THE ADAPTIVE RE-USE OF RESIDUAL BUILT FORM

by

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(1965)

Submitted in partial fulfillment
of the requirements for the
Degree of Master of
Architecture
at the
Massachusetts Institute of
Technology
June, 1972

Signature of Author

Department of Architecture, May 12, 1972

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on Graduate Students

JUL 7 1972
The following document is a pastiche of elements which result in a partial handbook for the conversion and recycling of residual built environment, the New England textile mill. The issues raised are frequently tangential to the direct process of architectural conversion. The thesis package, an arbitrary cross-section in time of ongoing work, is a loosely parallel and tangential network of thoughts on the issues of residual built form, recycling and specific attributes and availability of the mill prototype. Tangentially conceived, but ordered as follows:

1. Introduction: An historical, economic overview.
2. Positive attitudes toward built and natural landscape.
3. Existing attitudes toward found built form.
4. The building industry versus energy conservation.
6. The mill as a planning obstacle.
8. Mechanical systems: The evolution and a projective scenario.
9. Conversion details and design interventions.
10. Housing conversion study.

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The process of rapid industrialization and cyclical decay have left the New England industrial city with many residual sectors. Our first organized reaction to this condition was urban renewal. Its wholesale demolition of residual sectors in order to make them appealing sites for speculative development is now being reassessed negatively by planners.¹

The creation of these residual areas occurred as the center of gravity of American industry shifted from New England to the midwest and major industries moved from the city. The departure of the textile industry has left the once burgeoning cities of Lawrence, Lowell, Manchester, New Bedford, Fall River, Saaco and others in economic depression.

Modern industry in New England has evolved operational technologies and space requirements which make reuse of the textile mills in their present form impossible. They are no longer reliant upon the center-city, river-edge location for mechanical or hydro-electric power, or the movement of goods; nor is the vertical organization of the textile mill applicable to many of the heavy manufacturing industries. The mills find only occasional uses as storage structures since warehousing is no longer supported by industry where capitalization is marginal and rapid turnover is a critical aspect of the economy.

On the other hand, space needs are constantly being expressed in the forms of higher rents, air rights petitions, housing shortages, and school overflow. New building costs
have hindered the satisfaction of space needs, while large complexes of nineteenth century buildings stand empty. The disparity between these needs and the ability of existing facilities to satisfy them is an apparent issue when approaching the residual textile mill.
Positive Attitudes Toward Built and Natural Landscape

Speculation shows that primitive man, an early recycler of his residual environment, found positive utility in abandoned eaves, beneath fallen trees and eventually through the assemblage of dead vegetation or animal furs to complete the already partial enclosure of a gulley or hillside. His slim chances for survival were improved by the first shelter-making activities which made positive use of natural landscape. It is academic whether the survival attitude of positive landscape utilization were instinctual or taught. By natural selection, those who saved energy building shelter had more left for hunting, defense and procreation and therefore survival.

Today a didactic analogy might be made at a point in time when many scientists predict energy/resource depletion within our lifetime. (Forrester, World Dynamics; Meadows, The Limits of Growth; Fuller, Utopia or Oblivion; and McHale, the Future of the Future) Survival certainly is not dependent upon the recycling of building materials however basic attitudes, within which recycling falls, are these, I call for lack of a better phrase; a positive landscape attitude.

It would be simplistic, howbeit irresistible, to claim a direct lesson from this analogy between primitive man's conservation of building energies. However, modern expenditure of building energy can be averted by adopting just such attitudes towards what is there and its use. Maximum utility, the conservation of energy and the maximization
of built definition, seems directly applicable to a world faced with resource and energy depletion.

The direct application of an attitude/mandate derived from pre-tribal society does not imply that the mandate should have applied to the interim periods of tribalization, specialization, the development of building technology, industrialization, and finally retribalization. This McLuhanian argument acknowledges that successive levels of awareness allow for economies of scale to supercede the former at each stage without being inconsistent with an attitude which found utility in the residue of the previous stage. In other words, this argument is not intended to be recidivist by saying, "use what exists" to the exclusion of invention and new technology. This certainly did not occur in history. When the trabeated stone structures of the Greeks were improved on by the development of the arch by the Romans, the earlier definition was often lustily sacked and redeployed as foundations for new definition, or the stone was recut into the new forms. The economies of scale achieved by each successive technological leap never entirely destroyed the utility of the residual form; they do however force the issues of how these forms and materials are used thereafter.

At worst, the residual buildings of the earlier technology can be viewed as a munificent mine of building materials already rendered with great love into associative or utilitarian forms and certainly a long way from the
quarry or the clay pit.

As the ruling class has always determined civic form (the genre with which the architectural historian concerns himself), and they have traditionally been concerned with "higher" values than survival and shelter, there has been little evidence of this pragmatic recycling of existing definition in the "great works" or architecture. However concurrent vernacular practice has inevitably operated with an exploitive attitude toward existing built definition. So while the moguls, the Medici, and the monarchs would disdain the worn out suit or the once used marble or brick the indigene quickly saw its utility and gave it his love thereby acknowledging, if not understanding, the love already inherent in the component.

In the United States today, building wrecking is big business while material salvage is marginal. The wrecker often salvages the copper, lead and iron from the residual structure and then turns the remaining materials into landfill. Bidding on demolition rarely calculates the salvage commodity into the cost to the client. Since no market can be predicted for building materials other than scrap metal, immediate recycling of the brick and timber cannot be predicted so used materials profits are defrayed by handling and storage costs, usually to the point that anything but the heaviest timber is machine handled (ball and pinchers) and used for landfill. The attitude of the wrecker is to get out of the building with the least capital
outlay in labor and his contract is calculated to make a profit on the demolition alone. Energy put into salvage must be seen to be quickly returned by turnover as can be predicted in the scrap metal business. Only in rare cases are assembled elements salvaged such as windows, doors and fixtures.

Perhaps this is because the American has become so affixed to consumer values which like those of the moguls and the Medici, give high rating to the new, the fast, and the shiny. Only among odd antiquarians, who could afford to do otherwise, and a growing counter-culture, does any valuation for an object once used and once loved exist. On the one hand romantic associative values dictate this attitude and on the other a "rip off" attitude toward industrial society. Probably in neither case is maximum utility being achieved. For the rest of American society plugged into the mass industrial/consumer mill an attitude which devalues used material seems characteristically cavalier towards forms which soon may constitute the earth's largest mineral deposits.

Design theory has had much to say about the utility of the placement of built form relative to natural form for the greatest utility from the relationship. As has the organization of new forms to old forms been well discussed in ancient and modern times. Recently the school of thinking developed around Wright's organic architecture went to great length to show the utility of
using natural materials. This thinking seems so obvious when expressed in rural settings like those of which Wright, Soleri, and the stick builders of New England, are so fond. Here the elite find a rare continuity with the materials of their cosmos, the sort which vernacular builders have always felt through a positive attitude toward their environment and direct intervention whether it be urban or rural.

But here design theory stops. No one advocates indigenous materials in the urban landscape, and yet in other, poorer, more pragmatic cultures this practice is taken for granted. There is no design theory which makes of the party wall and contiguous form a positive thing. It has always been viewed as a regrettable result of crowding in the American city. And certainly no design theory ever advocated the reuse of nearby residual materials or the incorporation of existing form as anything but a necessary evil. The rural designer searches for a hill with which he associates his forms for greater drama or repose. And yet the urban designer demands a level site. A residual building is never seen as positive landscape as a hill is, and yet it is a hill, a cave, a forest and at very least a mine of indigenous materials.
"You exist, and you exist not. You are, and you are not. True, you are made out of diverse materials, but for your discovery an inventive mind was needed. This if a man pulled his house to pieces with the design of understanding it, all he would have before him would be heaps of bricks and stones and tiles. He would not be able to discover therein the silence, the shadows and the privacy they bestowed; nor would he see what service this mass of bricks and stones and tiles could render him, nor that they lacked the heart and soul... For in mere stone the heart and soul of man have no place..."

ANTOINE DE SAINT-EXUPÉRY
"NEVERMOON OF THE SNOW"

"As the general rate of change in society accelerates, however, the economics of permanence are and must be replaced by the economics of transience... Advancing technology tends to lower the costs of manufacture much more deeply than the costs of labor in other ways. One is automated, the other remains largely a handcrafted operation. This means that it often becomes cheaper to replace than to repair... Abandonment to fixed forms and function, we build for short-term use or, alternatively, attempt to have the product itself adaptable. We "play it cool," technologically..."

ALVIN TOFFLER
"FUTURE SHOCK"
Attitudes Toward Built Landscape

The formal implications of a man-made landscape, much of it now evolved through its usefulness, are many. Representative attitudes which have evolved toward the man-made landscape and how to approach it, however, are limited.

Demolition is the obvious solution for most situations of the "objet trouvé" in built form. Another solution, less common, is that demonstrated by the Custom House addition in 1915. This is singular because unlike most expansion or program change situations the addition is a direct response to the change in technology and urbanistic values during the period between the initial construction and the addition. The sanctity of the Greek temple had already been questioned by Young with the superimposition of the dome.5 This mix-and-match patchwork of stylistic elements was allowed by the new interest in archeology and classical revival stimulated by the findings of Stuart and Revett.6 It was to proceed apace through the nineteenth century with the superimposition of styles on the skeletons of American building. During this period urbanistic values toward a coarser texture evolved along with the technology capable of effecting these forms. Skyscrapers, iron and skeletal construction allowed this all to take place in the late nineteenth century. The Custom House tower does not seem , an unsympathetic reaction to constraints which under most other circumstances would have lead to demolition. The historical and symbolic value of the Custom House must have weighed in that subtle narrow band on the
"THE SCALE OF CIVILISATION AND, INDEED, OF AMERICAN
TOPOGRAPHY, WAS CHANGING BEYOND THE CAPACITY
OF A TEMPLE FORM TO CONTROL IT"

VINCENZ BRULI
"AMERICAN ARCHITECTURE AND URBANISM"

CUSTOM HOUSE, BOSTON
1837 ANIH. B. YOUNG

ADDITION
1915
valuation scale where, too rich for demolition yet too poor for historical preservation, another approach must be invented, in this case direct but bizarre.

The most recent example of something of the same thing out of the narrow band of values precluding either demolition or resurrection occurs at the Massachusetts Eye and Ear Infirmary for somewhat different reasons. The work of the existing building could not easily be relocated to allow for demolition and new construction. Here a new building is placed over the old connected only by circulation. The tower straddles the old building, but is not dependent upon its structure. This has less of the preservationist instinct in it since the new building in no way defers to any architectural qualities in the old (if there were any) and leaves the path clear at a future date to remove the old.

