Society for Industrial Archeology · New England Chapters

VOLUME 23 NUMBER 2 2003

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Call for Papers

Annual Conference on New England Industrial Archeology

February 14, 2004
at Plymouth State University
Plymouth, New Hampshire

Deadline for paper proposals: December 31, 2003.

The Southern and Northern New England Chapters of the Society for Industrial Archeology invite proposals for papers to be presented at the Annual Conference on New England Industrial Archeology. This year's conference is to be held at Plymouth State University in Plymouth, NH, on February 14, 2004. Presentations on all topics related to industrial archeology and history are welcome. The program committee especially encourages papers related to some of the general themes of industry in New England. There is particular interest in proposals from new members and those who have not spoken to the group in recent years. Proposals from non members are also encouraged. Proposals may include individual papers or reports on works in progress and are strictly limited to 20 minutes.

Formats: Each paper proposal must include: 1) title; 2) an abstract of not more than 300 words; 3) a one page resume for the presenter(s), including postal address, telephone/fax, and e-mail;) a list of audio-visual requirements. All proposers are asked to submit two (2) copies of their proposals.

Deadline: Proposals must be received by December 31, 2003.

Send paper copies of proposals to: Dr. David Starbuck, Department of Social Sciences, Plymouth State University, 17 High Street, Plymouth, NH 03264-2351. Inquiries are welcome at this address, or by phone (603) 535-3076 (office) and (518) 494-5583 (home) or by e-mail: Starbuck@Net Heaven.com.

Presidents' Comments

Southern New England Chapter

Planning for the Society for Industrial Archeology's 33rd Annual Conference in Providence and the Blackstone Valley continues. The conference will run from Thursday, June 10 to Sunday, June 13, 2004. The conference hotel is the Marriott Courtyard hotel adjacent to the Rhode Island Convention Center. Additional rooms will be available at the meticulously restored Providence Biltmore for members who prefer staying in a historic hotel. Paper sessions, the annual business meeting and luncheon will convene at the Convention Center.

The opening reception will be held at Slater Mill in Pawtucket. The adjacent Blackstone Valley Visitors Center will be the site of an orientation talk and refreshments. Docents will be stationed at operating machinery in the Slater Mill site to demonstrate and explain the significance of the equipment. This will not be a guided tour-rather, small groups or individuals can roam through the museum and concentrate on their area of interest.

We have secured the Rhode Island Foundation's building for the Newcomers reception and "Show and Tell," a free-form session where members are encouraged to present brief progress reports on current projects, preservation topics or subjects related to Industrial Archeology. The building is the former New Haven Railroad Station, restored and adapted for use as the Foundation's headquarters. All of these venues are within a two or three minute walk from the conference hotels.

We have added an additional session that will run concurrently with the formal paper presentations. Space will be available for "Poster Sessions." Conference attendees will be able to set up displays of artifacts, drawings, historic photographs, books for sale and IA subjects that are better presented in a "Science Fair" setting than in "Show and Tell" or as a formal paper.

Greg Galer, co-chair of the conference committee is continuing to arrange for tours of area industry. We will be requesting volunteers to write brief histories of the companies that have agreed to participate for publication in the 2004 Conference Guidebook. Currently, pre- and post-tours have been scheduled at the New England Museum of Wireless and Steam. The conference's closing event will be a buffet dinner aboard the "Bay Queen" on a cruise of upper Narragansett Bay. A narrator will describe some of the historical and industrial sites along the bay.

The "Call for Papers" will go out in November. If you have done research on the early industrialization of Southern New England or maritime activities in the area, please consider developing a presentation for the conference. If your work is in progress consider presenting it at the "Show and Tell" session or as a poster production.

A number of members of the Southern New England Chapter are familiar with the area and have volunteered to help organize and conduct the 2004 SIA Annual Conference. More volunteers will be needed as tour guides researchers and for arranging snack and drink service for "Show and Tell" the bus tours. If you want to volunteer you may contact Greg Galer or me at robert.stewart13@att.net or ggaler@stonehill.edu.

Bob Stewart
West Suffield, CT

Northern New England Chapter

The Northern New England Chapter held its Annual Meeting at the Bennington Museum in Bennington, VT, on Saturday, October 11, and we are most grateful to Richard Borges, Director of the Museum, and his staff for hosting an excellent meeting. Vic Rolando presented a most interesting program consisting of a talk about the "Parian Pottery Dig" conducted in Bennington in 1997-1998, and then tours (after lunch) of the Bennington Potters (a modern, commercial, pottery plant) and the Bennington Battle Monument. A good time was had by all.

At the Annual Meeting, new officers were elected for 2004, so I am writing this as outgoing Chapter President. Our new President is Dennis Howe, and Betty Hall and David Coughlin are continuing as our Chapter Vice Presidents. Carolyn Weatherwax is our new Chapter Treasurer (so please send dues to her now, 305 Heritage Way, Gansevoort, NY 12831), and I am the new Chapter Secretary. And, always a glutton for punishment (!), I am continuing as Editor after 23 years in the position.

Our Chapter will be hosting the Annual Conference on New England Industrial Archeology on February 14, 2004, once again at Plymouth State University, and I really hope that many of our members will consider presenting papers at the meeting. Abstracts may be sent to me at PSU, Department of Social Sciences, 17 High Street, Plymouth, NH 03264-1595. The roads to Plymouth, NH, are almost always excellent in the middle of the winter, and I look forward to seeing you there.

David Starbuck
Plymouth State University

BOOK REVIEWS

Maryland Mining Heritage Guide

Including Delaware and the District of Columbia
88 pages, illus. & maps,
$11.95 ($8.33 direct from publisher)

New Mexico Mining Heritage Guide

164 pages, illus. & maps,
$14.95 ($10.33 directly from publisher)

Both by John R. Park

Published by Stonerose Publishing Company,
7741 S.W. 59th Ct.
South Miami, FL 33143-5112

Back in the Volume 20, Number 2 (year 2000) issue of our *SIA-New England Chapters Newsletter,* I reviewed John Park's *Guidebook to Mining in America.* That 2-volume work reported on hundreds (thousands?) of sites, ruins, and aspects connected with mining and processing throughout the country - truly a labor of love if I ever saw one. John had requested updates and/or corrections to any errors or omissions, and I thought that some day I might see an updated revision. But what I have recently received is well beyond what I expected.

Last spring (2002) I received a copy of John Park's newest addition to his mining book - *Maryland Mining Heritage Guide including Delaware and the District of Columbia* and this spring I received another in what I suspect will be an ongoing series - *New Mexico Mining Heritage Guide*. Both are stand-alone publications that supplement and expand their sections in the original Mining in America guidebook.

The new Maryland mining guide has expanded the 33 entries in the Maryland, District of Columbia, and Delaware chapters in the Mining in America guide, adding 130 new entries and 9 new text inserts, adding up to 163 entries and 12 text inserts on 88 pages, 44 photos, and 4 maps that illustrate the entries. The New Mexico has increased the number of entries from 79 to a whopping 318 entries, 22 text inserts, 118 photos, and 25 maps on 163 pages. I have no idea where John found the time (or energy) to pull this all together from his home in Florida.

As they are in the original mining guide, entries in the current versions are concise, thumbnail descriptions of mines, museums, furnaces and kilns, quarries, etc., written plainly enough to whet anybody's appetite for adventure in the field. Driving data is bare-bones, but enough to get you into the area whence one must use local maps. In many cases, USGS topos are a must, especially for some of the New Mexico sites.

Both publications contain profuse symbols for site type identification, a list of abbreviation used, and for such ancillary information as to whether visited by the author, locations of public phones, and location codes. Whether a site name is printed bold uppercase, bold mixed, non-bold uppercase, or other combinations all mean something important and are explained in the legends. Nothing is left to guesswork - the sign of somebody taking advantage of every bit of space. Yet, the text isn't cluttered or confusing - well designed, laid out, and easy to read. Type size is slightly smaller than in the original Mining in America, but style is the same. Both are 5-inches wide by 8-inches high and plastic-comb bound - to fit on anybody's bookshelf and fit most backpacks and vehicle glove compartments.

Future issues in the works are for Arizona, Illinois, Iowa, Missouri, and West Virginia. Visit the website at http://stonerosepub.home.att.net or email at stonerosepub@att.net.

