplies. It did not become a practical or economical alternative for the New England region in general until later, when railroads could bring fuel to inland sites.[24] Thus textile mills, especially those built in the outlying rural portions of the state, away from the larger rivers, were limited in size in the early decades by the amount of water power they could obtain.

However, we can be even more specific. One of the most important factors is horizontal line shafting, which transmitted power from the water wheel's vertical main drive shaft to individual machines at each floor. Shafts in American mills were mounted at the ceiling, hung from the underside of beams, and on them were mounted flat-rimmed cast-iron wheels connected by leather belts to individual machines. Initially, these shafts were made of large pieces of heavy timber and they were square in cross-section (so that the wheels mounted on them would lock tightly to the shaft).[25] They were slow, about 50 rpm, and lost a great deal of energy through friction. This meant that the first factories were necessarily kept short because the cumbersome line shafting and pulley system was too inefficient to permit otherwise.[26]

As the industry developed, rules-of-thumb emerged showing that building dimensions were governed by mechanical requirements. Replying to a request from Charles Whitfield, Asa Arnold, a Rhode Island millwright and entrepreneur, wrote on December 23, 1827, the following recommendations for a cotton factory:

> As for the dimensions of a building it should be proportioned according to the kind of machines that are to be placed in it: say for 2000 spindles in mules (for fine work) 80 feet by 36 feet in the clear, 3 stories high with a porch 12 by 14 feet in front for stairways this will be a convenient size & will contain all the spinning on one floor, all the weaving on another & all preparation on the other — but if it is intended to make coarse goods & use throssles the building should be 72 feet by 42' in clear 3 stories with porch &c this width and height will be proper for a factory of any extent only varying in length.[27]

Confirming the practice of building lower textile mills in this country than in Great Britain, a Scottish observer, James Montgomery, wrote in 1840: "None that I am aware of exceed five stories in height, except for two at Dover, New Hampshire, which are six stories on one side and five on the other. The general height of the Mills in this country is three or four stories with an attic."[28]

It is evident that the pre-Civil War Rhode Island textile factories' quantitative changes were the result of technical and economic considerations. What about their structures?

Structure

The shift in textile mill construction can be characterized as a conservative change from the small-scale, wood-frame structure of Almy, Brown and Slater's

TABLE 2. Exterior Wall Construction (Data from 200 sites)

Decade	Wood-Frame	Wood-Frame & Stone	Wood-Frame & Brick	Stone	Brick
1790 - 1800	4				
1801 - 1810	9	4	1	4	
1811 - 1820	9	1		16	1
1821 - 1830	5	4		24	4
1831 - 1840	10	5		23	5
1841 - 1850	4	6		28	5
1851 - 1860	7	1		17	3
Totals:	48	21	1	112	18

1793 mill to slow-burning timber interiors supported usually by masonry walls, as, for example, we find at the Woonsocket company's No. 1 mill of 1827.[29] The transition from the one to the other is not as obvious as its narrow range might lead us to believe. In part this is due to the numerous alterations many factories have endured down to the present.

Although exterior stone bearing walls were preferred in Rhode Island as we see in Table 2, [30] wood-frame structures continued to be built throughout the period.[31] The first stone factories in the state appear in the early 1800s, the earliest thus far identified from written accounts being the long demolished Providence Mfg. Co.'s "Stone Jug" Mill of 1807 at Crompton, West Warwick.[32]

A structural mutation, in the form of wood-frame and stone, occurs from the second decade onward, usually consisting of a high basement, or the two lower stories, of stone, topped by an upper floor and attic of wood-frame construction.[33]

Rhode Islanders used brick, but it was less popular than either stone or wood-frame construction up to the Civil War. One of the best remaining early brick factories is the 1849 White Rock Mill just north of Westerly.[34] Why brick was not more popular in the state at this time is an interesting question. At Lowell and the other major textile cities on the Merrimack it was preferred from the outset.

My own view is that the choice had something to do with differences in business organization between the two regions. Rhode Islanders retained the co-partnership form through most of the pre-Civil War period. A major reason for this was that Rhode Island, in contrast to its neighbors, held a very restrictive incorporation policy until about mid-century. Thus the different legislative climates tended to foster co-partnerships in Rhode Island and corporations elsewhere in New England during this period, particularly in the large textile centers.[35]

I believe this carries with it implications about how business longevity is perceived in each case, and the kinds of architecture compatible with these perceptions. A co-partnership is apt to see itself in terms of the anticipated life-spans of the partners, and to build solidly within these mortal limits, perhaps allowing a slight margin for expansion. A corporation, however, is