The apparent similarities between the attitudes in the Custom House addition and those in the Massachusetts Eye and Ear addition end with the location of the addition.

The church in the Back Bay which Paul Rudolf is reconstructing on the site of the fire-gutted original, however, represents a similar attitude to that of the Custom House addition. Here by force of the accidental destruction of all but the stone shell of the church the attitude was developed to work with what remained of the structure as a recollection or reminiscence of the original context. This attitude is consistent with that
"The traditional notion that each object has a single, easily definable function clashes with all that we know about human psychology, about the role of values in decision making, and with ordinary common sense as well. All products are multi-functional."

Alvin Toffler
"Future Shock"
which would not tear down the Custom House although caused by different program motivation. Here the program was for a recreation of roughly the same spaces, not an archeological recreation but a response to the remains of the original in the context of the architectural vocabulary of 1972. The twenty-story tower extending from the Greek temple was conceived with the standards of building technology and urban design of the 1900's just as that of Rudolph is conceived, howbeit willfully, in the standards of building technology today.
The Building Industry Versus Energy Conservation

In Architectural Design, December, 1971, Colin Moorecraft addresses himself to the problems of power and energy in the overdeveloped countries of the world. "If buildings are analyzed as matter-energy systems extending in time to the raw materials which are the source of their components, and extended forward in time to their fate as post-demolition landfill, it becomes obvious that enormous quantities of energy are involved." 7

The building process consumes vast quantities of energy at every stage:

- energy to extract the materials from nature;
- energy to transport them to primary and successive processes;
- energy to assemble components from raw materials;
- energy to transport components to distribution agencies and thence to sites;
- energy to assemble the components;
- energy to maintain their use;
- energy to demolish them and transport their remains to a suitable resting place.

Movement of materials is a large part of the building process and a major energy consumer.

When compared with the building processes of primitive man whose survival was dependent upon the efficient utilization of energy the building processes of today seem wantonly inefficient, dictated by the demands of a short-sighted economy in which the commodity of style and short
term profits are the primary concerns of the technocracy. The primitive whose concern was survival in pre-tribal society had to be all things in his cosmos, his dwelling could only take a relatively small proportion of his energy output. This condition survives in most vernacular building situations in the world today.

Most buildings where energy is measured by dollars (not the only way to measure it) do not indulge themselves to as obviously inefficient materials choices as those made in the history of building for the purpose of symbolic tribute or aggrandisement. For the vernacular builder, however, the materials are always determined by the locale.

Vernacular man has a long history as a scavenger, a user of the building materials of earlier ages. These attitudes, were not a conscious attempt to forestall energy/resource exhaustion nor a political homage a currently popular theme of recycling. They were an untheoretical response to a local problem within a general framework in which survival ranks higher than architectural style and conservation of energy higher than preservation of antiquities. If many of the theories of world energy consumption currently in discussion are correct, then a reconsideration of the industrial process is in order, and the building industry in particular as a bulk consumer of material and energy.
The great number of areas in which energy (not always measured in dollars) can be saved just begins to be examined. Environmental costs are not related to material costs until the materials have vanished or in energy terms their energy is degraded to simpler forms—entropy. The second law of thermodynamics seems to persist.

In the world of consumer products a symbolic complexification of our world is being gained at the expense of the geophysical and biological environment—when energy is expended it is degraded to simpler forms. The increase of non-biologic systems ratio to biologic systems leads to a decrease in the complexity of natural systems. With the decrease of ecosystem complexity comes decreasing stability to say nothing of the already recognized pollution, and over-population. In the building industry ultimate solutions are not to be found in the areas of increased production efficiency (dollar measured) but in attitudinal change which measures enterprises in terms of energy dissipation or ecological costs. The beginning of such an attitudinal change has taken place in the minds of many people but the means of implementation in a technocratic society of such culturally conflicting attitudes doesn't seem within the range of non-political acts. A reversion to some of the pragmatic attitudes of the vernacular buildings and scavengers of low energy civilization may serve as a useful model from which to develop the attitudes necessary to survival.
The development of an attitude toward physical found objects in the natural and man-made landscape is necessary to be able to see them as positive features of a site or as building materials. The absurdity of demolishing and hauling away brick buildings to be used as fill and then re-amassing on the site materials for a brick building typifies the inefficiency of the design/building process, and all this on behalf of the style motives.

Imagine an industry establishing itself in an about-to-be-flattened urban renewal area and developing an energy conserving system for recycling the waste of existing buildings into cheap, not-to-be-transported building materials for use by the developers of the site. Even within the profit system an urban renewal agency could use its controls of sites to select developers based on their construction proposal and its utilization of energy and material conserving systems. To be certain, if there were financial gains to be made by it there would be available "instant,-handy-on-site-brick,-steel,-and-wood recycling machines" which would produce materials for reuse on the spot, cleaned brick, extruded steel shapes, and pressed board. But this is only halfway on the road toward attitudinal change, the energy for conversion of old materials to new is probably near equal to that for processing raw materials, this only saves the material quantities which are reused over raw materials expended plus the energy saved in transportation and distribution.
One design method might employ a saw on sites on which a heavy building is being wrecked to make the structural timber (already hauled at great expense—dollars and energy—to the site) into smaller members to be incorporated in the superceding structure. As a result of the demolition ethic of urban renewal the cleared site has become prerequisite for the urban redevelopment. No new technologies have been developed in reaction to the problem of material salvage; recycling or the use of existing buildings as foundations for new ones.

The alternative attitude of rehabilitation or renovation is one which has always operated as a cost saving ($) measure, the costs saved over replacing the building are usually a result of scale, the developer a single unit owner cannot undertake a project which would make him larger profits in large scale demolition, clear site, high rise development. So cost ($, not energy) saving maintains a certain sector of the environment from large scale plunder. This, however, is rarely done at a savings of energy, the finished materials are removed en masse as are the outdated mechanical systems—to be replaced at great labor cost ($ and energy) with new finishes and mechanical services. The remaking of the spaces only infrequently involves the introduction of new uses.

The attitudes of "adaptive reuse" begins to round out the attitudes toward found built form. Here the residual
structure becomes suitable for reuse by a different user than the one for which it was originally designed. A warehouse to a school, or a factory to housing or vice-versa (a possible solution to how a social disaster like the Saint Louis towers might be redeployed). Here cost saving can be great, material costs and energy costs, but general building systems do not lend themselves to incorporation into existing frames, nor do mechanical systems which are generally linear networks which must be woven through the already standing frame. Since the adaptation of the structural frame has never been considered a potential area for industrial R&D there exists no self-contained HVAC units of suitable design to easily plug in to service the non-differentiated loft space found in many residual structures. Nor are there self-contained or easily assembled plumbing stacks which would adapt easily to the spaces found. The industry is tooled up for new construction and the design flexibility of the elements of construction is limited to the "new construction design gambit" a single designed element repeating "ad nauseum". Markets have not been expressed for the tools to make adaptive reuse a popular attitude. Recent trends in the economy having nothing to do with energy conservation but more with a local shortage of development capital, have prevented many organisms from expanding into new facilities. This affect felt in housing, schools, and prisons is largely in the public sector where the tax
dollar cannot keep pace with the commercial dollar. Space needs are manifest everywhere, and only recently has adaptive reuse become an accepted if not advocated method of containing growth. The technology and industry have not caught up and the conversion process is still a comparatively expensive one.

Most of this discussion is speculative and depends upon projective resource analyses but if our current condition is any indication of our ability to predict environmental catastrophe the speculations of the futurists are conservative regarding ecological decay. No direct relationship between the expenditure of energy in building and the environmental costs can be made outside of beginning explorations such as Fuller's "World Game" and Forrester's "World Dynamics". If the cost to the local environment had been a concern when the first textile mills started polluting the rivers of New England would the reduction of profits to solve pollution problems then have allowed the growth of the regional economy and if not what would be lost for clean rivers. Much of this position is based upon a serious questioning of the values of economic growth.
"Out of the New England colonial, lumber and maritime building tradition came the internal structural characteristics of the early and later mills. It was the skeletal plan and timber method of flooring and side-supporting in colonial houses, barns, and ships that established precedent for the interior framework, construction of American manufactories."

BRYANT TOLLES
"Textile Mill Architecture in East Central New England"
The New England Textile Mill: A Vernacular Tradition

The early American textile village is a direct extension of a well understood colonial building tradition. The features it shares with earlier vernacular building are, "a shared image of life, an accepted model of buildings, a small number of building types and, finally, an accepted hierarchy and hence an accepted settlement pattern." In the centers of culture, this strong vernacular tradition had begun to acknowledge the "Architecture" of Europe. By the middle of the eighteenth century, many colonial architects had awareness of the Palladian principles followed in architectural circles in Europe. This tradition was being expressed by many American architects at the time that the first textile mills were built. By the turn of the century the classical revival was just beginning to achieve wide acceptance although it had existed since 1785 in the Richmond capitol building by Jefferson and Clerisseau.

With the beginning of the romantic-classic period American design was into a fully developed academic tradition of architecture. The development of the factory system in the United States, however, was slowed by the restraints of the British mercantilist system on entrepreneurial freedom and the transfer of technological gains. As a result the Industrial Revolution in England had established a strong tradition of industrial architecture by the time the American factory system began to develop. As in early colonial architecture the attitudes showed an un-self-conscious transposition of the architectural proto-
types of the fatherland coupled with a response to the available technology and materials. Much as the early architecture of the colonial period "share critical characteristics of linearity, planarity, and simplification of mass"\textsuperscript{13}, so does the early transposition of the mill/factory prototype. The mills also seem to bear a similar relationship to the English original which Scully describes as "distilled into a more rigid order, less compromised by variety, less rich in modulation"\textsuperscript{14} than its English predecessors. The mill architecture of New England, although one hundred years later in time, reflects the same process of transposition as other English prototypes (it was all that the settlers knew) to the colonial scene. As the Parson Capon house and others of its period show a puritanical tightening and ordering of the motifs of the English farmhouse in response to the materials available and the puritanical penchant for formal simplicity, so did the early textile mill. Henry Russell Hitchcock, speaking of an early stone mill in Rhode Island, said it is "directly in the line of the soundest American building seventeenth century tradition as the elaborate Carpenter-Adam houses and churches of the period are not."\textsuperscript{15}

The English mills contained, according to Tolles, "a measure of beauty, in their logical organization, in their discreet use and articulation of traditional Georgian motifs, in their use of structural materials, and in their relationship to neighboring buildings and natural surround-
This tradition he feels was passed on to the colonies with the loss of some elegance for the lack of economic progress—this may be so in the earliest mills of Rhode Island, but probably it is solely in the area of Georgian motifs that the aesthetic quality was lost. This was for reasons of austerity in taste as well as economic austerity. The local building tradition from which mill construction grew could be seen to be the same as that of New England barns, meeting houses or simply large farm-houses. The early mills were post, beam, joist and plank construction with clapboard sheathing but the exterior walls starting in 1810 were of masonry. This tradition was not only from English mill construction origins but from the local traditions of stone or brick masonry, already seen in grist and fulling mills along New England rivers.