Victor R. Rolando
Shaftsbury, VT

The NNEC-SIA Spring 2003 Field Tour

The Spring 2003 meeting and field trip sponsored by the Northern New England Chapter, SIA, took place on Saturday, May 10, a day offering splendid weather for such an undertaking. The itinerary allowed participants to visit six major sites whose connecting strand was either the long-abandoned Eastern Route of the Boston & Maine Railroad's Portland Division or its Conway Branch, previously the Portsmouth, Great Falls & Conway (PGF&C) Railroad.

Nineteen persons in all-twelve NNEC members, three SNEC members, and four guests-participated, with the majority meeting at the north end of the Sarah Mildred Long bridge, spanning the Piscataqua River between Portsmouth, NH, and Kittery, ME. The steel, double-decked, vertical-lift structure, accommodating By-Pass U.S. I on its upper level and the railroad stub line serving the Portsmouth Naval Shipyard on its lower level, was completed in the fall of 1940, only 12 years before this stretch of the Eastern Route was abandoned. Until 1927, the York Harbor & Beach Railroad turned off at Kittery Junction, just north of the Long Bridge's timber predecessor, and thereafter the first mile was retained. Thus the stub line now in place is historically the remnant of Eastern Route, YH&B, and Shipyard Railroad trackage. Members were able to view close-up not only the lower bridge level and the track leading downriver to the naval shipyard, but also the surviving concrete tunnel that permitted the Eastern Route's single-track main line to pass under the highway.

Thereafter the participants proceeded in convoy, with the next stop an unscheduled one, six miles from the starting point. In the field on the opposite side of Maine Route 236 from Marshwood Junior High School in Eliot, a linear array of concrete anchors and a granite-block abutment stand. They are the remnants of a steel bridge permitting the trolley cars of the Portsmouth, Dover & York Street Railway, later the Atlantic Shore Line, to pass over the B&M right of way, going to and from Rosemary Junction Station. The sites of that station and the railroad's Eliot depot both lie near the junior high school.

Nearly 4.5 miles to the northwest, at Jewett in South Berwick, Route 236 diverges left from the trackbed of the B&M's Eastern Route, onto that of its Conway Branch. Here, at the intersection of Fife Lane and the highway remain the ashlar block turntable pit and foundation of the three-bay locomotive house for the former Portsmouth, Great Falls & Conway RR. Ironically, the railroad never ran beyond this point into Portsmouth, but it did extend farther north than Conway, to Intervale in order to connect with the Portland & Ogdensburg RR, later the Maine Central RR. This location bore two previous names: Conway Junction, and before that, Brock's Crossing. The gran-

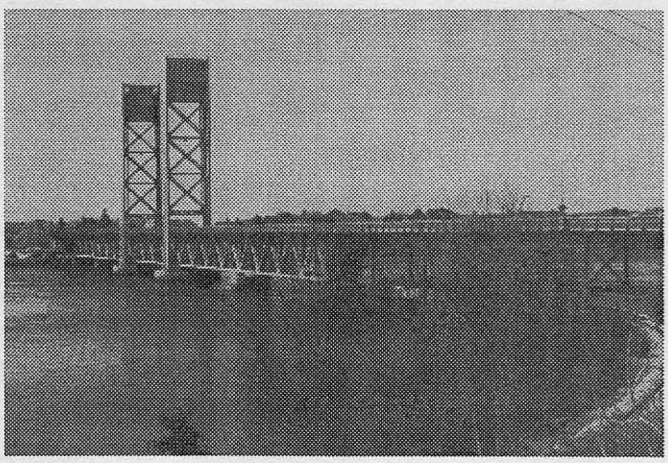


Fig. 1. The Sarah Mildred Long bridge, a vertical-lift structure completed in November 1940, spans the Piscataqua River between Portsmouth, NH, and Kittery, ME. Its lower deck accommodates the Boston & Maine (now Guilford) Railroad line curving downriver to serve the Portsmouth Naval Shipyard in

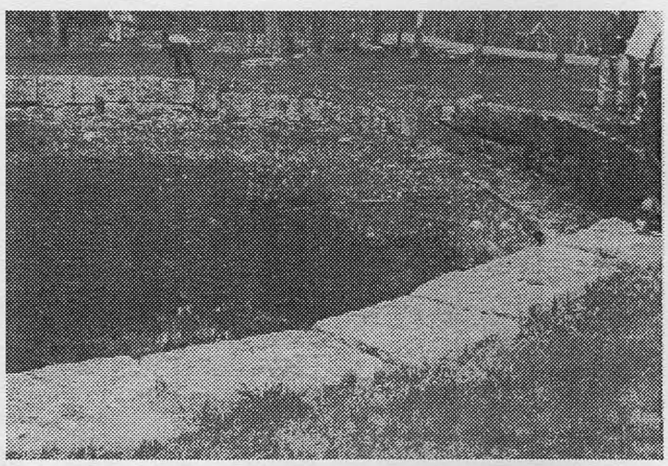


Fig. 2. The granite-block turntable pit and foundation beyond it for the threebay locomotive house, were built for the Portsmouth, Great Falls & Conway Railroad at Conway Junction, South Berwick, ME. The junction was later renamed Jewett by the Boston & Maine Railroad.

Fig. 3 The Burleigh woolen mill was constructed during the 1850s at Rocky Gorge, South Berwick, ME, using the falls of the Great Works or Asbenbedic River for the essential waterpower. The main mill building shown is a unique clapboard- over-brick construction. Th6 Great Works mill site is one of the oldest in Maine, in use since the mid- 17th century.

ite remnants are listed on the National Register of Historic Places.

Less than a mile farther, on Brattle Street just off Route 236, is the old woolen mill at Rocky Gorge, also known as Great Works. The watercourse is called the Great Works or Asbenbedic River, and powered the first sawmill here c1650, one of the earliest such sites in Maine-not at all surprising, given the height and power of the falls in the gorge. A tour of the mill was offered by the owners, John and Eric Truebe, who also participated in the day's tour. The main building that survives-the more extensive complex on the other side of the river no longer does-is an unusual clapboard - over-brick construction, the masonry interior wall apparently added inside the existing wood exterior. The mill was built by John H. Burleigh during the 1850s, and in the decades following, was operated under a series of names, including the Rocky Gorge Woolen Company. During World War II the mill made woolen army blankets, and postwar it saw successive changes in ownership before closing c1950. An older brick structure, likely a ginger mill, still stands on the other side of the river, and is now being used as an apartment building.

About 1.5 miles farther is the center of South Berwick. Continuing on Route 236, and then bearing left at the second split, the convoy arrived at Hog Point and the bridge across the Salmon Falls or Newichawannock River to Rollinsford, New Hampshire. Spanning the river at this point is the iron and steel trestle for the Boston & Maine RR's main line, formerly the Western Route of its Portland Division. That trestle was built in 1888, replacing a timber structure, and now consists of three different bridges, in decreasing size from east to west: the main deck truss over the river, and on the New Hampshire side, two successive deck girder bridges, spanning the trackbed of the old PGF~LC and Church Street. The iron trestle was upgraded in 1929; receiving two steel truss insertions and having rivets replace its original iron pins. The ashlar abutments and single pier for the long-gone branch-line RR bridge downriver remain, closely adjacent to the street bridge. The gazebo in Salmon Falls Village Park, in sight of the trestle and the dam and waterfall almost underneath, stands on the site of the branch-line station serving Rollinsford's mill village until the line was abandoned c1941.

Following the consolidation of the participants into a smaller number of vehicles, the convoy then headed west along the B&M (or Guilford) main line to visit the last surviving overhead, timber, boxed -pony-truss railroad bridge in the U.S., at the Rollins or Dodge Farm. Here the bridge permits an agricultural lane to pass over the railroad right of way to access distant acreage. The farm's main effort was a dairy herd, and accordingly, the overhead pony has three trusses, the third one supporting a cattle run parallel to the road deck. All three trusses are-or were, before being van-

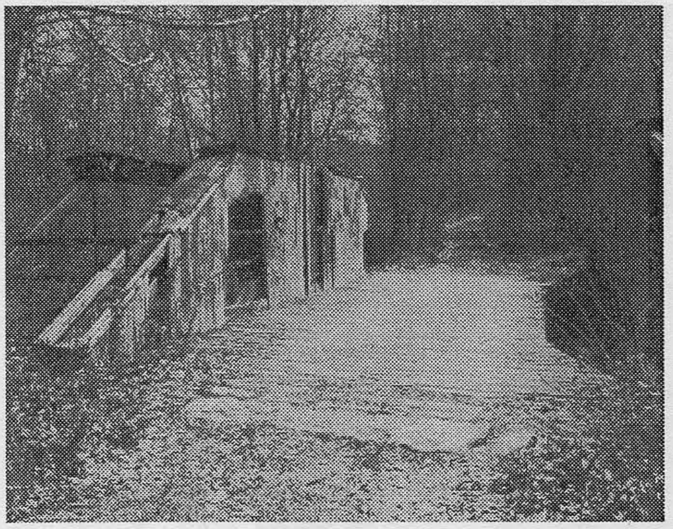


Fig. 4 Rollins Farm bridge spanning the Boston & Maine (now Guilford) RR main line at Rollinsford, NH, is a timber housed-pony-truss structure. It is unique among its handful of fellow survivors in being the last overhead railroad boxed pony now- standing, as well as for having three trusses in place, the third one (seen on the far left) to accomodate a cattle run.