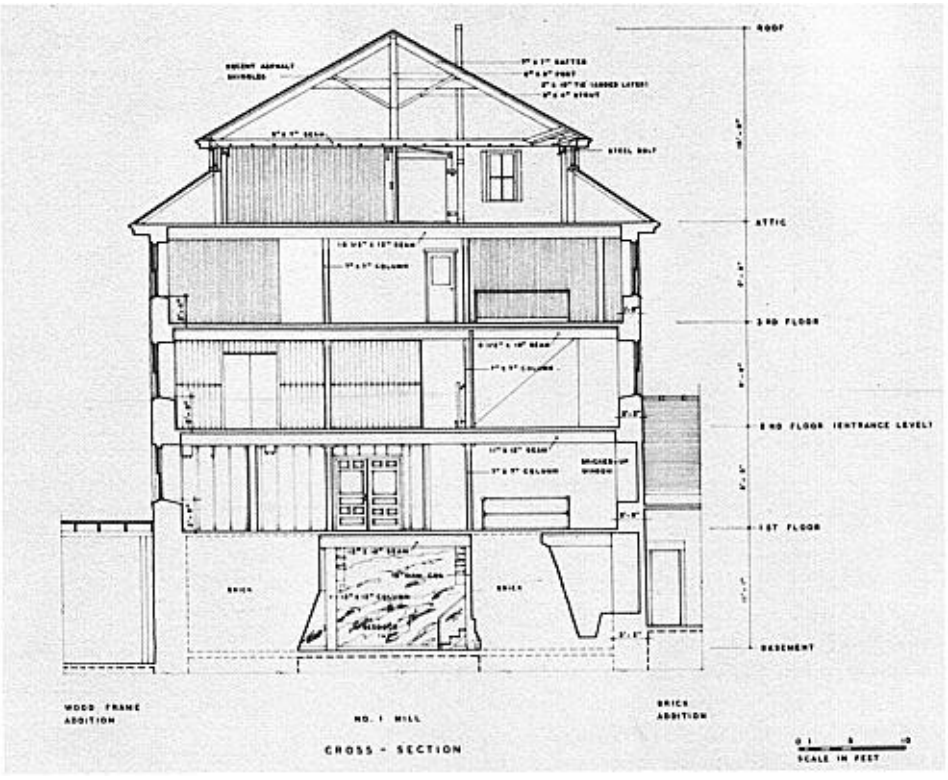


FIG. 2. CROSS-SECTION, WOONSOCKET COMPANY'S NO. 1 1827 MILL, WOONSOCKET, RHODE ISLAND. (Courtesy of the Historic American Buildings Survey, Washington, D.C.)

more likely to see itself extending well beyond the lifetimes of its founders, reaching far into the future. Specific long-range changes are not predictable, but the *concept* of change is implicit and the corporation tends to seek the most flexible type of construction to accommodate it. Stone walls are not easily altered, brick walls are. Bricks are modular, repetitive units, and brick walls may be simply breached in most instances for additions.

The use of masonry throughout New England was confined to the exterior load-bearing walls. There is no evidence of any substantial effort to bring masonry to the interior, as fire-proof structural flooring, as the British had done with brick arches and iron beams in several highly capitalized textile factories as early as the 1790s. The British system was known to the New England manufacturers,[36] but they generally thought it too expensive and, of course there was plenty of good timber available. Even after 1860, this method was generally confined to ceilings over boiler rooms in the mills.[37]

Fire was a very real threat to the early mills. Cotton or wool fibres were thick in the air, and stuck to walls and ceilings. Floors were oily. Machines could easily

TABLE 3. Configuration (Data from 128 sites)

Decade	Major Roof Types					Cupola		Tower		
	Gable w/ T.D. Mon.	Gable w/ Cl.Mon	Gable w/ Dormers	Gable w/ Fl. Skylights	Gable	C.	E.	C.	E.	X.
1790 - 1800	1		1				1			
1801 - 1810	3	4			2	1	2	1	2	
1811 - 1820	6	3	1		5	2	2	1	1	1
1821 - 1830	2	11	1		1	2	2	7	7	1
1831 - 1840	3	12	2	2	7	5	5	9	4	1
1841 - 1850	2	6	1	3	7	2	3	13	5	
1851 - 1860	2	5	3	1	5	1	1	8	2	3
Totals:	19	41	9	6	27	13	16	39	21	6

run hot or throw sparks, and up to the introduction of gaslight in about 1850, artificial lighting came from either exposed candles or oil lamps. Textile mills frequently burned.[38]

The answer which met the requirements of both economy and adequate fire resistance on the interior, throughout the textile industry, was slow-burning timber beams and wood-plank structural floors, usually supported by masonry exterior walls. As the Factory Mutual Fire Insurance Companies were formed and became influential beginning in the 1830s, this type of construction quickly became standardized and was adopted in all parts of New England and elsewhere.[39]

James Montgomery, again, describes the system as he saw it at Lowell in the late 1830s:

> the Mills in this country . . . are generally strong and durable. Instead of joists for supporting the floors, there are large beams about 14 inches by 12, extending across from side to side, having each end fastened to the side wall by a bolt and wall plate: these beams are about five feet apart, and supported in the centre by wooden pillars, with a double floor above. The under floor consists of planks three inches thick; the upper floor of one inch board. Some have the planks dressed on the under side, others have them lathed and plastered: the floor being in all four inches thick, is very strong and stiff.[40]

The earliest instance of slow-burning construction uncovered in Rhode Island to date is the Woonsocket Company's No. 1 Mill of 1827[41] (Figure 2). The system may have been used in the Merrimack Company's first mills at Lowell, Massachusetts, in 1822, but surviving records are not clear.[42] In any event, it does not seem to have been an American innovation. For example, the H. Hicks & Sons New Mill at Eastington, Gloucestershire of 1816 uses what appears to be this method of interior construction.[43]

Configuration

Basically, textile spinning and weaving mills were multi-tiered rectangular volumes. What gave them their distinctive configuration were the few elements that served to modulate this fundamental rectangularity. These were roof, cupola and

tower. Available data are presented in Table 3.[44]

Changes in roof design reveal a continuing preoccupation with efficient plan use of the upper story. Much of the experimentation is a search for means to achieve good natural lighting in the inevitable triangular space created by the gable roof. This was eventually resolved in the 1850s as practical bituminous coatings became available, permitting very shallow, almost flat, weather-tight roofs eliminating the attic entirely.[45] But that advance did not exert an influence on the Rhode Island mills until the very end of the pre-Civil War period and its major impact came later.[46]

The first important solution was the so-called "trap-door" monitor[47] (Figure 3). It had the advantage of admitting light without seriously complicating gable roof construction, being simply built on spacers set upon the rafters. However, it had the disadvantage of being rather limited in the amount of light obtained. The trap-door monitor continues down to 1860, as evident in Table 3. It reached its peak in the 1811-20 period.