So the early stone mills of the Black Stone and Pawtucket valleys were a response to the nascent industries demand for suitable undifferentiated space. Pierson's description of the architectural "program" for the textile mills of England can also be applied to those of New England: "Architecturally, the problem of the factory was to provide adequate space to accommodate the new machines, to bring them into the most efficient relationship with the sources of power and to develop new structural methods which would withstand the destructive forces of the machines in motion." The location along a river's edges was in order to harness
The earliest mills enclose work space and vertical circulation within a continuous surface rectangular enclosure.

**WOONSOCKET G&G MEMP, WOONSOCKET, R.I. 1855**

The construction of the textile mill established by early prototypes remained consistent for the rest of the century: a continuous surface brick or stone enclosure with a linear framework of heavy timber within.

**WOONSOCKET G&G MEMP, WOONSOCKET, R.I. 1829**

Early river island mills often oriented at right angles to the river. Stairs and bell were in tower at the end.

**BELKNAP-SULLOWAY MILL, LACONIA, N.H. 1823**

Mills sited parallel to the river often placed stair towers on the front face and bell towers on the ridge.
the kinetic energy by means of a water wheel to drive the spinning frames of the early Arkwright process which Slater introduced to the colonies—this determined the rough form of the mill.

Its length was determined by the practical distance from the drive belts that an overhead wooden drive shaft could sustain torque. The early mills rarely exceeded sixty feet. The belts of leather which transferred the power from the water wheel through holes in the floor to the upper floors determined the practical height of the building. The width of the mill was determined by lighting considerations and since no artificial lighting was yet practical, the mills were narrow and generously windowed, around thirty feet wide. Consequently, the mills were able to grow as the power transmission techniques improved. By 1836, six-story, one-hundred-foot long structures could be found.

Mill design and organization along the river was richly varied across New England. The Rhode Island mills of the Pawtucket and Black Stone Valleys were the earliest; they also remained the smallest for these reasons: the rivers were small and had at any single falls a limited motive power. Consequently, the first mills had to locate in unsettled regions where they established their own town based around the mill. The mill owner became a local patriarch providing all housing, education, and food for his workers. These mills were unable to use the
Crompton mules being used in northern New England because of patent restrictions, and therefore continued for a long time with the limited Arkwright process. As a result, the mill design in Connecticut and Rhode Island did not change from the early 1820's to the Civil War.

Stylistic characteristics separated each mill from the next; these occurred in design areas outside of the construction system. The tower frequently housed a bell which was the village's timepiece; it became the symbol of authority and dignity in the early mills. The otherwise unstyled mills would frequently be capped with cupolas reminiscent of early churches and meeting houses. Another style differentiating element was the clerestory, monitor window in the roof, lighting the attic floors. The quality of brickwork and stonework also was a major consideration. These measures of quality seem to be an early version of good public relations.

The mill city in England had degenerated into the well-publicized sweat shops which were to follow in the United States as well. As a result, public opinion was strong against the industrialization process. Mill owners in New England beat this image in the early years by the creation of a patriarchal village image with Utopian overtones. The mill as the center of, and reason for the agglomerations, partially replaced the roles played by churches, taverns, and other gathering areas in rural towns. The organization of the Lowell community around
the mill structure was Utopian in conception and in opera-
tion for almost thirty years.

While most of the worker housing of the Southern New
England villages was single-family or multi-family houses
and a rare boarding house, the housing provided by the
mill owners in the north along the Merrimack was largely
of the boarding house type, with separate residences for the
women and men. The "Lowell girls" were the first operatives
and were a major portion of the Merrimack Manufacturing
Company's first employees in Lowell. The atmosphere was
upright, moral and cultured. Manchester and Lawrence
also developed along these lines as ideal institutional
communities with a philanthropic, moral tone. The northern
mills orientation to the river was very different from the
Rhode Island mills to their rivers. The Black Stone and
Pawtucket Rivers are slow rivers of comparably less volume
than the northern rivers. The mills are mostly built at
right angles to the river direction—in some cases they
straddle the power source whether river or canal. The
site considerations were varied but the general role for
these southern New England towns was to have a limited
number of mills organized around a falls, a number which
could not be increased due to the limitations of motive
power in the rivers. Thus a radial or axial organization
with the drop allows the greatest number of connections
to a limited power source. The Massachusetts and New
Hampshire mills, however, were sited along more powerful
"Until the early eighteenth century, almost all the buildings of Lowell were vernacular in style, with only a few exceptions they can be classified as the products of folk art. The architecture which illustrates how eighteenth century traditions persisted in cultural backwaters."

J. Coolege: "Mill and Mansion"

"Planning had nothing to do with its quality, for planning was not recognized as a controlling activity. Planning was merely a technique for arranging nearly certain given things."

J. Coolege: "Mill and Mansion"
waterways and were organized to be able to grow in a linear fashion, parallel to the river. It was understood that the bulk of water could be carried along the river in canals or penstocks to successive developments.

The earliest mills to use this organization were the first Boston Company mills in Waltham on the Charles River in 1813. This Waltham mill was a six story brick structure forty feet wide and ninety feet long, a major jump in size from its Rhode Island predecessors. This mill set a standard for successive mill design and operations. The process incorporated all five processes, carding, condensing, spinning (Crompton mules), weaving, and finishing into one building which produced, for the first time, a finished product.

Along with the operational change, the resultant size difference and the changed orientation to the river and growth, the Waltham mills established a formal organization which was to dominate mill design up to the Civil War. The stairs were placed in a tower outside of the mill, a Georgian bell cupola was placed over the center of the mill rather than at the end as previously, the windows were larger in response to the increased width. Advantages of spatial organization and fire safety were achieved by the stair tower to say nothing of the establishment of an aesthetic prototype which prevailed thereafter. This was a fusion point of diverse influences both English and local to establish a factory prototype.
The growth process in the Androscoggin Valley while incremental was ordered and systematic. The early mill towns of 1800 and 1810 were connected with dominating, infall elements which gave a new elemental scale. Successive growth occurred at this new scale.

Merrimack River

View of Manchester from Rockaford

"Simply are the early industrial buildings of the related vernacular architecture of New England manufacturing towns before the mid-nineteenth century reduced to an architect, occasionally, company officials or local mechanics. In most cases, the builder or his agent was the designer or a pattern. More often these same builders have been millwright or builders who had to decide that many decisions were left to those creating them. By the second decade of the century, however, a few builders and architects appear, especially in the burgeoning mill villages founded by the larger textile corporations."

Richard Canova, "Three Architects of Early New Hampshire Mill Towns"
The mills of the sort I have described are found still today in rural settings where the limitations of water power and transport to market coupled with a long series of economic depressions has kept many of them at the scale of their beginnings. The Crown and Eagle in North Uxbridge, Massachusetts, many mills in the Pawtucket Valley in Harris, Fiskeville, Arkwright, Georgiaville, and Woonsocket and those in Harrisville, New Hampshire serve as a good cross-section of what remains of the mill village.

Another form of development took place along the mighty Merrimack. The mills built initially in Lowell by the Merrimack Company were based on the Waltham prototype. Built in 1823, these mills were arranged in a quadrangle of six with generously proportioned open spaces between the buildings creating much the same aura as Harvard Yard, or Dartmouth Row. Similar planning of groups was also to be found in Manchester, New Hampshire, and Lawrence, Massachusetts, where canals were dug parallel to the river making large areas available for mill development. The Amoskeag and Stark Manufacturing Company developed at the same time in a parallel fashion. The Stark #1 and #2 mills were built side by side in 1838 according to the Georgian ordering of the day, but immediate growth caused them to be connected, not with the single story storage and picker houses which soon filled the ground spaces as Lowell grew, but with a dominant central
"WITH A WORKING WEEK OF SIX DAYS, AND A WORKING DAY OF AT LEAST TWELVE HOURS, THE FIRST ESSENTIAL WAS THAT THE OCCUPANTS SHOULD BE IN A COMPACT GROUP NEAR THE MILLS..... THE FACT THAT THE HOUSES WOULD BE NEXT TO THE MILLS NECESSARILY MEANT THAT THEY MUST ADVERTISE IN UNFAVOURABLE TERMS THE INJUSTICE OF THE COMPANY."

-John Coolidge
"MILL AND MANSION"

"MAD OR STUDY WAS IMMENSELY SLUMMER HOUSING AROUND THE MILL. THE HORRIFIC ORGANIZATION IS CLEAR ON THE ORGAN. OUTFARMS, FARMS, SCHOOL, WORKERS HOUSING AND MIGRANTS HOUSING, ALL ARE ACCOMPANIED BY A CROW WHOSE WAKING ALES ARE THE ORGAN'S LENDING DIRECTLY TO WORK."
block and tower which unified the two in 1842.

The scale of the mill yard had changed from the Waltham prototype by 1850, the gently scaled Georgian planning was lost as industrial growth called for the enlargement of the mills. Pitched roofs and clerestories were extended to flat or gently sloping designs which increased use area. Buildings were connected by picker houses, the stately groupings were lost in a push to expand. New mills "remained essentially conservative in scheme, but lost the attributes of well proportioned and finely detailed design and coherent, articulated arrangements of building placement and environmental interrelationship."18

The Amoskeag mill yard shows the before and after of this process clearly. The formal spacing of Stark #1 and #2 (1838) and Amoskeag #1 and #2 (1840) clearly come from the same urbanistic mold as the Merrimack Company's first quadrangle. But Amoskeag reacted with coherence to the space problem and simply expanded at the next order of magnitude. The linear expansion still had a semblance of formal order to it. The Amoskeag social organization was Utopian in the same way as the Lowell plan. The mills sat at formal intervals parallel to canals and rivers faced perpendicularly by rows of worker housing (stepping down the hill in the Manchester case). The formality and classicism of this organization can be contrasted with the romantic dispersal of the worker housing from the mills found in the rural towns. Rural organization was a product of
site conditions more than symbolic order. The scale of the Manchester and Lowell mills largely accounts for the planning order, but also a self-conscious notion of Utopian city is carried with these exclusively company towns in which societal order and morality are mirrored in the organization of daily life. Strong feelings of loyalty prevailed in the early days of these cities in which the mills set the hours, rang the bells, built the houses, and drew the streets. None of these major textile cities have any feelings left of the original mills, most have been demolished or rebuilt in flat roof construction with Lombard-Romanesque towers from the later romantic revivalist periods. The ideal of these early mill cities can be today perceived in settings like Harvard yard where the brick work and building placement is similar.