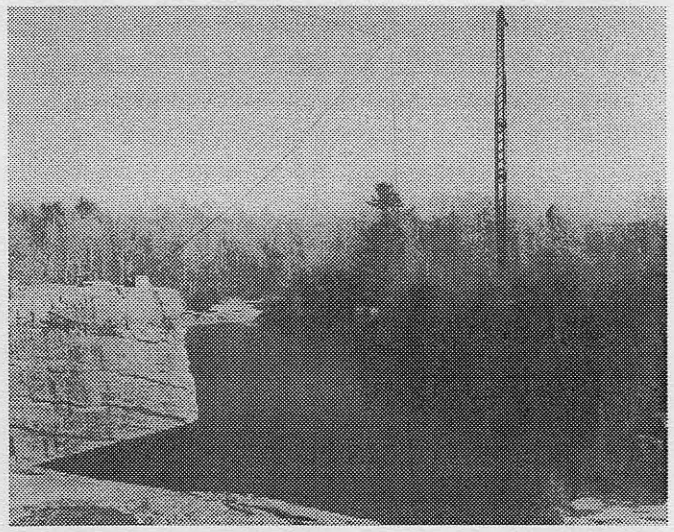


Fig. 5 The Swenson pink granite quarry at Bald Hill, Wells, Maine, was abandoned in 1974 after being in use for half a century. Several structures survive here, including one of the three tall cranes erected to lift the massive ashlar blocks out of the. quarry.

All photographs by Nelson H. Lawry

dalized-boxed or sheathed to protect the trusses from the deleterious effects of weather and the smoke blast from steam locomotives. Where once there were thousands of such housed pony truss bridges, spanning brooks, rivers, and canals, now six survive in North America: one in western Quebec and five in the United States, of which four stand in the Granite State.

On its return from the boxed pony bridge site, the convoy passed through Salmon Falls village, so the participants could view the brick textile mills there.

After lunch and the short business meeting, addressing only the location of next fall's meeting and tour (almost certainly to be in western Vermont/eastern New York), the convoy pushed on, now over Maine Route 4. Five miles from the center of South Berwick, Hussey Brook runs under both the highway and the closely adjacent trackbed of the B&M's Eastern Route, abandoned in 1952. The convoy made its second unscheduled stop of the day, to allow the participants to see the original stone arch for the passage of the brook under the trackbed, with " 1842" graven in the stone, marking the year of construction of the original Portland, Saco & Portsmouth Railroad.

The last stop was the abandoned pink granite quarry at Bald Hill in Wells, about five miles from the center of North Berwick (where the Eastern and Western Routes of B&M's Portland Division once crossed at grade). A lengthy walk-about of the site was encouraged by owner Richard Bois, Jr., who also participated in the day's tour. The quarry was purchased in 1925 by the Miniutti brothers, and they sold it four years later to the Swenson brothers of Concord, NH. The operation was served for nearly 20 years by a spur from the B&M RR's Eastern Route. After the portion of the Eastern Route between North Berwick and South Portland, Maine, was abandoned in 1944, the spur was converted into a stub line running north out of North Berwick, maintained by the railroad until the 1960s but paid for by Swenson. In 1974, after the quality of the Bald Hill stone had declined, foreign competition had adversely impacted on the domestic granite market, and pumping out the seepage had become energy-intensive, the quarry closed. Today, structures still standing include a single derrick, a boiler house (an adjacent one has collapsed), an oil tank, and two granite block explosives shacks off in the woods.

The tour ended in mid-afternoon.

Nelson H. Lawry
Rollinsford, NH

Fall 2003 NNEC-SIA Champlain Canal Tour

The fall 2003 NNEC tour was held on Saturday, October 18, along the portion of the Champlain Canal leading south from the lake of the same name, between Whitehall and Kingsbury, New York. It also encompassed the Feeder Canal still flowing from the Hudson River at Glens Falls east into the parent waterway at Kingsbury. Fourteen persons, both chapter members and history-aware local residents, took part in the event, which was organized by field site committeeman Gerry DeMuro.

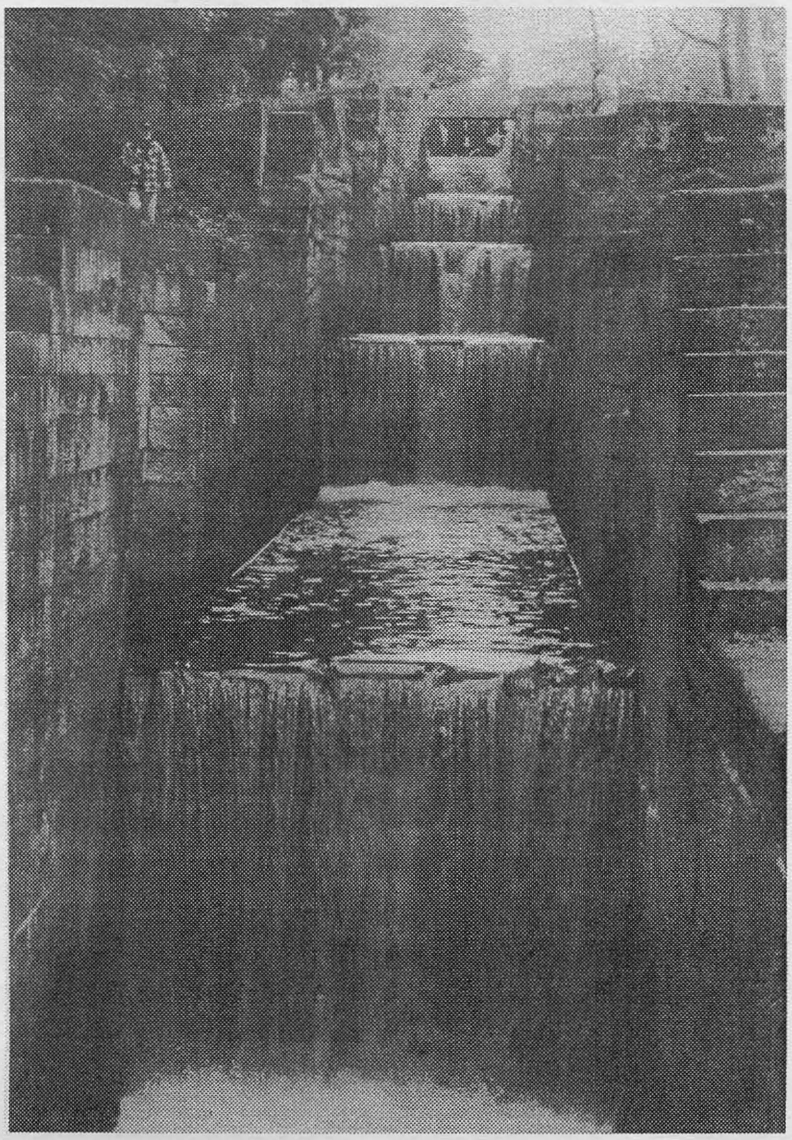
The north-south Champlain Canal was built contemporaneously with the longer east-west Erie Canal during the early 19th century, both constructions intended to be part of the major canal system undertaken by the state of New York. Modifications to the Empire State's aqueduct-type canals soon after their original construction made them wider, deeper, and more efficiently fed. As completed during the early 1820s, the Champlain Canal was 12 feet wide at the top, seven feet wide at the bottom, and four feet deep, Within a decade or so, the enlargement resulted in a canal 40 feet wide at the top, 28 feet wide at the bottom, and five feet deep. Other changes were made between the 1850s and 1870s, especially during the Civil War, when the military threat from Great Britain through Canada was hardly a negligible one, and the possession of an internal transportation system near the northern border was "thus logistically sensible.