The roof type that proved most successful for Rhode Island and the textile industry as a whole was the clerestory monitor[48] (Figure 2). Structurally more complicated than any of the other categories, it nevertheless gave the maximum

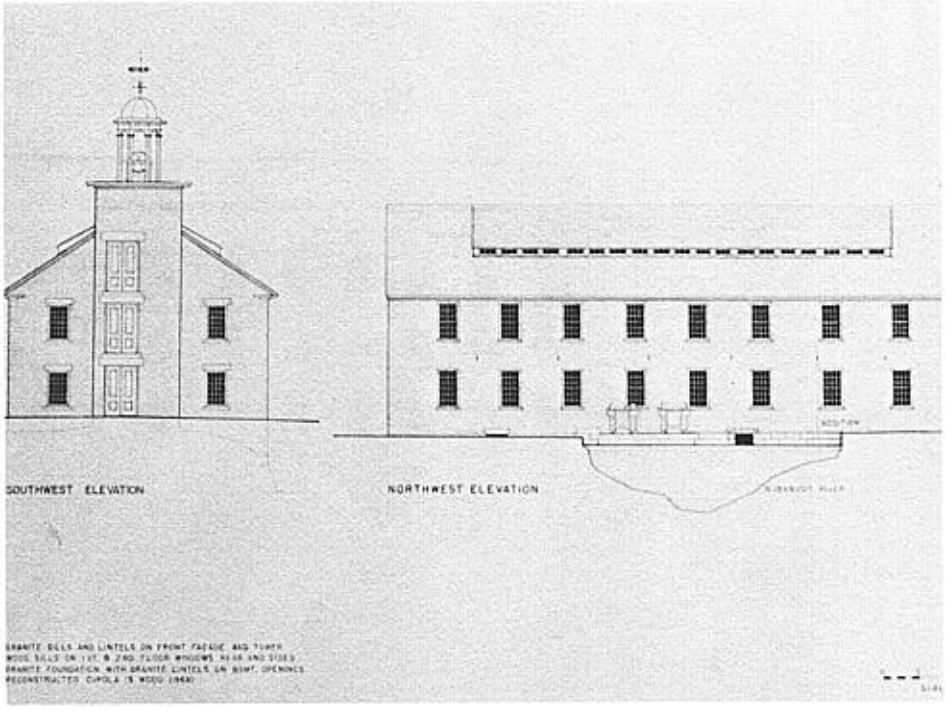


FIG. 3. SOUTHWEST AND NORTHWEST ELEVATIONS OF THE HARRIS MILL, c.1832, HARRISVILLE, NEW HAMPSHIRE. (Courtesy of the Historic American Buildings Survey, Washington, D.C.)

amount of light possible and provided the most practical alternative for machinery layout in the attic, allowing spinning mules or jacks to be conveniently tucked under the window sills. What made it difficult to construct was the linear continuity required to accommodate the long strip of windows on each side. This created a break in what would have been an otherwise uniform plane of roof rafters. 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.

The second and third configurational elements — 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.[49]

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 unencumbered interior floor space, allowing utmost freedom for arranging machinery and production flow.

The earliest extant Rhode Island textile factory with a clerestory monitor roof is also the earliest surviving instance where the stairs were placed in an abutting tower. It is the Lippitt Mill at West Warwick of 1810 (Figure 4).[50]

Decorative Style

Comments on decorative style in industrial architecture are rather sparse but there have been several of interest. In 1939, Henry Russell Hitchcock wrote: "The earliest stone mills of the first quarter of the [19th] 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... Down through the sixties the type did not change very much . . ."[51] He also observed: "Most of the mills of the Romantic period [meaning from about 1820 on] have some stylistic touches, Greek, or Romanesque, or Italianate."[52] Vincent Scully finds in them a surface tension which he believes is part of their general character: "So in that sense, [intellectual rigor and visual order] the gray-granite or red-brick factories of New England's nineteenth century belong to the same righteous, hard-working family as the colonial house; they are taller and high-shouldered, but no less taut, with windows tight on the surface and a tense balance between masonry piers and glass panes."[53] For Alan Gowans the American factory of this period possesses a quality he calls "Vestigal Classicism," embodying "vaguely classical proportions and simplified classical forms."[54]

Each provides useful insight. As Hitchcock observes, the factories' fundamental stylistic character does not change radically in the pre-1860s.[55] The tightly stretched facade perceived by Scully is present in many of these buildings[56] as is the suggestion of classical proportions Gowans recognizes.[57]

Following these guidelines, then, the

FIG. 4. LIPPITT MILL, 1810, WEST WARWICK, RHODE ISLAND. Photo by Theodore Anton Sande.

predominant style of the Rhode Island textile factory before the Civil War may be defined as utilitarian Adamesque-Federal. That is, it is basically a simplified interpretation of late Colonial and Early Republican architecture. It is this that I have chosen to call Republican in Table 4.[58]

But I disagree with both Hitchcock and Scully where they imply that the source resides in 18th-century domestic architecture. A close look at these buildings surely reveals other, and more startling, connections. The 19th-century textile factory's essential stylistic conservatism derives not from the 18th-century American house, nor from pre-industrial utilitarian structures of residential scale, such as grist and fulling mills. Instead, I submit, it comes from institutional and, especially, ecclesiastical buildings of the Colonial and Early Republican periods. From the beginning we find evidence of this equation in the way in which the configurational elements are treated.