Most of the rural towns were laid out in an ad hoc plan oriented to the river in a way determined by the river's course and local geography. Worker housing was built in orderly rows but rarely with a specific formal orientation to the mill or the river. Harrisville without the rigid ordering device of the grid plan functions as an urbanistic whole probably because it has not departed from Georgian values. "It still understood or had faith in the traditional hierarchies of function and of scale, in a rural landscape still idyllic."19

An inherited but informal set of principles seems to have been operating in the development of early industrial
"The aesthetic quality is not especially created for each house. It is traditional and handed down through the generations. This appearance happens because there is a shared sense of life, an accepted model of buildings, a small number of building types and, finally, an accepted hierarchy and means in accepted settlement pattern. The distinction between traditional and modern societies can be understood in terms of the contrast between informal controls of scarcity and consensus in the former, and hierarchy and interorganizational specialization in the latter, which would seem to correspond with Geddes's concept of substitution of the technical order for the moral order."

James Summey, "House Form and Culture"
architecture. Whether the principles be labeled Georgian as I have or romantic-rational or other, the consistency of these social and corporate entities suggests that an underlying tradition if not understanding determined these early industrial agglomerations. The principles are accumulated over the previous century and in a rural application by unsophisticated non-designers and engineers take on many of the characteristics of vernacular architecture anywhere.

Although the vernacular user is not exclusively the actor in his own domicile, the manorial patriarch has established a "form language" which successive users evolve. A continuity is created through an understood growth matrix consisting of a "form language", a consistent building technique, and an assumed consistency of materials. Incremental growth can take place without master planning and the results as seen in Harrisville, North Uxbridge, etc. are cohesive, reflecting the social organization. Their quality seems to come from their interactive growth matrix. The unstated rules are well described by Alison and Peter Smithson:

Interpreting Eames (Charles Eames on the Leta, AD, September, 1966) form language sets up a dialogue between object and user. The object suggests how it can be used, the user responds by using it well--the object improves; or it is used badly--the object is degraded, the dialogue creases. It can, of course, revive for there is a secret and permanent life in things intensely made that can come alive for other uses, other generations. Even when the damage is extremely severe, even when only a ruin or a fragment is left. But in its first period of life, if it is to establish what it has in it, the object must have love.
It is this quality which makes the adaptive reuse of mill architecture a positive enterprise while the adaptive reuse of the Saint Louis apartment complex is almost inconceivable although not impossible according to the positive landscape theory.

Concurrent architectural trends were not being felt in the cultural backwashs of mill towns. Federal style, neo-classicism and the Greek Revival, stimulated by the archeological copybooks of Stuart and Revetts, were having severe effects on public buildings and exterior space in the sophisticated centers. Says Sculley:

...the special American predilection for the purest possible temple form, so marked, that romantic-classicism came commonly to be called "The Greek Revival" by American historians may perhaps be regarded in the end as another demonstration of fundamental anti-urban tendencies...The Greek temple does not really want to get along with other buildings in the street, but to stand free outside.

The mills whether layed out on Georgian principles (Lowell), or growing incrementally (Harrisville), have an urbanistic, consistent coherency which was not to be felt in public buildings of the same period. This positive quality was achieved by the accident of unsophisticated business-like builders who built from traditions which were practical, not avant-garde for their time. The ideals of pre-revolution romantic classicism, intellectual order and visual order are the roots of early mill design and as such are an extension in time of these attitudes. The inherited Georgian organizational ideals and understood materials are the principles upon which the New England
Textile mill design, layout, and fire prevention measures as recommended by the Factory Insurance Association in 1916.
village vernacular grew as 100 years later did the mill village. This seems consistent as the setting for the American industrial revolution which was going through its first stages in the textile mills of New England. But in the climate of social and economic revolution that accompanied industrial growth, the qualities of understood values and inherited ideals did not long remain unaffected by these changes.

The concern for safety in the early mills was expressed early in the development of the prototype. Zachariah Allen is credited with the use of the outside stair as a safe exit as well as to house a water tank feeding a sprinkler system. Zach Allen also developed a slow burning or "fire resistant" construction. The earliest mills were of post, beam, joist and plank construction, not unlike barn or house construction. The replacement of 3"x6" joists at 3'o.c. and two layers of 1" plank with 3" spliced plank spanning six-eight feet between the beams made a wood surface which had less surface area and could handle the same loading. The reduction of surface made this construction burn less quickly thus called "slow burning" construction.

Cast iron columns were also introduced in American mill design but their penchant for collapse in fire and the Pemberton Mill disaster in 1860 ended this practice.

The role of architects in the early mill building was merely as an arbiter of the accepted prototype and
he may well have been only a local builder or the mill owner. As pointed out by Richard Candee, the builders in southern New Hampshire, Samuel Shepherd and William Kimball probably had the benefit of contact with the books of Asher Benjamin, *The American Builders Companion*, and *The Rudiments of Architecture*, and even may have had knowledge of the classical studies of Stuart and Revett. The infiltration of the rural vernacular tradition by academic classicism was a slow process prior to the Civil War and rarely had any affect on the mill layout although it may be seen in the towers and cornice details of some mid-century mills.

The development of industrial architecture after the Civil War continued on the lines developed just before the war. The slow burning construction prevailed while brick took over as the cheapest building material. The mill owners were now in the exalted position of leaders in American industry. They had the same need to create an image with their mills as the government leaders of the earlier Greek revival had with their public architecture. The value of the building as public relations no longer was calculated to lure suspicious souls from their rural settings to work in the Utopian setting of their manufacturing enclave. The motive had evolved as had the scale and competitiveness of the industry. By mid-century the mill owner was moving away from the mill towns to cultural centers leaving agents to handle his investment.
His heightened contact with "happening"architecture made him aware of the successive waves of revivalism underway in American architecture. This awareness coupled with the public relations motive produced a short period of Greek revival mills, and then the more comfortable Italiante, Lombard Romanesque motif became the dominant industrial style. Ameskeag shows this best.

This occurred simultaneously with the rise of the insurance company in American industry. As a result of the Pemberton Mill collapse in 1860, insurance companies refused to insure mill construction that did not conform to their standards. These standard were outlined by the Factory Mutual Company in the form of suggested mill layouts from which very few mills after 1860 departed. The only area for design hereafter was the choice of style which determines the details of the cornice and the symbolic tower. The towers during this period are elegant and represent as high styles as were currently enjoying popularity in the elegant architecture of the city. Industrial architecture in its limited embellishment has caught up with architecture de rigeur, that is, what superficial acknowledgements of architectural style that were made, were made in the highest order of American architecture to be gleaned from the practice. Lombard-Romanesques, Tudor, Greek Revival, Queen Anne, High Victorian, all were represented in mill towers across New England, but the layout and construction was being determined by Factory Mutual Fire Insurance's suggested plans.
"The scale and impersonal character of the activities were bound to
give these new communities a self-sufficiency which the old ones
strangely lacked."  "The villages had been wholly dependent
upon the single figure of the owner, reflecting him in every
building."

J. Cowles.
"Mill and Mansion"
The incorporation of the steam engine in the late nineteenth century allowed factory locations on other than river edge sites. As the buildings grew wider and longer with increased power potential from new power sources (steam turbines and electricity) the need for more light changed the brick construction. The windows were increased in size relative to the walls. Columns were expressed on the exterior rather than the interior as they had been. Thickened brick piers appeared between the widened windows; this was the first step from a bearing wall system toward a columnar structure and finally to the concrete frame which was to begin in the early twentieth century. Engineering, here, has been accused of having superceded architecture; this evolution does not seem to me to be one of aesthetic to philistine values. The tradition of the first mills design was an aesthetic non-choice made by practical, unsophisticated men of the only functional type available in a style which only by the accident of architectural conservatism is appealing to us today. Were these mills to have been graced with the impediments of the Greek Revival, which we inherit in so many of our public buildings from that period, they would undoubtedly be far less appealing as the applied ornament of various revivals seems to have fewer associative values today than it did then.

The conservative bourgeoisie who founded American industry were as homely as the pioneers in their choice
Cheshire Mills, Harrisville, N.H. 1847

Monadnock Mfg. Co., Claremont, N.H. 1842

Essex Co. Machine Shop, Lawrence, Mass. 1846
of architecture and are to be credited only with the consistency with which they held to their Puritan ethics and forms, producing a consistent vernacular style. Their mill designs were engineering decisions based upon the available resources as were the bulk of buildings in that area called romantic classic; it is not surprising therefore that mill design effectively evolved on the change in engineering principles and that architectural ornament was employed only as public relations and symbols of power, as in the early mills space planning and the social scheme had been. But this is consistent with the change in the intentions of the mill owners. The mill towns of Lowell or Manchester wishes to create Utopian images of romantic-classicism as public relations to smooth over the introduction of industry to an agrarian nation; the result was nuts and bolts buildings organized into clearly defined rigidly paternalistic social systems.

Pevsner, in describing the nineteenth century in Europe, sees a preceding but parallel phenomena:

- The nineteenth century lost the rococo's lightness of touch and the romantic's emotional fervor. But it stuck to variety of style, because associational values were the only values in architecture accessible to the new ruling class.23

And of the advent of the new ruling class:

"Now those to whom visual sensibility was given saw so much beauty destroyed all around by the sudden immense and uncontrolled growth of cities and factories that they despaired of their century and turned to a more inspiring past. Moreover, the iron-master and mill owner, as a rule self made men of no education, felt no longer bound to one
particular accepted taste as the gentleman had been who was brought up to believe in the role of taste. It would have been bad manners to build against it. the new manufacturer had no manners and he was a convinced individualist. 24

In New England the quality paralleling the rococo that Pevsner laments passing is the vernacular Georgian tradition in which the early mills were built. And like the "new ruling class" in Europe fifty years earlier, the New England mill owners by the middle of the century were no longer bound to the romantic-classic tradition for their consciousness was changed as was their position. They now left their managers in the mill towns and lived in Boston or the North Shore, the clear social system of early Lowell, Lawrence and Manchester was now being disrupted by the influx of immigrants, the growth of the labor movement, and, simply, size. Power and wealth in this new context was the ideal to be represented in architectural motifs--tall, ornate, elaborate bell towers still sounding the workers in and out of their fourteen-hour days seemed the logical place for the application of architectural energies. America's ruling class was found to be consistent to its methods, the staggering strength of the huge mills along the Merrimack have outlived the dynasties which created them. But the dialogue has not ended, and the new user is going to be able to cull the inherent qualities generated by the love which went into their original conception, howbeit for purposes of private gain and prestige or utopian.
"Typically the institution creates the town, and at first completely controls it. However, the very success of the institution soon builds up so large a town that the citizens soon begin to have a corporate consciousness and it is no longer possible to rule them directly. By the time the institution ceases to progress, the town may have reached such a size that for a time it snowballs, regardless of the fortunes of the parent. Then a balance of power is struck. This is upset by the decline of the institution which always precedes and is more precipitate than that of the town....