Commercial goods carried on the waterway included timber, lime, clay, marble, coal, and agricultural products, particularly hay, potatoes, and apples. Although initially, mules plodding the adjacent towpath pulled the barges, in later years, steamboats took over the task.

During the first two decades of the 20th century, the new water level Champlain Canal was built by dredging Wood Creek. Steam tugs pulling strings of barges became a common sight, and petroleum was added to the list of manufactured products transported on the canal. Today, pleasure craft constitute virtually all vessels negotiating the Champlain Canal, as regular industrial traffic has ceased.

Following the morning rendezvous, the tour group drove to Lock No. 12 on the new canal, adjacent to the woefully ravaged Whitehall waterfront. There, Herman Brown, whose forebears included four generations of canal men, gave the orientation -talk, with supplemental input provided by local historians Wayne Senecal and Marvin Fraser. While on site, the party observed a cabin cruiser transitting the lock.

From Whitehall, the party went south on state Route 22 and U.S. Route 4 to Fort Ann, stopping en



The Fall 2003 NNEC tour attenders enjoy the five combined locks of the Feeder Canal at Kingsbury, New York. Photo by Nelson H. Lawry route to see the remnant of the once large holding basin at Mill Pond Brook on the old canal, now marshy and overgrown. The ashlar-block remnant of the basin's wasteweir, which drained off excess water into Wood Creek, is still visible on the far (east) side of the marshy expanse.

The old waterway at Fort Ann features a spur canal that joins diagonally with the parent entity and once provided access to village warehouses. Two of the brick structures still stand and enjoy adaptive reuse, one of them a particularly lovely example of Greek revival architecture. Local historians Virginia Parrott and Grey Haye lent their expertise to this segment of the tour.

Traveling south from Fort Ann, the members of the tour went next to Smiths Basin, where they met Marie Fountaine, the village historian, and Edith Wright, who wrote the history of the village 41 years ago. A commercial village once arose around the canal holding basin and later all but disappeared. Most of the actual basin is grown in, but a long granite retaining wall remains adjacent to the section of the old canal. The former Smiths Basin Hotel, whose last use was as a store and post office, stands abandoned, but there are plans to rehabilitate this wonderful clapboard structure. Leading from the wasteweir, the drainage canal, 7 x 7 feet in cross section and now shored up by timbers, lies closely adjacent to a road and is in danger of collapse from the estimated 400 heavy trucks a day from a planned modem quarry operation. This under-taking would also threaten the traces of early Native American history in the area.

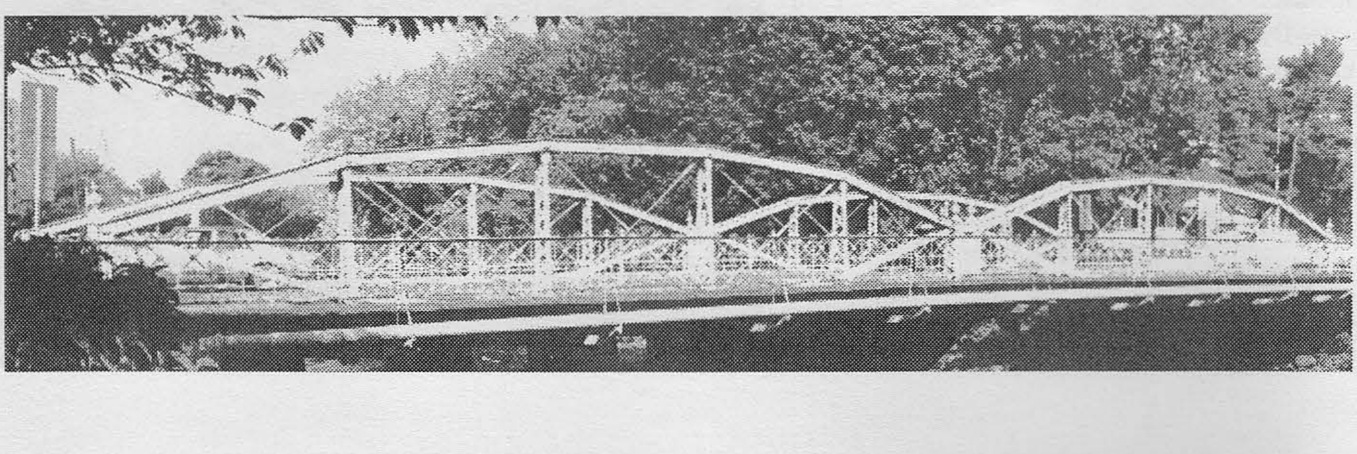
In addition to the production and transport of potatoes, apples, hay, and milk, limestone was quarried in the hills above Smiths Bason and burned in several kilns near the village. Thousands of cords of wood were barged in to fire these kilns, and the lime thereby produced was either used for agriculture or transported south to Albany and New York City for construction purposes. The group drove up to and walked into one large, abandoned limestone quarry. Thereafter, the convoy continued south on Towpath Road, following the canal.

The final asset, and arguably the high point of the tour, was the 7-milelong Feeder Canal built during the mid-1820s and originating at the 12-foot high, 770-foot-long dam spanning the Hudson River at Glens Falls. The tour leader for this portion was Raymond Howard, president of the Feeder Canal Alliance. The canal runs east through Hudson Falls to Kingsbury to provide water for the parent Champlain Canal. Because of the substantial volume of water flowing east from the river, each lock in the Feeder Canal-which was enlarged in the early 1830s for barge traffic-required a parallel sluiceway to ensure bypass of the water when the lock was in use. Because this canal would otherwise have permitted only a lengthy one-way occupancy once a barge or barges began transit, a small holding basin was provided about halfway along its length to relieve this situation.

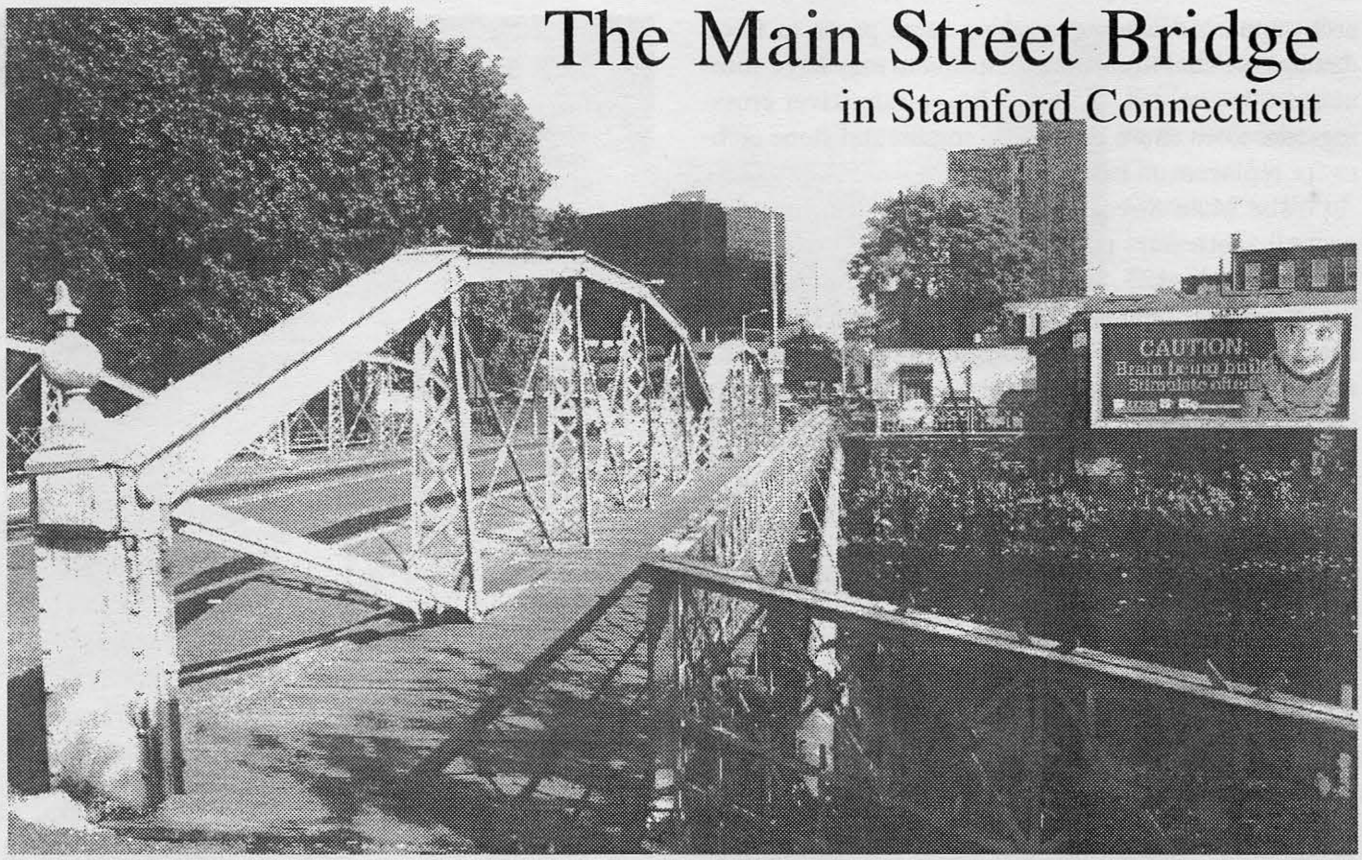
The best known and most popular feature of the Feeder Canal, the five combination locks, or more casually, "the five combines", is 500 feet long and 55 feet high (each 100-foot-long lock thus lifting the vessel or barge 11 feet vertically) and was once paralleled by a like number of falls in the sluiceway, part of which can still be seen. The accompanying photograph shows the main Feeder Canal.