There seems an almost conscious attempt to give the early textile factory a splendid civic presence, as we can see in comparing Murdock's 1844 woolen mill at Proctorsville, Vermont (Figure 5) and its counterpart, William Price's old North Church in Boston of 1723 (Figure 6). Their plain red-brick facades are drawn forward and rise dramatically upward in towers richly capped with white. Or we can compare the c.1843 Rodman Mill at Rocky Brook (whose tower originally terminated in a splendid belfry) (Figure 7), and John Holden Greene's 1810 St. John's Cathedral in Providence (Figure 8). The relationship of these buildings does not depend upon the tower placement at the gable end. Equally impressive is the c.1825 Crown Mill [See cover.] at North Uxbridge, Massachusetts, near the Rhode Island border, which is typical of many of the Rhode Island mills of the time as well. A profound kinship exists between the older ecclesiastical buildings and the newer factories. We have in their juxtaposition a kind of mutation not recognized in the factory building before, but one that has been studied extensively in other areas by Elting Morison.[59] The American textile factory in its formative period represents, I believe, an architectural accommodation to technological change in its transference of stylistic motifs. This totally new building type possesses a tension within it that goes far

TABLE 4. Decorative Style (Data from 87 sites)

Decade	Republican	Greek Revival	Italianate
1790 - 1800	2		
1801 - 1810	5		
1811 - 1820	12		
1821 - 1830	12	4	
1831 - 1840	10	10	
1841 - 1850	5	12	3
1851 - 1860	5	4	3
Totals:	51	30	6

deeper than Scullian surface linearity. It is a tenseness resulting from the fundamental contradiction between the factory's stylistically retardataire exterior, clinging for reassurance to the past; at the same time the new technology contained within is reaching out to future promise. One seems to find here in part a physical manifestation of R.H. Tawney's observations on the Puritan movement and capitalism: "Among the numerous forces which had gone to form it, some not inconsiderable part may reasonably be ascribed to the emphasis on the life of business enterprise as the appropriate field for Christian endeavor, and on the qualities needed for success in it, which was characteristic of Puritanism. *These qualities, and the admiration of them, remained, when the religious preference, and the restraints which it imposed, had weakened or disappeared.*" [60] (Emphasis added.)

These essential qualities remained and were woven into the fabric of American industrialism. As John A. Kouwenhoven tells us, the first 100 years saw the United States firmly established as a technological civilization, which he defines as: "a civilization founded on power-driven machinery which indefinitely multiplies the capacity for producing goods, and [is] upheld and served by science in all its branches. At most this civilization is two hundred years old, and there has never before been any order comparable to it."[61]

FIG. 5. MURDOCK'S WOOLEN MILL, 1844, PROCTORSVILLE, VERMONT. Photo by Theodore Anton Sande.

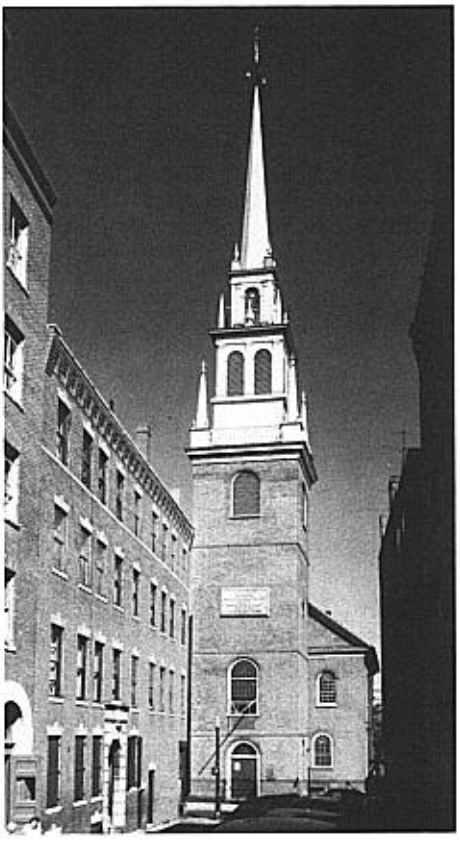


FIG. 6. OLD NORTH CHURCH, 1723, BOSTON, MASSACHUSETTS. WILLIAM PRICE, ARCHITECT. (Courtesy of Sandak, Inc.)

FIG. 7. RODMAN MILL, c.1843, ROCKY BROOK, RHODE ISLAND. (Courtesy of the Smithsonian Institution.)