The citizens having progressed from the level of parasites to the status of purveyors, now becomes the masters of the institution that nurtured them. In a single dramatic incident they symbolize their superiority...."

-- JOAN COOLEY, "MILL AND MANSION"
The Mill As A Planning Obstacle

One need only look at the plan of the final complex to grasp the random character of its growth. But it was practical and it met the requirements. The Industrial Revolution was met by piecemeal adjustments, as phase after phase of life fell under its destructive and creative forces. The additive character...(of the complex) was as indicative of the age to which it belonged as was its Georgian respectability.25

Pierson's description of an English manufactory of the eighteenth century can be accurately applied to most of the textile mills in New England during the early nineteenth century. The conception of the mills as I have discussed in the history of mill design was an expression of vernacular understanding of "Georgian respectability" characteristic of eighteenth century village commons and academic complexes. This perception of the mills is reinforced by numerous contemporary views of the mills.

Operational modes dictated the design of the textile mill. As these modes were evolving rapidly, the engineer/designer was forced to deal with growth and changes in power utilization and goods transmission incrementally. The towers provided vertical circulation and had loading doors at each level and a block and tackle for the delivery of machines and materials. A vertical organization of production was possible for the early textile mills which was not for other early industries due to the light weight of the materials. A typical organization placed wool storage in out buildings as well as the picking and cleaning of the wool. The clean wool was then hauled
THE GROWTH OF MONADNOCK MILLS FROM 1900 TO 1910 RESULTED IN CONTINUOUS RAPIDITY DEFINITION FOR ALMOST A THOUSAND FEET ALONG THE RIVER EDGE. IT OCCURS AT THE POINT OF CONVERGENCE BETWEEN THE RIVER AND THE DIRECTION OF THE TOWN, DIRECTLY ADJACENT TO THE COMMERCIAL AND CIVIL CENTER.

THE COMPANY HAD ORGANIZED. THE MILL, NOW KNOWN AS MILL #1, WAS PUT UP AND FIRST PRODUCED. A POWER AND TENEMENT HOUSES BUILT.

IN 1902 THE COMPANY BUILT THE GRIST AND SAW MILL, AND CANNED BONE ON THE NORTH SIDE OF THE RIVER ON THE ISLAND.

IN 1903 THE MILL WAS RUNNER WOODENED IN THE ROADAGE OF DRAINED, MILL. AT THE NORTH END OF THE RIVER, WHICH WAS OPERATED AS A COTTON MILL.

LATER, MILL #2, IN SER THE GAS WANTED, WHICH HOUSES SURROUNDED THE MILL.

AND VILLAGE WITH GAS FOR ILLUMINATION, WHERE DART. IN 1904 THE POWER HOUSE, DERIVED FROM THE ILLUMINATED RIVER, WAS SUPPLEMENTED BY A TWO-HORSE AND FIFTY HORSE POWER STEAM ENGINE. THE DAIRY FOR WHICH網站 THE MILL. AND THE ENGLISH POWER IN TIMES OF LOW WATER. IN 1905 A BRICK BUILDING BETWEEN MILLS #1 AND #2 WAS ERECTED, TO BE USED FOR BEEHIVE AND MANUFACTURE THE GOODS MADE. IN 1906 A WAlTED MILL, ONE HUNDRED AND FIFTY FEET ON THE GROUND, THREE STORES AND BASEMENT WAS BUILT WEST OF AND IN A LINE WITH THE ORIGINALLY

THE BIOGRAPHIC "A HISTORY OF THE TOWN OF CLARENCE, N.H."
to the top floor for spooling, warping, and slashing; then it would go to the third level for spinning, second level for carding, and the first for weaving and finishing. This vertical organization which relies on block and tackle and gravity for the large part of the movement of goods through successive processes does not make a major design criteria of the movement of materials. These operational criteria affect very little the organization of the mill yard, so the Georgian planning ideal was not in conflict with the operations which originally took place in one building.

The organization of the other building of the complex was also subject to the standards of the day. Boarding houses, tenements, and double and single family houses built by the manufacturers to house their employees were located near the mills often at right angles to the mill direction, thereby the street passing the row houses fell on axis with the entrance to the mill. The ideal structure and simplicity of the operatives daily movement was organized by the mills, with a more self-consciously designed, time/energy and cost/benefit attitude 'to worker movement. Except where the geography dictated otherwise, this formal organization based on walking distances used a directional grid form. The clearly hierarchic organization expressed a benevolent humanism on the mill's part, and may have been one of the earliest uses of behaviorist thinking to regulate the lives of the working class.
WORKER HOUSING - ROWTYPE C. 1880

MONADNOCK MILLS BOARDING HOUSE 1844
Many of the smaller towns aspired to this formality but curtailed growth. left the grid of worker housing only partially built. Claremont, with its early tenements located directly in front of its mills during a growth stage, began a series of row houses across the river, stepping down the hill as the Manchester housing does. Only one block was built which stands out in a town which never grew to a city as an anachronistic urban form. Presumably aspirations to the greatness of Amoskeag prompted the Monadnock Company to build the partial rowhouse.

The growth process for the textile town was determined increasingly by economic conditions which fluctuated frequently. Increased demand first produced outbuildings and then new mills usually in line with the original and paralleling the river. These millyards were then filled in with random store houses, picker houses, machine shops and counting houses. Goods movement in only a small way determined the location of these new buildings. They often filled the Georgian spaces between mills as the most readily available and already partially defined space. The pragmatic planners of the millyards saw the additive advantages of the positive landscape of the already partially defined millyards. While their view was largely utilitarian and economic it expresses an attitude toward building connectivity which was neither Georgian nor was it modern (1840's modern was Greek revival, the epitome of discontinuous urban form). The quality of these complexes was
THE SUGAR RIVER "IS THE OUTLET OF DIAMOND LAKE... (V) IS EIGHT HUNDRED AND TWENTY FEET ABOVE CONNEMARA KNEW,... AND WHICH IT ENTRAPES IN THE TOWN OF CLAREMONT.... FOR YEARS SUGAR RIVER HAS FURNISHED THE POWER FOR A VERY LARGE NUMBER OF MILLS.... UPON THIS WATER POWER THEY DEPEND FOR THEIR FUTURE GROWTH AND PROSPERITY.... IN THE TOWN OF CLAREMONT IT (THE RIVER) FALLS THREE HUNDRED FEET OR MORE, AND THERE ARE THIRTEEN EXCELLENT MILL PAPILLIONES. ON THESE MILL... IT IS ESTIMATED THAT ONE MILL FURNISHES ONE THOUSAND FOWLER'S.*

OBS. S.B. WHITE
"A HISTORY OF CLAREMONT, N.H.*

"ITS HEAVY HABITUALLY CONSTRUCTION HAS INHIBITED IT LONG LIFE... ITS LACK OF AESTHETIC PROVOCATION HAS KEPT IT FROM BECOMING "CATOIS," BUT IT HAS SURVIVED THE HATE OF THE OWN DURABILITY, THAT IS IT HAS WITHSTOOD ITS UNPOPULARITY; SOCIAL, AND ECONOMIC VALUE ARE PROBABLY IT BULL.*

"THE COMMUNITY IS CONFRONTED WITH TWO CHOICES, IT CAN WATCH THE BUILDING DECOMPOSE IN THE FAMILAR PATTERNS, WHILE ALLOWING IT TO HOUSE A SERIES OF LOWER AND LOWER GOSE, FRAGMENTS, OR IT CAN INTERPRET ACTUALLY WITH PHYSICAL REDEVELOPMENT.*

EDUCATIONAL FACILITIES \LABORATORY
"SPACE IS WHERE YOU FIND IT"
decidedly urban, which in towns like Claremont and Franklin constitute continuous urban definition well outscaling the villages supporting them.

The town which in many cases grew up after the mills was often left to grow by itself. But as at Lawrence, Lowell, and Manchester, it is directly a result of the mill organization and forms itself to service the mills.

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.26

In other towns, where the mills located in established farming communities such as Claremont and Franklin, the town was less determined by the mill location. However, a typical medium-sized mill town whether originally planned as a mill town or not, usually evidences a parallel organization dictated by river, mills, the main street, and shops. Later in the nineteenth century the downtown usually adopted its own urban form with two parallel rows of speculatively built merchantile blocks constituting the main street. This form often would be the only one to balance in scale that of the mills. In none of the mill towns does the architecture of the main street leave the same indication of the scale of the endeavor, for, indeed, the mills always outscaled the commercial center in bulk and use intensity.

The next stage in the process was determined by the ill effects of wars, national slumps, the rise of labor

Aiken's Hominy Mill & Knitting Mill, SC

Aiken's Hominy Mill & Knitting Mill, SC

Hominy Mill & Knitting Mill, SC

Wachesaw Creek

Late 19th century illustration drawing of Aiken's complex

Winnsissippi river

Central St.

Mill and pastoral neighborhood situated. Central Street and commercial center are adjacent.

View from east
and foreign and regional competition. The failure of the New England textile industry began prior to the Civil War. Many rejuvenations occurred, but after the depression in the thirties and again the recession of the mid-fifties the industry all but folded entirely in the northeast. In each New England town the immediate effect of the closing of the mills was felt differently. When the colossus Amoskeag closed in Manchester in 1936, almost the entire city was affected. While in 1970, after a slow decline, the demise of the Stevens Company of Franklin put only a few score out of work in a town of seven thousand. However, from a planning point of view, the existence in a town of a building complex, greater in scale than anything else locally, creates major problems of assimilation. The process in Manchester is described thus:

The citizens having progressed from the level of parasites to the status of purveyor, now became scavengers of the institution that nourished them. In a single dramatic incident, they symbolize their superiority...the burghers of Manchester, New Hampshire, buy up the largest cotton mills in the world for a paltry $5,000,000.27

The magnitude of the problem of assimilation is evidenced by the number of these buildings standing empty in the towns abandoned by the textile industry. A pattern of use has established itself in some areas—the buildings come under diverse ownership and are rented at low rates to small or beginning industries, or factory outlets for bulk products, furniture to clothing. This marginal use is followed by light warehousing use. The structures are
not well suited for this, their loading capacity is not up to industrial warehousing nor are the lifts designed for these needs. Furthermore, the need for these types of nascent industry, wholesale commercial, and warehousing in no way approaches the quantity of millspace left by the textile industry. There are numerous empty buildings in each of the textile centers of New England.