A number of industries sprang up along the Feeder Canal, including lumber mills and cement works, so barges carrying timber, finished boards, cement, limestone, and coal would have been common sights. The last stop of the tour was the long-abandoned canalside coal storage facility, with its five large concrete gang silos and ancillary wooden structures, still standing in an otherwise residential setting.

Nelson H. Lawry
Rollinsford, NH



The Main Street Bridge
in Stamford Connecticut



View east of south trusses and original railing.

SIA New Englanders are familiar with the vanishing work of the Berlin Iron Bridge Company, which erected over 100 of its patented lenticular pony truss structures in Connecticut and over 500 more in other states. No more than seventeen of these bridges survive in Connecticut. In Stamford, the well-preserved Main Street Bridge built over the Rippowam River in 1888 is distinctive as perhaps the widest of its type ever built, as the only surviving two-span example in Connecticut, and as the last surviving wrought-iron lenticular truss on a major urban Connecticut street. The bridge also has local significance as the second bridge rebuilt by the City of Stamford in response to a demand for road and bridge improvements during an era of industrial, commercial, and residential growth. The Main Street Bridge was placed on the National Register of Historic Places in 1987.

By the mid 1880s, Stamford's selectmen came under increasing pressure to improve the community's poorly-maintained system of roads and bridges. Industrial development and commercial growth, associated with the town's proximity to New York City and location along a major railroad corridor, spurred a population increase of over 60% in the 1880s. With road and bridge conditions often seen as a hindrance to trade and a civic embarrassment, local newspapers and prominent citizens pressed for systematic improvements beginning in 1886. Beginning first in the congested town center, the selectmen soon began to rebuild river crossings. The Main Street crossing of Rippowam River, one of the oldest and most important bridge sites in Stamford, was the second in town to be improved in this campaign. This section of Main Street was part of the Boston Post Road by the beginning of the 19th century. After securing estimates for stone, iron, and wood bridges here in the winter of 1887-1888, the selectmen secured approval of the Berlin Iron Bridge Company's $13,000 bid in April 1888.

Beginning in the late 17th century, earlier Main Street crossings of the Rippowam were timber bridges which did not last very long because of flood damage and structural deterioration. Although the selectmen in 1888 received a low bid of $9,000 for a timber bridge, the town's choice was clearly between a metal truss and arched stone masonry. In this case, the cheapest stone arch bridge was over twice the cost of the Berlin Iron Bridge Company's proposal, and raised questions about whether the stream obstructions created by multiple

Plate to left: general view of the Main Street bridge to the northeast.

arch supports made the crossing more prone to flood damage. A dam immediately upstream may have stimulated this concern. At other Rippowam River crossings, the town chose both metal trusses and stone arches for replacement bridges.

The Main Street Bridge is a two-span, pin-connected lenticular pony-truss structure, extending approximately 125 feet between rubble stone abutments over the tidal Rippowam River. Each five-panel span is 61.8 feet long with independent end portals, and rests on a central 6-foot-wide, 44-foot-long pier of rubble masonry and concrete. During bridge modifications c1900 to support street railway traffic, eight additional 4-foot-wide, 11-foot-long concrete piers set beneath the floor beams reduced the actual load-bearing spans to the 12.2- foot distances between panel connections. The bridge's structural components are made of wrought iron. The paired trusses in each span have posts 1.5 feet wide at bottom with tapered profiles, centered 36.5 feet apart to define a 35-foot roadway area. Tapered floor beams hung from lower chord pins on looped-rod hanger bars are 50 feet long, cantilevered transversely beyond the roadway to support a 6-foot-wide sidewalk on either side. The roadway and sidewalks are about 10 feet above the mean tidal elevation of the river.

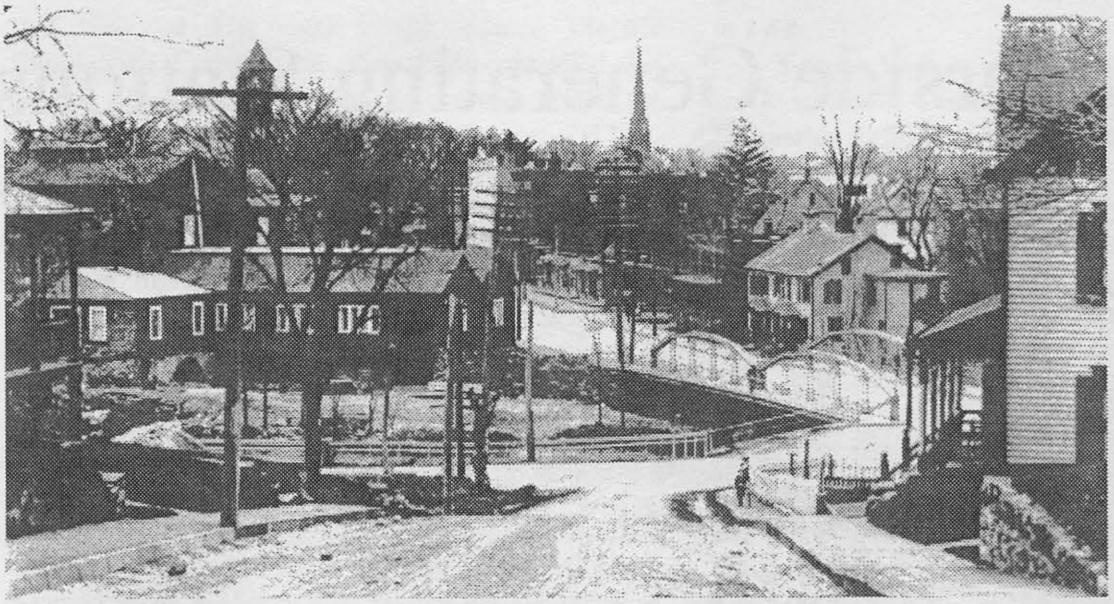
Each five-panel truss span has a maximum depth of 9 feet between pinned connections. Top chords and end posts are riveted, open box sections of _-inch rolled plates, angles, and lacing bars. The tapered lattice-girder web verticals consist of similar riveted angles and lacing bars. The bottom chords consist of paired rectangular-section eyebars. Diagonal round rods with threaded turnbuckle tighteners stiffen the central three panels in each truss. Each of the eight end posts originally had a cast-iron orb finial; the one at the northwest of the bridge has not survived one of many past encounters between end posts and automobiles.

The tapered floor beams are 2.9 feet high at midpoint and 1 foot high at the ends, consisting of built-up I-section riveted plates and angles with web stiffeners below stringer and pin bearing points. Welded-on angles installed c.1985 reinforce two floor beams under the western span. Under each travel lane, the floor beams support 6 wrought-iron, 7-inch-high, built-up I-beam stringers at 2.25-foot centers. The 13-inch-thick deck, probably rebuilt for the c1900 installation of two street railway tracks, consists of concrete slabs poured around the stringers, a sand cushion, brick in which the tracks are set, and asphalt pavement. Nine-inch-square concrete curbs alongside the trusses narrow the roadbed to 33 feet.

Detail to north of endposts at bridge center.

Floor beam ends support timber sidewalks, as well as utility conduits below the walkway decking. The sidewalks have decorative railings consisting originally of a lattice of wrought-iron straps with cast-iron rosettes at the intersections. Simple 2-inch-square plates have replaced the rosettes on the north railing, which has evidently been completely rebuilt. The railings extend away from the bridge at various angles along adjacent sidewalks and parking areas along the river. An 8-inch-diameter gas main runs along the south edge of the bridge, between the posts and support rods of the railing.