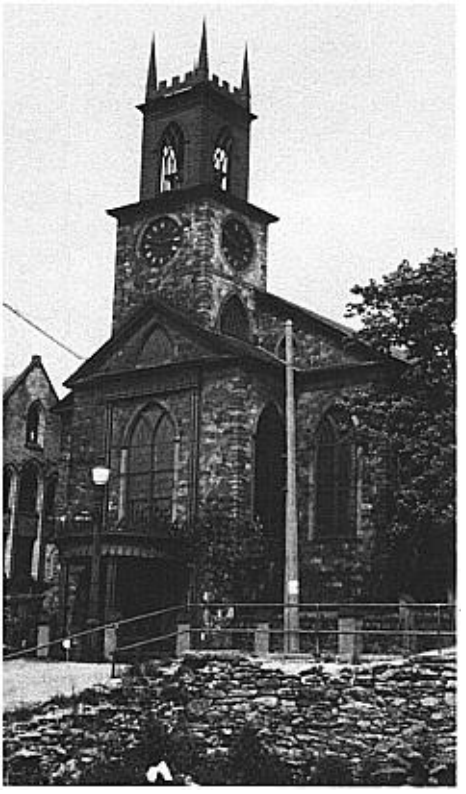


FIG. 8. ST. JOHN'S CATHEDRAL, 1810, PROVIDENCE, RHODE ISLAND. JOHN HOLDEN GREENE, ARCHITECT. (Courtesy of the Art Department, Williams College.)

Over and over again we find this confirmed in the comments of foreign visitors in the first half of the 19th century. Dickens,[62] Chevalier,[63] and especially, Alexis de Tocqueville[64] recognized how deeply and quickly industrial roots dug into the American soil, and how harmoniously industry blended into American society before 1840. In its most profound sense, industry's potential was perceived by Ralph Waldo Emerson, who pled for the recognition of its vitality as a source of artistic inspiration: "It is vain that we look for genius to reiterate its miracles in the old arts;" he wrote, "It is its instinct to find *beauty* and *holiness* in new and necessary facts, in the field and roadside, in the *shop* and *mill*."[65] (Emphasis added.)

The mill, then, takes on symbolic meaning, becoming more than just a place where people work and things are made. The owners' and the workers' personal commitments demanded much more than that. A tacit transfer of allegiance from the old faith to the new was required.

For example, returning to the quotation with which we began, we can now see in it

more than Zachariah Allen's weariness from an eight-month building campaign. Allen looks back wistfully to the happier time when nothing competed with his childhood celebration of Christmas. Yet, at the same moment, he is irresistably drawn forward into a new technological creed whose obligations he cannot ignore on the coming holiday: "I shall be compelled to go out to my mill tomorrow." Allen, who would later become an important contributor to mechanization in the American textile industry, here seems to want to retain something from his past faith, while simultaneously recognizing his commitment to a new order. If, as Tawney points out, the old faith contained values contributive to capitalism, it could not fully prepare one for the shock of transition to the next step, industrialism. So that in the Morisonian sense, Allen appears to be struggling toward an accommodation not unlike that which seems present in the factory's decorative style.

The harsh meaning of this industrialism was perhaps best identified by Andre Malraux:

> The factory, which is still only a kind of church of the catacombs, must become what the cathedral was, and men must see in it, instead of gods, human power struggling against the Earth...[66]

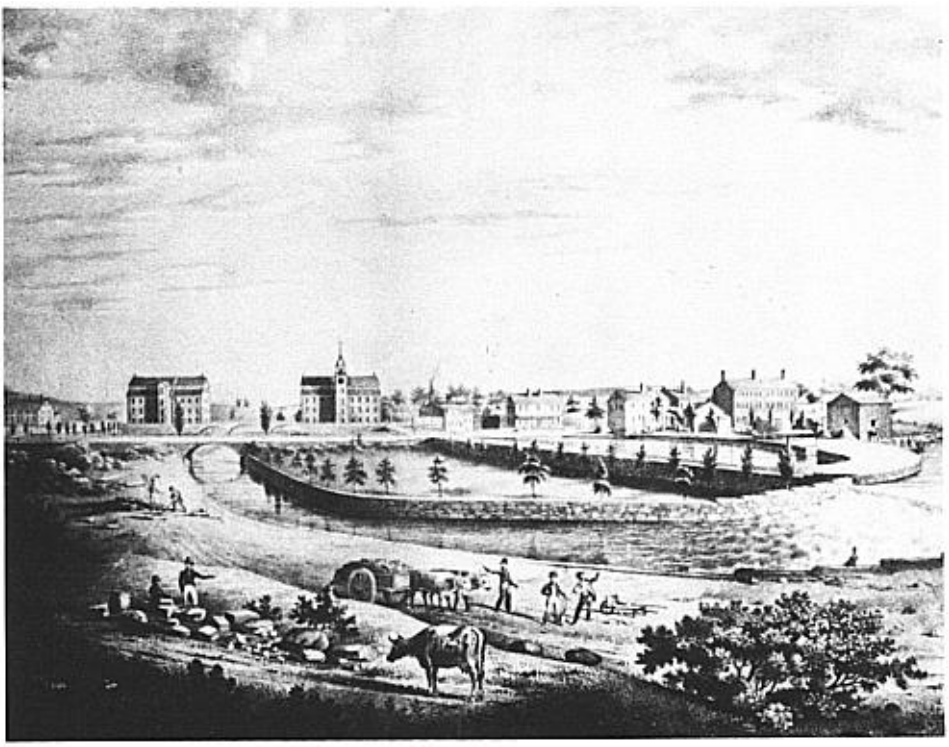


FIG. 9. CROWN AND EAGLE MILLS, UXBRIDGE, MASSACHUSETTS. c.1840 VIEW. (Courtesy of the Historic American Buildings Survey, Washington, D.C.)