As new industry slowly develops in New England, the mill sites would seem a valuable legacy from the earlier industrial period. However, the industrial process as well as the distribution of goods has changed critically from the time of the creation of the mill yard. First the advent of the steam engine and later the spread of the national power grid removed the need for a river edge location as a power source. The development of the high speed road network and the trucking industry removed industries' dependence on river or train transport for access to markets. The demands of heavy trucking for space (turning radius, parking, etc.) make the typical mill yard an unsatisfactory size, relative to the capacity of its closely packed buildings to produce. Typical new factories locate in ex-urban, highway oriented settings where land values and therefore rents are low compared with center-city sites.

The horizontal organization of the textile mill has been superceded in many industries by a horizontal organization in which machines like the forklift, conveyer belt and overhead carrier obviate a need for large single story construc-
tion. The textile mill is bypassed by the Butler building in the competition to house new industries.

In the meantime, the mill town has grown to new forms dependent on decentralized activity. Automobiles allow the residents to commute in and out of town to work, shopping is no longer solely located in the center of the town near the industrial and residential center. These old agglomerations of local merchants have lost their local monopolies to the shopping centers which locate, like the new industry, on the outskirts of town closer to the main regional roads. Most towns have a main axis determined by the river and the major road through the town. Development of the strips at either end of the town at the expense of the center is typical. The primary factors are a growing identification with brand name franchises (Dunkin Donuts, MacDonalds, Colonel Sander's, etc.) and the problem of parking in the downtown area, which like the mill yard, is a hangover of the era before cars.

Within the context of the declining center is the sleeping hulk of the textile mill, providing little or no employment, revenue, or vitality. As residual building, it implies all the black history associated with industry, sweatshops, pollution and finally economic downfall. The legacy of the textile mills is seen by the town in an unromantic associative light. The mills, begrimed by over a hundred years of use, hide their qualities except in the most rural cases.
Even the river, the "raison d'etre" for the whole operation, is of little residual value to the town as it is, polluted, brown and bubbly, and until recently always out of the control of any single town to affect. Consequently the river is never seen as a natural attribute about which recreation or simply civic identity might be focussed.

The recent water pollution control legislation may soon make the New England river an attribute for the towns astride them. This breakthrough may make certain significant changes in the way the towns see their residual mills.

Typically the mills stand as continuous masonry barriers between the town centers and the soon to be un-polluted rivers. Up to now, the polluted river was comfortably separated from the downtown by the industrial strip along its edge, this may become a less desirable relationship as the river improves. An argument for Urban Renewal (demolition) seems to be developing in the small towns as it has already in Lowell and Manchester.

The problems which become critical in the analysis of the residual mill yards when considering adaptive reuse for the buildings seem to center around three issues: parking, the mills as a barrier, and the inherited negative connotations of industrial architecture.

The parking problem, coupled with the difficulty of truck access for ongoing industrial activity in the mill yard prompted Manchester to partially demolish the mill
buildings to make "flatscape"\textsuperscript{28} for trucking and parking. In Lowell, urban renewal leveled the bulk of the mills in hope that the prime land occupied by them would be developed by modern industry, but for many of the reasons I have cited, the land has not been developed.

One possible solution to parking is the parking garage. These buildings which standardly today are built of precaste or "in situ" concrete have two possible deployments in complement to the mill yard and already built definition. First a parking garage could be located in that space between the town center and the row of mills, here it ostensibly serves the commercial center but leaves the possibility when new life is generated within the mill yard that it also services that.

A mental set against mill buildings in Laconia by local merchants continually threatens their mills with a three level parking garage in their place along the river. In Manchester, the mills have been partially removed as well as parking garages built. An unexamined approach which has yet to be developed is the conversion of some mills to parking structures. Many are sixty to eighty feet wide, a suitable dimension for parking. The use of the mill framing as formwork for an "in situ" concrete parking garage might allow the retention of the major brick definition on behalf of the high quality of vernacular continuity formerly displayed by the mill yard. This sort of approach certainly seems worth exploration at the scale of the
"THE CONFLICT AND EFFORT OF SCIENTIFIC IMPROVEMENT IN MANUFACTURES ARE PAINFUL,... AS THEY TEND TO REDUCE THE MANUFACTURER... FROM THE NERVOUS STRESS OF ACTIVITY WHICH... HIS MIND AND FATIGUE HIS DEXTERITY... OF EFFORTS WHICH DISTORT HIS HEALTH AND..."

ANDREW URE
"PHILOSOPHY OF MANUFACTURE"

ERLY 19TH CENTURY VIEW OF LOWELL MILLS

ROMANTIC LANDSCAPE WITH LOWELL AND MILLS

OF THE BOMBS IN STOUDLEY, GREAT BRITAIN, 1811...

AT STOUDLEY, NEW MODEL TOWN,... THE WEAKERS BAVE INTO FACTORIES, DESTROYED LOOMS AND OTHER MACHINERY. FIFTEEN OF THE BROTHERS WERE CAPTURED... THE WRITERS OF THESE LINES WAS PRESENT DURING THE DESTRUCTION BY FIRE OF ONE OF THE MANCHESTER FACTORIES. THE BURNING BUILDING WAS SURROUNDED BY THOUSANDS OF SYMPATHIZING PEOPLE, WHO, FACES REDDENED BY THE ASCENDING FLAMES, EXPRESS..."

JOHN LUDLOW & LLOYD JAMES
"PROGRESS OF THE WORKING CLASS 1852-1857"

OF THE BOMBS IN LOWELL...

"SLOWLY THE REALIZATION CAME THE OLD DAYS OF COOPERATIVE EFFORT WERE... AND THAT SUCCESS IN THE FUTURE WOULD BE OBTAINED BY EFFORTS... THE BITTER STRUGGLE WOULD BE BETWEEN MILL AND MILL, EMPLOYER AND EMPLOYEE..."

J. COOLIDGE
"WILLIAM MANSFIELD"
Lawrence, Lowell and Manchester mill yards.

The problem of the mills as a wall between the city center and the river is most poignantly felt because the mills are largely uninhabited. Were they to be intensely used and their open spaces landscaped for public use, the adjacency to the river would no longer be a wall. Penetration to enjoy the positive aspects of the river could easily be achieved through or between buildings. The river in return would generate qualities which would make the adjacent properties desirable locations.

All of these partial scenarios are dependant upon the assumption that the mills represent a quality which is worth retaining in part or full, or that there is an economic advantage to the owner to reuse existing definition rather than demolish and build anew. The critical force preventing even an economic non-emotional argument from operating in the mill towns is the ingrained prejudice against the industrial residue. Whether this is a result of personal hardship at the hands of declining industry or the associative valuations which rightly connect industry, exploitation, unemployment, and pollution; in any case, the prejudice seems incapable of projecting new uses in the spaces of the mill yard. Were a more exploitative attitude to be taken by public opinion, the mill buildings might be seen as the final and deserved "rip off" from the retreating textile industry. The residue of the textile industry could be viewed by the towns as a
low-priced built matrix for the future growth of the town. The prices for which these buildings can be bought is usually less than that which the same site cleared would cost. This is usually related to the cost of demolition which is around forty cents per square foot of floor area. A typical residual mill which has no updated or usable mechanical systems can be bought for as low as thirty cents a square foot. Usually the only thing preventing the demolition of the buildings is cost of demolition compared to the going cleared land values. As these rise, more demolition can be expected unless the utility of the buildings can be proven.
"THE TRADITIONAL NOTION THAT EACH OBJECT HAS A SINGLE, EASILY DEFINABLE FUNCTION CLASHES WITH ALL THAT WE KNOW ABOUT HUMAN PSYCHOLOGY; ABOUT THE ROLE OF VALUES IN DECISION MAKING; AND WITH ORDINARY COMMON SENSE AS WELL. ALL PRODUCTS ARE MULTI-FUNCTIONAL."

ALVIN TOFFLER, "FUTURE SHOCK"

THE CHASE MILL, BUILT THE LATE 19TH CENTURY IS STILL OPERATING, AS A MILL. ITS RURAL SETTING OVERLOOKING THE MEADOWS VALLEY IN SUNDALE, N.H., HAS GIVEN RISE TO NUMEROUS PROPOSALS FOR CONVERSION, INCLUDING HOUSING FOR THE ELDERLY.
Adaptive Reuse: Examples

The goals and intentions of those actively engaged in the "mill scene" can be categorized as can the approaches taken to the mills' renovation. Obviously, the restoration of nineteenth century mill buildings to nineteenth century mill buildings has limited utility in anything but an academic context and, this is being undertaken by Old Sturbridge Village where an early nineteenth century stone mill is being relocated. Here the goal is to restore it to its original condition and use.

Another approach to conserving mill buildings is that which SPNEA seems to use, that is by preserving the building as empty museum-like recollections of past eras in the hope of financing becoming available for active museumship. This seems less constructive than an active demonstration in a single building. Resources for putting these buildings into suspended animation, (no mean sum for something which has no future potential to provide income) is not available while space needs abound along the urban corridor in which the bulk of these mill buildings occur. Adaptive reuse seems to be the answer to many of these conflicts. Were there to be an investment incentive, a far greater range of building types might be restored to use, satisfying antiquarians who live in fear of the wreckers' ball while satisfying space needs in a variety of areas.

Adaptive reuse has operated from the beginning of the history of buildings; temples became fortresses, became
storehouses, became churches, became temples again. In the comparably short history of American building, the precedent already stands. The causes are always the same: general social/economic/cultural change. Country estates of the wealthy elite no longer exist in the same quantities as they did; most of these have been turned into institutional use more commensurate with their operational scale today. An early example, the grist mill, now replaced by mass food processing and industrial change has evolved to other uses. The textile mill has more recently in New England undergone a similar change, as labor markets and manufacturing processes change. This building type is now available in large quantity as a resource. Speculation on the adaptive reuse of highrise office blocks is probably called for as the next building type to evolve out of social/economic relevance.

Some of the useful precedents for the adaptive reuse of industrial buildings should be mentioned:

The conversion of the old Ghiradelli candy factory complex, a tightly knit industrial complex of the late nineteenth century into a high-fashion commercial complex is the most discussed example of conversion and can serve as an excellent case against the standard argument that brick factory buildings are not a "nice place to be." The location of Ghiradelli Square is a key to its success and a quality that most industrial complexes cannot boast.