The Main Street Bridge is one of the larger examples of the patented crossings erected by the Berlin Iron Bridge Company. Located in East Berlin, Connecticut, the state's only major bridge company was a very successful player in the intensely competitive northeastern United States municipal bridge market during the late 19th century. The company and its predecessor, the Corrugated Metal Company, thrived on variants of the bridge design promoted by William O. Douglas, who secured an 1878 lenticular truss patent from the United States despite earlier use of the form in Europe and two American patents issued in the 1850s. Douglas worked briefly at Corrugated Metal in the late 1870s, and the firm began selling and erecting wrought-iron lenticular truss bridges by the time his first patent was issued. After acquiring Douglas's patent, the firm quickly moved beyond its iron roof truss products and concen-



c1910 view southeast of Main Street Bridge and environs, including Diamond Ice Company to left of bridge. Courtesy of Stamford Historical Society.

trated on the bridge fabrication implicit in its 1883 corporate re-naming. The lenticular truss, with a distinctive profile of symmetrically-curved top and bottom chords that allowed for an economical use of material, was used for most of the Berlin Iron Bridge Company's nearly 1000 crossings completed into the late 1890s.

The company evidently sold few lenticular trusses after 1895. Each chord segment end had to be machined to a different angle, and lateral stability became an issue as spans lengthened without commensurate roadway widening. A second Douglas patent in 1885 addressed the latter problem with a modified bracing system, but was rarely used. In 1900, J.P. Morgan's American Bridge Company absorbed Berlin Iron Bridge Company and twenty-three other bridge firms into a would-be monopoly controlling half of American bridge fabricating capacity.

Depending on roadway design considerations, Berlin Iron Bridge Company produced a number of variations on the lenticular form in spans ranging from 27 to nearly 300 feet in length. Built largely before the advent of widespread field riveting, the company's lenticular structures all used pinned connections, which facilitated the erection of the bridge. Many engineers of the period also favored pinned joints because of the belief that they transmitted forces more consistently. Depending on span length, bottom chords consisted of paired round rods or, for spans over about 40 feet, rectangular-section bars with eyes at each end as seen at the Main Street Bridge. Almost two thirds of the individual spans completed by Berlin Iron Bridge Company under 80 feet long were pony trusses, in which there is no horizontal bracing over the roadway. Some had the bottom chords secured with pins, others had bottom chords bolted through castings on top of the end posts. Tapering the floor beams and web verticals saved weight, but some pony trusses had straight members for these components. A variety of railing ornamentation was available, with the type used on the Main Street Bridge among the most ornate. Many Berlin bridges were built without any decorative elaboration, though local highway officials could opt for several different types of end-post finials and other portal ornamentation.

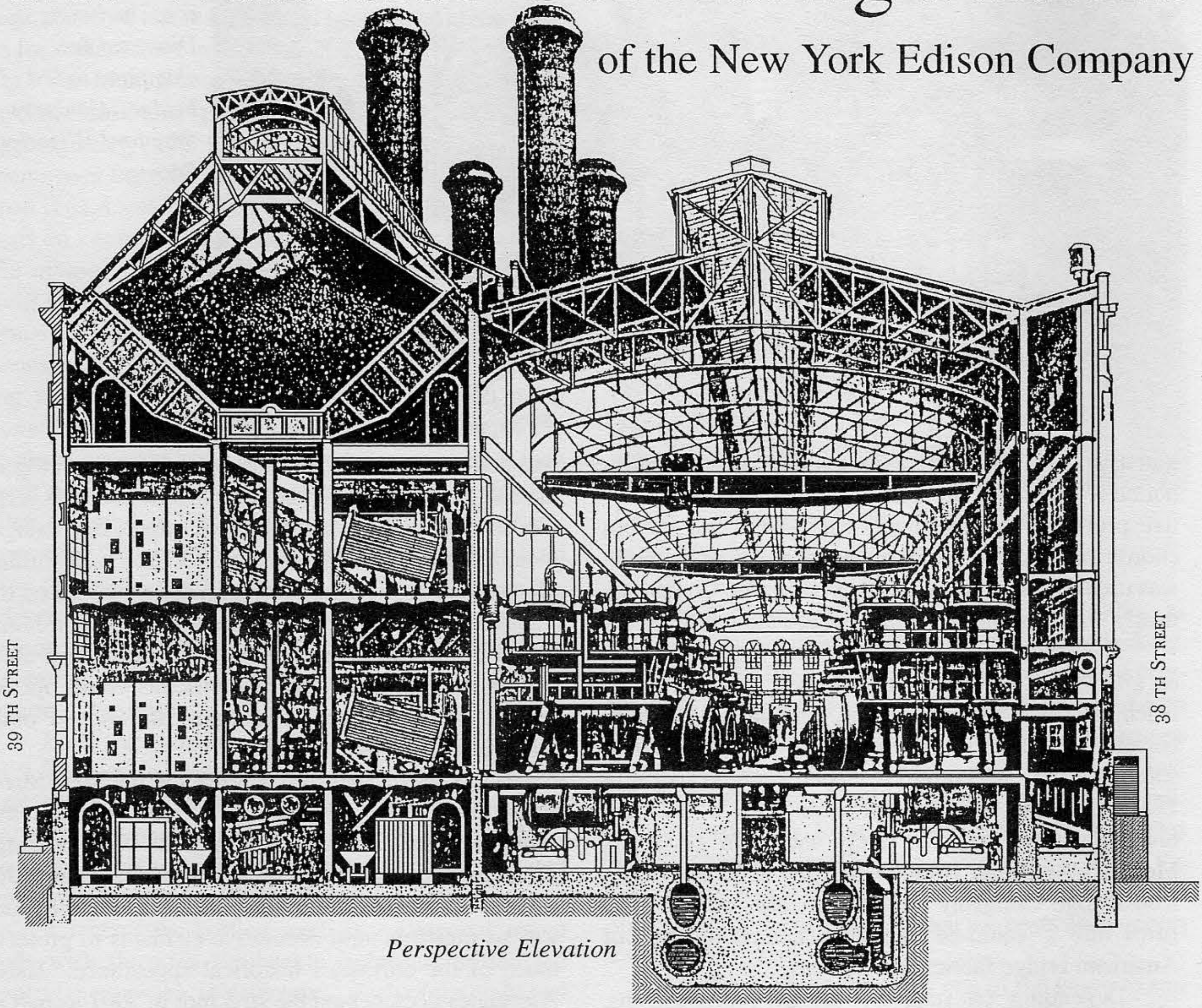
The City of Stamford is replacing the Main Street Bridge with the assistance of the Connecticut Department of Transportation's State Local Bridge Program. Original bridge replacement design included a plan to re-use the truss components above the roadway as non-structural decorative elements to preserve much of the crossing's historical appearance. Raber Associates documented the structure in 2001 as part of the design process. A copy of the full documentation is permanently archived as part of the Connecticut Historic Preservation Collection at the Dodd Research Center, University of Connecticut. Following completion of most design work, the city opted to replace the bridge with a pedestrian-only crossing for which no re-use of original fabric appears feasible. The original trusses and other components will be removed, and will become available for re-use in park or museum environments. Additional mitigatory measures will also be completed in consultation with the Connecticut State Historic Preservation Office.

Michael S. Raber
Raber Associates

Summary Report

The Waterside Generating Stations

of the New York Edison Company



Perspective Elevation

Waterside, located on the East Side of mid-town Manhattan, was an important site during the development of electric power technology during the early twentieth century. It was extensively documented in the technical literature of that time. As a result, records of its original mechanical and electrical configurations are available today, in spite of the many changes that have occurred.

Ultimately consisting of two power plants, the Waterside Generating Stations have been providing electric power to midtown Manhattan since 1901. The first station, Waterside No. 1, generated 25-cycle alternating current using a combination of reciprocating steam engines and steam turbines as prime movers for the alternators. Throughout the twentieth century, Waterside was subjected to several extensive renovations of its generating equipment in order to keep up with the electric power demands of the expanding midtown area. As a result, the interior of Waterside today bears practically no resemblance to its original appearance. Significant portions of the exterior architecture, however, have remained as originally designed and constructed.