What I am suggesting, then, is that something close to what Malraux advocated had already appeared in the United States 150 years ago. The industrial cathedral was built in 19th-century New England. The ecclesiastical analogy is present both in the stylistic transference observed and the factory's visual dominance over the 19th-century town as the church had provided the focal point for the 18th-century village (Figure 9). The factory displaced the church, becoming the place where the American worker celebrated his unique sectarianism, freely choosing to sacrifice himself to mechanized processes in an effort to gain financial independence and improved social status.

Conclusion

The Rhode Island textile factory of the pre-Civil War period offers an ideal case study of the many strands of influence, technical, economic, and cultural, that in various ways — some impelling, some restraining — contribute to the shaping of all architecture.

For example, we saw that volume was directly affected by mechanical and production requirements and power available. Structure was determined by considerations of economy and reducing the risk of fire. Configurational elements resulted from the search for maximum use of interior space for manufacturing purposes. Decorative style seems not merely a reduction of embellishment to simplest terms, but a conservative accommodation to technological change. This accommodation appears to equate the 19th-century textile factory with the 18th-century church, causing the former to reach beyond utilitarian purpose and geographic limitations to become a significant and complex architectural statement of our transformation to a technological civilization.

Notes

[1] Zachariah Allen, "Diary, 1821-1825," Providence, Rhode Island, Rhode Island Historical Society Manuscript Collection, K-A432$_Z$, December 24th, 1822.

[2] *Ibid.*

[3] *Ibid.*, July 2nd, 1821; May 10, 1822.

[4] Jennifer Tann, *The Development of the Factory*, London, 1970, p. 7.

[5] *Ibid.* Also see *Country Life* 28 Nov., 1974, p. 1675.

[6] *Ibid.*, p. 7-9.

[7] Andrew Ure, *The Philosophy of Manufactures*, 1835, p. 13.

[8] Caroline F. Ware, *The Early New England Cotton Manufacture*, Boston, 1931, Chapters I and II. For a recent assessment of Samuel Slater's role, see: Paul E. Rivard, *Samuel Slater*, Pawtucket, 1974.

[9] William H. Pierson, Jr., "Industrial Architecture in the Berkshires" (unpublished Ph.D. Dissertation, Yale University), New Haven, 1949, pp. 49-50. Also see George S. White, *Memoir of Samuel Slater*, Philadelphia, 1836, *passim.*

[10] Theodore Anton Sande, *The Architecture of the Rhode Island Textile Industry, 1790-1860*, (Ph.D. Dissertation, University of Pennsylvania), Ann Arbor, Michigan, 1972, p. 174. Site development as presented in Graph 1, is not synonymous with either building construction or the total number of active textile firms at a particular date. Individual sites frequently changed ownership, lost buildings due to fire and other causes or had new structures added, during their industrial careers. In some instances textile manufacture was later discontinued entirely, the site being either abandoned or converted to other use.

A geographic approach to New England industry is R. G. LeBlanc, *Location of Manufacturing in New England in the 19th-Century* (Hanover, 1969).

For a general discussion of economic conditions at the time, see D. C. North, *The Economic Growth of the United States, 1790-1860* (New York, 1966). For the textile industry and economic and geographic factors see J. H. Burgy, *The New England Cotton Textile Industry*, (Baltimore, 1932); P. J. Coleman, *The Transformation of Rhode Island, 1790-1860*, (Providence, 1969); and K. B. Mayer, *Economic Development and Population Growth in Rhode Island* (Providence, 1953).

[11] Not discussed in detail are: power mechanisms (*i.e.*: water wheels and turbines or steam engines), heating, lighting, sanitation or mechanical fire prevention systems. In concentrating on the spinning and weaving mills, ancillary structures, such as picker houses, bleacheries, boiler houses and office buildings have been ignored. In each instance, the factor or structure in question failed to exert a significant influence upon the *purely architectural* character of the factory building itself, in my opinion. However, the reader is cautioned that all are important for a full understanding of the textile industry during its formative period.

[12] Sande, *op. cit.*, p. 176. Under Ratio: W/L, the columns headed Mean and Median refer to the category of figures used. Range gives the least and greatest dimensions or number of stories observed within a decade. Reading vertically, one can make comparisons between decades within columns.

[13] The ranges for all categories are significant, suggesting the extent of experimentation in planning, and reflecting the effect of local site conditions upon recommended standards in mill design. The latter was clearly recognized by George S. White, (*op. cit.*), who cautioned: "The situation of the ground, or space upon which the mill is to be erected, must always be taken into consideration in laying down the plan or fixing upon the particular form in which the house is to be built; and in some cases this plan must just be made to suit the situation or place in which it must stand." (pp. 305-306).

[14] Rivard, *op. cit.*, p. 26.

[15] D. J. Jeremy, *Henry Wansey and His American Journal, 1794*, Philadelphia, 1970. Regrettably, Wansey bypassed Rhode Island.

[16] *Ibid.*, p. 73.

[17] *Ibid.*, pp. 82-83.

[18] *Ibid.*, p. 78, (footnote 81).

[19] Sande, *op. cit.*, p. 40: Yellow Mill, Pawtucket, 1803; p. 137: Table 3 (Architectural Variables: 1801-1810).

[20] *Ibid.*, p. 55: Providence Manufacturing Co. Mill, Crompton, West Warwick, 1807; and p. 137, Table 3.