The nearby Cannery, a very plain brick factory building,
is another development which has capitalized upon location. Major restructuring of stair and circulation with concrete poured in place has updated the structure of the complex as well as creating a strong foil for the undifferentiated spaces which so easily lend themselves to commercial use.

But the strongest qualities in either is the richness of the irreproducible nineteenth century brickwork. Sand blasted to a rich rust/pink, the brick corbels, arches, soffits, are commonplace details from a long gone craftsman's age, and as such are an invaluable reminder of the quality with which an incremental growth system can operate.

The Cannery project helps to show the potential spatial opportunities that can be achieved within the regular grid matrix of an industrial building. Here, a subtractive carving process was used.

Academic space needs are the first to be felt as population growth outstrips economic growth. Adaptive reuse has already set scattered precedents even in the highly coded restricted area of public education. The Franklyn Arsenal Guage building in Philadelphia was a government testing laboratory built in 1925, a concrete frame dropslab, mushroom column construction type which prevailed during the period. With minimal formal changes, major partitioning, surface treatments and HVAC plumbing and electrical alterations, this residual building was turned into a competitive academic building for only 45% of the cost of a comparable new facility. The level
of architectural intervention with the primary structure was minimal so that unlike Ghiradelli and the Cannery the spaces did not change distinctly from their undifferentiated continuous open factory space except through local smaller scale intervention, furniture and partitioning and graphics. In a building with as large a structural bay (30') flexibility exists also in the exterior surfaces which are mostly infill glass and brick between the structural column and slab. Some alteration of the uniform industrial glazing systems produces a differentiated and more digestable format for the new use.

A bathhouse in South Boston was converted into a high school annex for a comparatively low cost of $11/δ compared with the current $40/δ new building cost. A concrete building from the late 1920's, the bathhouse provides a single large space which was divided into 16 classrooms serviced by a single loaded corridor, the mechanical systems were largely utilized.

The use of factories in Philadelphia, Chicago, and New York for public schools has now been tested in a number of situations averaging $12/δ as conversion cost. These precedents are useful when trying to make conversion a palatable alternative for the board/town/region involved. The structural types do not directly relate to those of the nineteenth century. Although undifferentiated factory is the result in either case, the later concrete construc-
tion is usually larger bay dimensions (20'-30') than typical mill construction (8'x20'). There are more, but smaller columns in mill construction. Mill construction is timber and defined as type III by the uniform building code while the concrete warehouse/factory is type II construction. This is equivalent to the difference defined in the nineteenth century between fire resistant construction and fire proof construction.

For use as schools in most regions, heavy timber construction (type III) is not approved for public school use despite the fact that most public schools still in use built prior to 1900 are of this same construction, (there are innumerable buildings of this sort in use today with heavy timber, fire-resistant construction). The richness of brick and stone detailing in the buildings of the late nineteenth century is uniformly better than that of industrial or institutional brick work of the early twentieth century. As a source of environmental quality, I don't think this factor can be overlooked.

The major argument, therefore, against use of mills as academic sites seems to be the fire code restriction, as spatial adaptability seems to have been well documented.

The applicability of the mill construction type to housing needs has only been superficially tested. A 221(D)3 FHA financed housing project in Meriden, Connecticut transformed the late nineteenth century mill building of the architectural type expressed into two-bedroom,
one-bedroom, and efficiency apartments at low cost. The approach was a maximum packing system in which units were grouped around central corridors. The facade was rendered unidentifiable as mill construction by the application of surface veneers uniformly around the window bays. This application of architectonics seems to be in the vocabulary of facelifting and not at all sympathetic with whatever quality may have been in the original masonry construction.

A large single mill in Suncook, New Hampshire, was proposed as housing for the elderly. A rural setting and a view across the farmlands of the Merrimack River Valley make this mill one of the most appealing for adaptive reuse. A similar setting and comparable qualities have made the Crown and Eagle Mill in North Uxbridge, Massachusetts a more recent candidate for the housing market. The 221(D)3 housing proposal made for that building was forestalled at the eleventh hour by the intervention of the still conversation minded Society for the Preservation of New England Antiquities. A real question of priorities arises here.

Laconia, New Hampshire has managed over much local hostility to save two mills from the fate of urban renewal demolition. The Busiel Mill was developed privately by a local lawyer into offices for his own firm and rental space. Extensive work on the brick work, sand blasting, and repainting has produced a building of a sort of pink
Georgian quality which serves as an excellent example of the surface that can be retrieved from the often begrimed exteriors of urban mills.

Adaptation of this 40'x90' mill is facilitated by an elevator and enclosed fire stairs placed on the interior of the mill. The cost projected on this project is $22/+. The Belknap Mill adjacent to the Busiel Mill is being done as a civic undertaking with solicited funds for use as institutional space, museum, meetings, teachings and social services. The non-profit nature of the users makes the project more difficult to effect but when completed will be an excellent example of the utilization of available space for joint occupancy by hitherto unrelated institutional activities.
Mechanical Systems--Existing and Conversion

The measure of the utility of an existing mechanical system in a mill building is entirely dependent upon local conditions; however, one or two generalizations may be made about its relation to the building type.

The traditional methods of heating a brick bearing wall, post, beam, and plank mill building evolved through the nineteenth century as did all the technology of energy transfer. The earliest mills were heated by wood burning stoves at either end. This provided uneven heat, a problem further compounded by the general inefficiency of the structure at resisting heat loss. The R value (reciprocal of the heat loss factor) which measures the total resistance of the wall section to resist heat loss is very low for uninsulated solid masonry walls. A 12" brick wall has a 2.54 R value. This is equivalent in resistance value to 3/4" tongue and groove wood siding. This, coupled with 30% glazing whose resistance is even less, makes a comparatively difficult building to heat, a factor of great importance when planning conversion.

As the heating techniques became more sophisticated, the mills adopted two other approaches to heating. With the advent of steam power from coal furnaces, steam pipes were run around the periphery of the mill usually in three or four pipe banks which provided radiant heat under the windows--another development which took place in the later part of the nineteenth century was the use of hollow brick piers between the windows. Fed from a common plenum
at the bottom, air was heated by the coal burning furnace. This early version of the forced hot air system utilized heat from the steam turbines.

Both these systems were appropriate for the open unpartitioned floors of the textile mill. It is unlikely that these systems would be applicable to conversion of the building to uses which would require major interventions in the spaces. However, both systems can be directive in how the structure could be heated. The nature of the construction discourages major ducting of forced hot air through the floors so that the steam pipes prototype offers the easiest installation. Modern forced hot water baseboard radiation is an efficient heating technique which requires only minor intervention with the existing structure.

Where the use of the space is to be open undifferentiated by partitions a hot air application could be made with a shaft of ducts throwing heat from the center towards the windows. Ducting in the opposite direction of the beams must be below the beams so the contingent problem with exposed ducts and hung ceilings are largely dependent upon the uses and user.

A simple solution that can be found in many conversions to office space or housing predicated upon the double loaded corridor is a hung ceiling above the corridor containing ducts with supplies into the adjacent peripheral spaces.
Another approach to the problem which allows the user to subdivide the floors into autonomous zones is self-contained fan coil units hung from the ceiling. These do not rely on convection as does the radiant baseboard heat, so that although the unit is self-contained this is not enough, exhaust air must be ducted out of the space. One system being experimented with for application for outdated school structures is a combined self-contained unit based on combined air heating and air cooling capabilities with close control of moisture level and pollen count. The unit installed on the ceiling would draw exterior air through an opening, either an existing window or a new opening in the wall, from outside. Air passing through filters and either heating or refrigerating coils would then be delivered "pure" to the classroom. Return air ducts would take exhaust air to the outside.

The principles behind most traditional environmental control systems by their interiorization and insulation of the built environment seem to acknowledge passively the continuance of external polluting practices and in so doing make the continuance of these practices possible. The utilization of traditional heating and air conditioning practices allows only short-term, stop gap solutions to larger environmental problems. I look, therefore, to the tradition of the total ecology textile village for prototypical solutions and local autonomy.
The textile village in its earliest period of patriarchal control provided the total life supports for its inhabitants from farming for their food to later generating power for electricity in the mill village, steam for heating, and gas for lighting the surrounding buildings. An opportunity to reinstitute this autonomy lies within the remains of this earlier structure.

River head and power generation usually had much to do with the growth capabilities of the towns or cities which grew along New England rivers. The mills which grew beyond the capacity of the river to power them were in trouble in times of drought and ice blockage. As a result, this partially determined the industrial growth in certain areas prior to the invention and availability of the steam engine and railroad.

With the coming of the railroad to deliver coal and raw materials and haul goods to market, the mill was no longer dependent on its river-edge location for power generation or the distribution of goods. Finally, electricity replaced the steam engine and the mills were entirely disengaged from the rivers as a motive power.

The history of Harrisville, New Hampshire, a small mill village, shows a typical evolution of the motive power; in 1832, an undershot waterwheel was installed to drive the spinning machines. The first turbine was installed by the Cheshire Mills in 1851; however, interruptions in production due to a waning water supply forced the Cheshire Mills to install a reserve steam turbine in 1884. The
railroad had been connecting Harrisville with outside markets since 1878.

It wasn't until 1948 that mechanical belt drive was replaced by electric motors mounted on the ceilings. What has happened in the late nineteenth century is a plugging in of the previously self-contained local ecology to sources of outside energy, the railroad, and coal. This direction implied a new dependency and loss of control of environmental quality. At the same time that mills were getting away from dependence upon the river and involved with the national power grid, they have been unable to become independent of the river as a plumbing system.

As a derivative of the early concept of a self-contained ecology at the scale of a corporation, or a settlement, I will examine as a conversion alternative a mechanical system which is based on the original motive power propositions yet is not exploitative but instead reinforces positive aspects of the local ecology.

The concept of "total energy" has been proven a cost saving in a number of installations including a J.M. Field's store in Chelmsford, Massachusetts, and schools in Lansing, Michigan (130,000 $ ) and McAllen, Texas (212,000 $ ).

Total energy is deceptively simple...the school or college installs its own electric generating system, then captures the system's "waste heat", converts it into steam or hot water, and uses this by-product for heating, air conditioning, and domestic hot water. In appropriate situations, fuel costs to power the generating system are less than the cost of electricity from a public utility. And the heat supplied
by the recovery system represents fuel that would otherwise have to be paid for.

The case is made for self-contained energy plants to integrate the energy of a building's operation to complement each other. A proposition which seems from the EFL study to operate both ecologically and financially.