ELECTRICAL BACKGROUND

In 1882, Thomas A. Edison placed the Pearl Street Generating Station into operation in lower Manhattan. This station generated direct current (DC), in accordance with the state of electric power development of that time, at 110 volts. The Edison Electric Illuminating Company of New York controlled this electric power supply system. By the mid-1890's, the Pearl Street Station had been replaced by several larger DC generating stations, located throughout downtown and midtown Manhattan. Established electrical theory indicated that, to transmit an equivalent amount of power, higher voltage reduces the current required, with a correspondingly lower voltage drop. When theory was applied to design, the DC distribution system evolved into a three-wire 110/220-volt configuration. This decreased the amount of voltage drop in the underground feeder cables and reduced transmission losses.

During the 1890's, the electric power industry had begun to realize that the future of the industry depended upon the use of alternating current (AC), rather than direct current. This development was the result of the pioneering work in this field by such notables as Nikola Tesla and William Stanley. Tesla developed the concept of "polyphase" AC systems that led to the development of a practical AC motor, and Stanley perfected the use of the transformer to allow power to be efficiently transmitted over long distances at high voltage. Transformers located at the customer's premises would lower the voltage to safer functional levels.

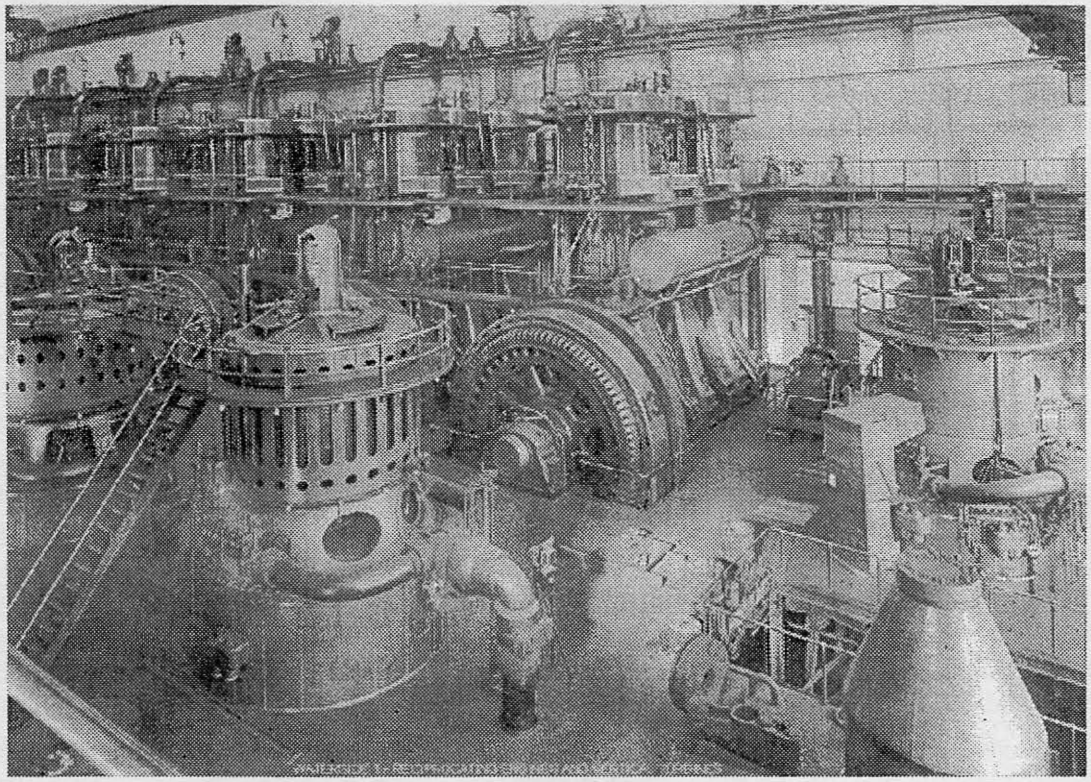
By the turn of the twentieth century, the Edison Electric Illuminating Company had been reorganized into the New York Edison Company. Due to the phenomenal growth of Manhattan, the future generation of electric power there was destined to take the form of high voltage AC generated by a large, more efficient, central generating stations. As a result Waterside Station No. 1 went into operation in 1901. The exterior of the generator room portion of Waterside No. 1 still retains its original 1901 appearance. The Edison Company constructed this station along the east side of First Avenue in Manhattan and it occupied the entire city block from 38th Street to 39th Street. The station extended easterly from First Avenue to the East River, where barges unloaded large amounts of coal and took away ashes for disposal.

The electrical growth in Manhattan was so rapid that, even before this first Waterside station was completed, the company realized that more generating capacity than it could ultimately supply would soon be needed. This led to the design and construction of adjacent Waterside Station No. 2 on the city block immediately to the north of Waterside No. 1. The Waterside No. 2 exterior was designed to be more ornate than that of Waterside No. 1. It went on stream in 1906.

Since a large established 110/220-volt DC network existed throughout lower and midtown Manhattan by the time the Waterside Stations went into operation, New York Edison was forced to continue to supply this network. Thus, the electric power first generated at Waterside was in the form of 6600-volt, three-phase, 25-cycle alternating current. There were two reasons for the choice of a 25-cycle frequency, rather than the 60-cycle frequency, which was eventually to become the standard in this country. 25-cycles had been introduced in 1895 with the installation of the first significant hydroelectric generation located at Niagara Falls. Westinghouse, the designer of the first generators there, chose low frequency, due to the slow operating speed of the waterwheels, 250-rpm, which were to drive the generators. In order to obtain a frequency close to 60-cycles at that speed, generators having windings with either 28 or 30 magnetic poles would have been required. Such machines would have been very costly to construct. The 25-cycle generators, which were used, required only 12 magnetic poles. As a result of the tremendous success of the Niagara Falls installation, 25-cycles was to become an industry standard for generating stations utilizing slow speed prime movers. The 6600-volt, 25-cycle AC power from Waterside went to a large number of substations that changed it into low voltage DC power by means of machines known as "rotary converters".

BOILER INSTALLATIONS

The boiler house of Waterside No. 1 originally contained a total of 56 boilers, on two levels. The boilers were designed for a steam pressure of 225 psi., but operated at 175 psi. The Waterside No. 1 boilers were equipped with Wainwright feed water heaters and Worthington steam engine driven feed water pumps. Some of the Waterside No. 1 boilers were hand-fired. The stoker-fired boilers were used to maintain steam for the "base" load on the electric power system. The Waterside No. 2 boiler installation was similar that in Waterside No. 1. Four D'Oiler Engineering Company feed water pumps, each handling 1000 gallons per minute, were driven by 300-horsepower turbines built by the Terry Steam Turbine Company. The steam mains were fourteen inches in diameter, and were tied back into the Waterside No. 1 steam system. These two boiler houses operated essentially as one steam-generating installation after 1906. The Mead-Morrison Company of New York City built the coal-handling



Early photo of Waterside No. 1 Engine Room, showing new vertical turbines and original engines (from southeast corner) Courtesy of the Hall of Electrical History at the Schenectady Museum, Schenectady, New York

installation, and Rawson & Morrison steam hoisting engines drove the clamshell lifts.

The original plan for Waterside No. 1 required installation of sixteen huge reciprocating steam engines, each engine being directly coupled to an alternating current generator. This was totally consistent with the common practice for steam generating stations through the 1890's. However, as Waterside No. 1 was being planned, great advances were being made in the development of steam turbines as prime movers for generators. In particular, the General Electric Company had introduced the Curtis steam turbine for this purpose by the end of the nineteenth century. Thus, only eleven of the originally planned sixteen reciprocating engines were actually installed in Waterside No. 1. The remaining engine room space was devoted to the installation of vertical turbine-generator units. The first such unit was installed by General Electric in 1905. The reciprocating engines were in operation until the early 1920's, when more steam turbine units replaced them. The Westinghouse Machine Company built the engines, while General Electric and the Stanley Electric Manufacturing Company built the direct-coupled generators.

Engine speed was controllable from the electrical switchboard in the elevated control room at the west end of the engine room. This was necessary during start-up to allow the generator to be "synchronized" to the alternating current power system; as well as to be able to control the division of load among all of the generators paralleled on the system. The first turbine-generator unit installed in Waterside No. 1 was located in the northeast corner of the engine room. Eventually, seven more vertical turbine units would be installed as the original engines were removed. By 1923, the company replaced the last of the reciprocating engines with horizontal turbine units of 35,000-kilowatt capacity. For Waterside No. 2, no reciprocating steam engines were ever contemplated. The original Waterside No. 2 installation consisted of eight vertical turbine units and two horizontal turbine units. These latter two units were very early horizontal turbine designs, each turbine driving two generators. The eight vertical units were five-stage Curtis turbines built by the General Electric Company. During the early twentieth century, turbine-generator manufacturers learned that vertical turbine units could not be designed for outputs greater than 20,000-kilowatts. Later renovations were restricted to horizontal turbines.