[21] See George S. White, *op. cit.*, for Slater's early years in England. Tann, *op. cit.*, p. 135.

[22] Jeremy, *op. cit.*, p. 84.

[23] See Coleman, *op. cit.*, Chapters Three and Four for an excellent discussion of the R.I. textile industry's economic growth.

[24] White, *op. cit.*, p. 302. Coleman, *op. cit.*, pp. 108-110. Ware, *op. cit.*, p. 82.

[25] Zachariah Allen, "The Transmission of Power from the Motor to the Machine," *New England Cotton Manufacturers' Association Proceedings*, No. 10 (April 19, 1871), Boston, 1871, pp. 15-16.

[26] *Ibid.*, pp. 17-18. This issue of the *New England Cotton Manufacturers' Association Proceedings* and No. 11 (Oct., 1871), contain a series of articles on power transmission. Zachariah Allen made an important set of improvements beginning in the late 1830s. His refined iron shaft and pulley system proved considerably lighter and faster, about 200 rpm initially, was much more efficient and allowed the same water wheel to distribute power over considerably greater distances.

[27] Asa Arnold, "Correspondence, 1820-1855," Providence, Rhode Island, Rhode Island Historical Society Manuscript Collection, K-AR64, Letter to C. Whitfield, 23 Dec., 1827. (Replying to Whitfield's letter of Dec. 2, 1827.)

[28] J. Montgomery, *A Practical Detail of the Cotton Manufacture of the United States of America . . .* (Glasgow, 1840), p. 15. This was severely criticized the following year in an anonymous work titled: *Justitia, Strictures on Montgomery . . .* (Newburyport, 1841). Montgomery's major fault seems to have been a tendency to generalize on the American textile industry from his limited experiences at Lowell and several other sites. In this case he seems to have been close to the mark. Operations within a textile mill varied from one location to another, but in general, after 1813, when all spinning and weaving processes were combined under one roof for the first time anywhere by the Boston Manufacturing Company at Waltham, Massachusetts, (See Ware, *op. cit.*, pp. 60ff.), one finds preparation on the lower floors, weaving on the main floor and spinning on the upper floors. In the early years a machine shop may also be found on the lowest floor, since there were few independent textile machinery manufacturers in the initial decades.

[29] For discussion of the development of factory structural systems in Great Britain and the United States for this period see W. H. Pierson, Jr., *op. cit.* In particular, Chapters II, III and VII. Also by the same author, and more accessible, is his article "Notes on the Early Industrial Architecture in England," *Journal of the Society of Architectural Historians*, No. 8, 1949. A must for any serious student of this subject is W. Fairbairn, *Mills and Mill Work*, (London, 1863). An article of special interest is T. C. Bannister, "The First Iron-Framed Buildings," *The Architectural Review*, April, 1950, which deals with important technological developments in the British mill structures beginning in the 1790s. More recently, Tann, *op. cit.*, Chapter 9.

[30] Sande, *op. cit.*, p. 190.

[31] *Ibid.*, pp. 62 and 159. For example, the still extant 1858 Hopkins Mill at Nooseneck, West Greenwich.

[32] See Footnote 20. The term *stone* is rather all encompassing. Actually several types of stone wall were used. One that mainly occurs in the Woonasquatucket River area is rubble stone covered with white-washed mortar on the exterior and plaster on the interior. This method required less care in building and used cheaper stone than ashlar (that is finished quarry stone) masonry. Moreover, it provided a durable, easily maintained weather surface that, white-washed periodically, retained an attractive finish. More common was exposed rubble stone, occasionally with random ashlar trim. Rough-textured, quarry-faced ashlar in regular coursing is also found in a number of mills. Fieldstone was used for rubble walls, granite for the more carefully tailored ashlar.

[33] A handsome example is the Rockville Manufacturing Company's 1844 Upper Mill. This seems to have been a practical solution to the problem of constructing gable ends for the complicated clerestory monitor roofs. By building the upper floors in wood-frame rather than masonry, a considerable amount of difficult stone cutting was eliminated where masonry would have otherwise met the roof's irregular gable end.

[34] The White Rock Company built a textile mill in the same style a year earlier, in 1848, at Stillmanville, Connecticut on the west bank of the Pawcatuck River, closer to Westerly. It is still standing. Sande, *op. cit.*, pp. 87 and 155. The choice does not seem to depend upon regional availability of materials. Stone was plentiful throughout New England and the Rhode Islanders could make bricks just as well as others in the northeast. After the Civil War, brick textile factories predominate in much of New England, including Rhode Island, and are correlative with the popular Lombard Romanesque style. (Pierson *Industrial Architecture*, pp. 224-227.)

[35] Coleman, *op. cit.*, pp. 110-119.

[36] Zachariah Allen, "Journal of European Trip, 1825," Providence, Rhode Island, Rhode Island Historical Society Manuscript Collection, K-A432$_Z$, April 22nd, 1825.

[37] Proprietors of Locks and Canals Collection of Working Drawings, Lowell, Massachusetts, Lowell Technological Institute, Shelf 106, #636 (c.1853 detail of built-up iron beams and masonry arch floor systems); Shelf 112, #2401 (Sketch of Proposed Fire Proof Floor over the Boilers at the Boott Cotton Mills, Dec. 7, 1882).

[38] Sande, *op. cit.*, pp. 1-89, "Catalog of Known Textile Mill Sites, 1790-1860," records numerous mill burnings. Pierson "Industrial Architecture," pp. 177-180.