Waste heat is not lost in the atmosphere but directly applied through heat converters to the system's demands. Cost savings in the total operation due to cutting heating fuel needs are realized; this also reduces the per capita fuel resource depletion. This may be an appropriate installation in more modernized textile mills which already have portions of the electric generating system. For conversion to one of the many uses, school, office, factory, or shopping center, the utilization of the total energy concept would seem to be entirely appropriate.

However, as appealing as "total energy" may be in capturing hitherto wasted resources the precedent of "total energy" practiced by the early textile mill comes much closer to a realization of "total energy" in that no fuel had to be transported or burnt. Water head can turn modern turbines to generate electricity with great efficiency, eliminating the need for outside fuel for running the turbines. Electricity can be used as a source of light, heat, and power, eliminating the need for other power sources.

The mechanical scenario for the conversion of textile mills is not complete without looking at the waste disposal
systems operating in the traditional textile mill and the existing problems of conversion. Prior to recent anti-pollution laws, the major industrial complexes located along rivers used the water as a power source and as a waste disposal medium. For many small mill towns clustered around the edge of a river, this has become a critical problem. The city of Manchester, New Hampshire was not able to effect the transition to "modern" waste disposal systems without demolishing one-third of the mill yards to accommodate the system.

Many river edge villages have geological conditions which preclude traditional septic and leeching systems. One possibility which is being developed is an anaerobic solid waste digester system. These self-contained systems reduce organic waste through biologic conversion to CO₂, hydrogen sulphide, and methane. The methane can be used as a combustible gas source for cooking or heating.

The elements are now ready to be assembled, the found object, the built landscape, the abandoned textile mill complex, the built in logistics of a source of hydro-electric power, recently developed technologies for total energies, self-contained environments. These pieces could be put together by any number of users, institutions, cooperatives or even speculators. Cost savings can be made in initial building purchase cost, in the conversion cost by the use of recycled materials, operational costs in the self feeding total energy system which accrue
over time against a higher initial cost for mechanical systems.

The direction of this argument is toward self-defining closed systems in which local participants would determine their own environment independent of larger systems.

Closed systems of this sort represent more than potential efficiency. In fact, they represent the development of a new synthesis. The family unit will have moved from the early freedom of its earth related closed system (the land, a well, septic tank, compost, and fireplace) through the linear development of public utilities to a new level of independence and dispersion. High technology products will supply human needs free of the constraints and the preconceptions in our present view of utilities.

Although the residual buildings of the textile era can be viewed as a "rip off" from a passed culture, many of the other legacies of the industrial period, such as pollution and the economic class system, are more difficult to find utility in. In keeping with an attitude which tries to view "problems" as "benefits" it seems suitable to view the mill site, once the worst polluter in New England, as a test case for closed system biological conversion and total energy systems. Manchester has used its mill site for a city scale sewage treatment plant, but this is only a partial utilization of the available energies in the mill yard ecology. It is expensive and produces no usable by-products. At one stage the mills produced the power for a whole city from their water power privileges, at the same time the river was the sewage system for the city. Soon federal and state laws will force river edge communities to adopt sewage treatment systems. But the
installations are not capable of returning energy to their users as some of the systems being experimented with are. With this approach the user is in a position of paying, first for the errors of the industrial age, and second the ongoing cost of treatment, a non-productive process. The concept of "total energy" reduces operating costs against a greater installation cost. In closed system biologic conversion of waste, free energy is tapped at two stages, methane from the breakdown of organic waste can be burned for fuel and solid organic waste can be used as fertilizer or in hydroponic gardening. The details are endless but the goal of a closed system is to get beyond the present stage of linear connectivity. A prototypical self-determining environment in which local participation determines local practices and the cost to the environment can be measured and controlled directly. The local ecology can unplug from national grid systems enough to regain control over local environmental quality.
Detail 1

Detail 2

Detail 3

The subdivision of a building into public and private zones or ownership can be achieved with standard drywall construction. By adding a sound barrier, such as a 2" board wall, the sound transmission can be reduced. Sound insulation in floors can be achieved by adding a 2" plywood or sheetrock. An additional 2" board wall can increase the sound insulation further. Sound insulation time which would be useful in open or high noise environments.
A REACHABLE STORM SASH APPLIED FROM OUTSIDE TO EXISTING DOUBLE HUNG WINDOW.

THE TRADITIONAL STEEL INDUSTRIAL SASH CAN BE USED IN LARGE OPENINGS, AND MAY BE FOUND IN NEARLY IRREDUCIBLE BUILDINGS (EACH). A THREE-CONSTRUCTION WINDOW IS DETAILED IN SUCH A WAY AS TO ALLOW USE OF THE OLD SASH AS WELL AS FIXED PLATE GLASS AND A VARIETY OF OPERABLE ELEMENTS.

CONVERSION
ENLARGED OPENING
STORM SASH
THE EASIEST AND MOST DIRECT SPATIAL INTERVENTION IS THE REMOVAL OF EXISTING FLANKS. THIS PARTIAL DIVIDING OF THE INTERIOR SPACE, CAN BE USED TO OPACELY CREATE A WELL. AT TWO STORY SPANS OR THE REMOVED MATERIALS MAY BE REUSED IN A LIBRARY OF BEARABLE ORGANIZATIONS, BRINGING FROM ENTRANCE AND LOBBY TO FURNITURE, WITHIN THE SPACE.

USE

ALTERNATIVES

FORM

INTERNAL CARVING

COMPONENT REALLOCATION
Window openings may be enlarged to coffin height and frame extended as outside "canopies." An assembly of timber construction uses the structural frame as a matrix for brick, glass, and fixed glazing. The voids design a single structural solution similar to window-wall construction.

Use Alternatives

Form

Greenhouse Window Extension
USE ALTERNATIVES

FORM

ROOF AS GROUND
EXTENSION OF FRAMING
A MAXIMUM PACKING APPROACH

LEVELS 1, 2, 3, 4

DIFFERENT APARTMENTS: 550 sq
ONE BEDROOM APART. 420 sq
TWO BEDROOM APART. 620 sq
EACH OF TOTAL SPACES IS IRREGULAR (MAINS)
ENHANCES CIRCULATION.

SECTION A/A

LEVEL 1 & 2

APARTMENT BLOCK SEPARATE TO THE
FULL PROJECT IN ANOTHER TO ITS VARIOUS ADVANTAGES.
IN THIS CASE IT WOULD USE LIVING MULTICOLORED
AND AN ELEVATED ROOF FLOOR CORNER INTO THE
APARTMENT.

BELLOW

THE ZONE APPROACH CREATES SEPARATE AND
WALLS, STAIRWELL, ALLUMS FOR CONSIDERED
UNIT DESIGN - COLLECTIVE ORGANIZATION ALLOWS MORE
FEATURES IN A UNIT, AS OPPORTUNITIES FOR INDOOR
OPENINGS WITHOUT BLOCKING OR CORRIDORS.
A SEPARATE ELEVATOR AND SMALL TOILET LAVS
ONLY AT THE CIRCULATION LEVELS. FIRE ESCAPE
IS ACQUIRED WITH FIRE ESCAPE ХABIT AT HEIGHTS.

A ZONE APPROACH WITH INDIVIDUAL DESIGN

HOUSING CONVERSION
2 BAY 40' MILL
A MAXIMUM PACKING APPROACH

THE W.I.R. LEVELS ITSELF TO THE MAXIMUM PACKING SOLUTION WITH LABOUR UNITS. THE SINGLE-UNBED CONVERSION SOLUTION IS IMPOSSIBLE FOR THE MILL TYPE.

A MULTI-ENTRY, PARTY WALL APPROACH


HOUSING CONVERSION
3 BAY 60' MILL
CARVING - A SUBTRACTIVE APPROACH ALTERNATIVE ONE

GROUNDS FLOOR PLAN

ONE METHOD OF CREATING MORE LIGHT, PRIVATE EXTERIOR SPACE AND A VARIETY OF
UNITS HAD THE BO WALLS PURSUED. INSTEAD OF OBLITERATING THE MILL,
CARVING MAY BE APPLIED TO THE INTERIOR FRAMES OR CONTINUOUS SURFACE.
CARVING MIGHT BE USED TO REDUCE THE WEIGHT OF STRUCTURES ALTERNATIVE PLANS COMBINE AN ELEVATION BLANK ON CARVED
UDGES APPROPRIATELY IN THE WALLS OR ALTERNATIVE PLANS OR IN THE ELEVATION
CUTOUTS. THE ENTIRE EXTERIOR IS ALTERED, ALTHOUGH THE EXTERIOR HAS REMAINED THE EXTERIOR
CARVING.

CARVING - ALTERNATIVE TWO

WHEN CARVING THE LINER FRAMEWORK ONLY
A LIGHT PRODUCER LIGHT AND AIRFLOW
SPACE. MATERIALS CAPTURED FROM THE MILL, CUT INTO THE UNITS
AND ON THE INTERIOR WALLS ARE DRAWN OUT.

CARVING - 3RD OR 4TH FLOOR PLAN

SECTION A

SECTION B

HOUSING CONVERSION

3 BAY 60' MILL

CARVING

SUBTRACTIVE DESIGN
This partial view of a "carved" mill shows a number of the interventions already described. The large quantity of materials removed would be used in the exterior definition and elsewhere.

HOUSING CONVERSION
3 BAY 60' MILL

CARVING
SUBTRACTIVE DESIGN
FOOTNOTES


13. Scully, p. 13


18. Telles, p. 239.
21. Scully, p. 64.
27. Cooledge, p. 113.
28. Banham, Reyner. "The Architecture of Wampanoag", in Meaning in Architecture, ed., Charles Jencki and George Baird, New York, 1970, p. 101. Banham coins the term "flatscape" from the enormous undefined surface required by the container transport industry. "Flatscape" is a term of approbation for a value-free environment whose analog can be seen in the wharf side deserts where definition alters with the daily shipping movement. Although the advocacy of a value-free environment is directly in opposition to my thesis, Banham's characterization of current industrial goods movement practices is poignant and contributes to an understanding of the evolved utility of nineteenth century industrial structures.
30. A group described to me by Burton Phinney is experimenting with the possibility of updating mechanical equipment in schools with self-contained ceiling hung units which would deliver filtered, de-ionized, heated or cool air to a classroom, the unit would also contain the lighting system.
FOOTNOTES ON ILLUSTRATIONS

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Illustrations: Scully, p. 69.

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Illustrations: Courtesy of the print collection in the Merrimack Valley Textile Museum, North Andover, Massachusetts (MVTM).

Page 25
Illustrations: Courtesy of Richard Candee of Old Sturbridge Village.

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Cooledge, p. 27.
Illustrations: Cooledge, p. 27.
"East View of Lowell" courtesy of Richard Candee, OSV.

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