[39] *The Factory Mutuals, 1835-1935*, Providence: Manufacturers' Mutual Fire Insurance Company, 1935, *passim.*

[40] Montgomery, *op. cit.*, pp. 22-23.

[41] T. Sande, *The New England Textile Mill Survey*, Washington, D.C., 1971, pp. 160-167.

[42] Proprietors of Locks and Canals Collection of Working Drawings, Lowell, Mass., Lowell Technological Institute, Shelf 106, #581 and #582 (both titled: "Drawing of one of the Merrimack Mills, Lowell, made by P. T. Jackson at the time of their erection, about 1822"). These strongly suggest slow-burning construction, but attempts to confirm it in PL&C written accounts at the Baker Library, Harvard, have to date been inconclusive.

[43] Tann, *op. cit.*, p. 30.

[44] Sande, *Architecture*, p. 212. Abbreviations in Table: T.D. Mon.=Trap door monitor; Cl. Mon.=Clerestory monitor; Fl.=Flat; C.=center of roof; E.=gable end of roof; X.=eccentric (corner).

[45] Charles E. Peterson, "Preliminary Notes on California Brea Roofs," Philadelphia, 1965. (Typescript, courtesy of the author.)

[46] After the Civil War, New England textile mills predominantly had shallow pitched roofs. Frequently older factories were modified by removing the original roof, building up the exterior walls to make a full top floor and then

covering this with a virtually flat roof. For instance, see Sande, *New England*, pp. 47-55, Union Mills, Fall River, Mass.

[47] The name comes from its appearance, which looks like a hinged section of the main roof, raised so that a row of windows could be inserted at its lower edge.

[48] Here also the name is derived from external appearance, but is misleading, since the continuous strips of window do not admit light to a lower level within the building as they would, for example, in a medieval church.

[49] The bell called workers to the mill in the morning, signalled the noon hour, and rang the end of the working day in the evening.

[50] Sande, *New England*, pp. 147-152. This building bears a close resemblance to Arkwright's 1777 Lower Mill at Cromford, Derbyshire. Whether the relation is more than coincidental is uncertain. As far as I know, no records have yet come to light that would confirm a link between the two. However, we do have what seems to be a precedent in the apparent clerestory monitor roof of Arkwright's factory.

Although the Lippitt Mill is the earliest surviving example of both the separate stair tower and clerestory monitor roof, it is not the earliest known instance of the former and may not be of the latter. Papers on another Rhode Island factory on which I am currently doing research confirm the use of stair and toilet towers at a considerably earlier date and other evidence strongly suggests the use of the clerestory monitor in this earlier building as well.

[51] Henry-Russell Hitchcock, *Rhode Island Architecture*, Providence, 1939, p. 42.

[52] *Ibid.*

[53] Vincent Scully, *American Architecture and Urbanism*, New York, 1969, p. 56.

[54] Alan Gowans, *Images of American Living*, Philadelphia, 1964, p. 218.

[55] 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 . . ." (*The Functional Tradition in Early Industrial Buildings*, London, 1958, p. 19.)

[56] Scully has identified surface tension as one of the principal characteristics of early American architecture. Take, for example: "the most characteristically American buildings of the colonial period, however closely imitative of European prototypes they may have been intended to be, were usually thin screens around interior spaces, light and impermanent . . ." (*Modern Architecture*, N.Y., 1961, p. 17). Also see his: "The Precisionist Strain in American Architecture," *Art in America*, No. 3, 1960, pp. 46-53.

[57] The classicism Gowans refers to is that derived from English 18th century sources as translated in Colonial Renaissance and Baroque provincial architecture and not the Greek Revival style popular in the first half of the 19th century. A rare exception, a pure Greek Revival textile mill is the Woonsocket Co.'s No. 2 Mill of 1833. (See Sande, *New England*, pp. 168-174.)

[58] Sande, *Architecture*, p. 220.

[59] Elting E. Morison, *Men, Machines and Modern Times*, Cambridge, Mass., 1966.

[60] R. H. Tawney, *Religion and the Rise of Capitalism*, New York, 1926, p. 273.

[61] John A. Kouwenhaven, *The Arts in Modern American Civilization*, New York, 1948, p. 4. And he is echoed by Siegfried Giedion in *Mechanization Takes Command*, N.Y., 1948, v.: "The process leading up to the present role of mechanization can nowhere be observed better than in the United States, where the new methods of production were first applied, and where mechanization is inextricably woven into the pattern of thought and customs."

[62] Charles Dickens, *American Notes*, 1842.

[63] M. Chevalier, *Society, manners and politics in the U.S.; being a series of letters on North America*, 1839.

[64] Alexis de Tocqueville, *Democracy in America*, 1835, 1840. Indeed, de Tocqueville could say with full assurance that: "no people in the world have made such rapid progress in trade and manufactures as the Americans" and the reason for this: "In the United States the greatest undertakings and speculations are executed without difficulty, because the whole population are engaged in productive industry, and because the poorest as well as the most opulent members of the commonwealth are ready to combine their efforts for these purposes." Richard D. Heffner, (ed.), *Democracy in America*, N.Y., 1956, pp. 215-216.

[65] R. W. Emerson, *Essays*, "Art" (1841) *First Series*, N.Y., n.d., p. 363.

[66] André Malraux, *Man's Fate*, 1934, (Vintage edition, 1961), pp. 330-331.