ELECTRICAL SYSTEM

The original concept for the use of the Waterside Stations involved the generation of high voltage alternating current that would be utilized by rotary converters in substations to produce the low voltage direct current, needed for the existing DC distribution networks in Manhattan. To a large extent, this mode of operation existed through the late 1970's.

Even though the New York Edison Company was constrained to provide DC power for the existing underground networks in Manhattan, the use of alternating current, at a frequency of 60-cycles, by new customers in both The Bronx and Manhattan was increasing during the early years of the twentieth century. The United Electric Light and Power Company provided this AC power. When U.E.L.&P. faced a crisis due to the loss of their existing 60-cycle generating station shortly after the turn of the century, they reached an agreement with New York Edison whereby the 60-cycle power required for their system would be generated at Waterside.

One of the first vertical turbine generators installed in Waterside No. 1 was actually a 60-cycle machine to be used by U.E.L.&P. Upon completion of Waterside No. 2, the main source of 60-cycle power for U.E.L.&P. was the two horizontal turbine-generator units that were installed at the west end of the turbine room. Each of these turbines actually drove two generators. One of these was a 25-cycle machine for use by New York Edison, and the other was a 60-cycle machine for use by U.E.L.&P. Both generators could not be used simultaneously. As a result, a rather complicated standard operating procedure was instituted which determined the times of day during which these turbine sets would be used to produce either 25-cycle or 60-cycle power. The usage of Waterside generating facilities by U.E.L.&P. ended in 1913 when their new generating station at 201st Street in upper Manhattan went on stream.

Operators in the elevated control room controlled the 6600-volt "high-tension" output of the Waterside No. 1 generators. In 1911, the company initiated an extensive remodeling of the Waterside No. 1 engine room. The primary reason for this was the replacement of four of the original eleven reciprocating engine units by three 20,000-kilowatt vertical turbine units. The original 1906 Waterside No. 2 High Board control room and the 1911 installation in Waterside No.1 were similar. Ultimately modifications during the early 1990's, placed a computerized "Central Control Room" at the west end of the Waterside No. 2 turbine room, directly beneath the original High Board. Today, this facility controls all remaining generators and boilers in both Waterside No. 1 and Waterside No. 2.

The company removed the last original reciprocating steam engines from Waterside No. 1 in 1923. The original vertical turbine units in Waterside No. 2 continued in operation until the late 1930's when they were replaced with four large hydrogen-cooled horizontal units having generating capacities as high as 65,000-kilowatts. At the west end of the turbine room, newer single-generator horizontal units had already replaced the original dual-generator horizontal units. One of these was a 22,000-kilowatt, 25-cycle unit, and the other became a 40,000-kilowatt, 60-cycle unit.

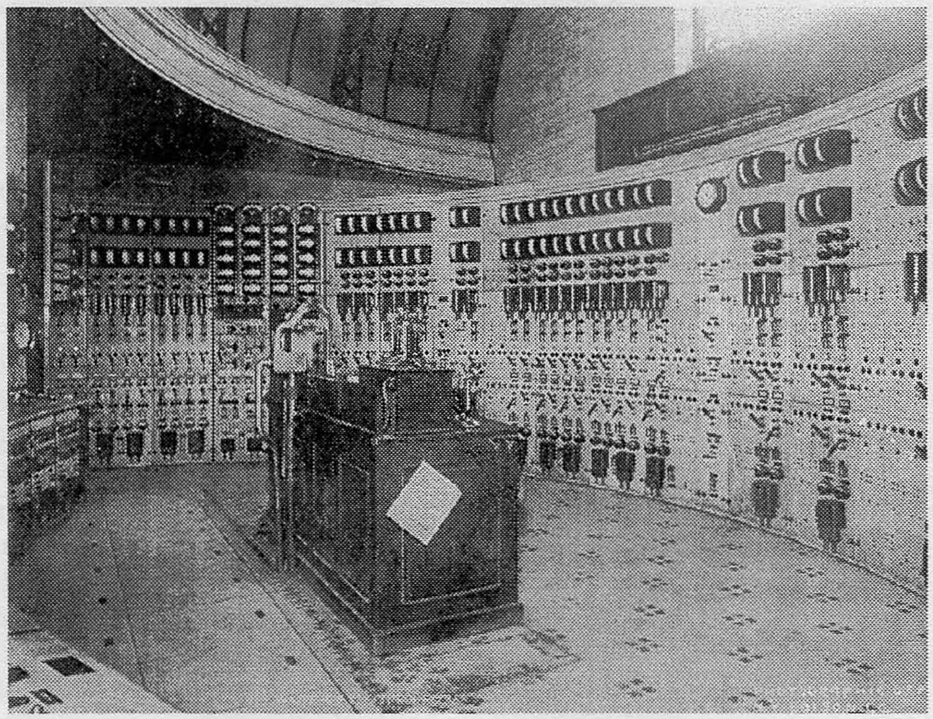
The four new turbine-generators were also 60-cycle units. In addition, these steam turbines were what were referred to as "topping" turbines. These operated at a steam pressure of 1200-psi, supplied by eight new boiler units that replaced the 96 original boilers in the Waterside No. 2 boiler house. These turbines exhausted steam at a pressure of 200-psi, which then was used to drive the older low-pressure turbines still in use. Thus, the new turbines used the "top" of the available energy in the high-pressure steam.

By the mid-1930s, in Waterside No. 1, a total of four 35,000-kilowatt, 25-cycle horizontal turbine-generator units had been installed. Two of these had been installed in the early 1920's, replacing the last of the steam engine units; the three 1911 vintage 20,000-kilowatt vertical turbine units were still in operation. Another major renovation took place during the late 1940's. This involved the boiler house structure of Waterside No. 1. At this time, all of the original boilers were removed. The space was then utilized for the installation of ten new boilers and two new 60-cycle horizontal turbine-generator units.

These units were each rated at 50,000-kilowatts and, like the 1930's units installed in Waterside No. 2, were high-pressure topping turbines. Also, as with those Waterside No. 2 units, these generators were cooled by hydrogen gas rather than air. Hydrogen cooling of electrical generators had been introduced in the 1930's. The characteristics of hydrogen gas are such that it acts as a much more efficient cooling medium, as compared to air, and it produces much less "windage" or frictional loss due to rotation. The disadvantage of hydrogen gas is, of course, that great care much be exercised in order to avoid air leaks, which could lead to a highly explosive mixture.

FREQUENCY CHANGERS

During the late 1920's, a structure was built to the north of Waterside No. 2. This was known as Waterside Tie Station because it contained two rotating electrical machines, known as frequency changers, which func-



Waterside No. 2 Control Room, circa 1909 - View South showing marble "High Board" feeder panels.
Courtesy of the Hall of Electrical History at the Schenectady Museum, Schenectady, New York

tioned to tie together the original 25-cycle system and the newer 60-cycle system of the New York Edison Company. This tie increased the reliability of both systems since power could then be interchanged back and forth as needed.

The frequency changers each consisted of two rotating electrical machines coupled together. One machine was a constant speed "synchronous" motor that served to drive the set. The other was an induction-type of machine known as a "frequency converter". Its operation was such that the stator, or non-rotating part, was electrically connected to the 60-cycle power system and the rotor, or rotating part, was electrically connected to the 25-cycle power system. Thus, power could be magnetically between the two systems, in either direction, as desired.

The rating of each of these sets was 40,000-kilowatts. By the time of their installation, both Waterside Stations were generating 60-cycles as well as 25-cycles, one of the frequency changers was connected to the "busses" in each of the two stations. New sections added to the High Boards in the respective stations controlled the operation of the machines.

These frequency changers operated until the late 1970's when the last of the old rotary converter substations in Manhattan was finally retired. This meant that there was no longer a need for 25-cycle power for the operation of those machines. Thus, the 25-cycle power system gradually fell out of use, having been replaced by the expanding 60-cycle system, which supplied AC power directly to Consolidated Edison customers. Interestingly, however, there are still today roughly 4000 customers in New York City that require DC power for the operation of old DC motors (elevators, ventilation fans, water pumps, and so forth) in buildings whose electrical systems have not been modernized. This DC power is now supplied by means of solid-state rectifier units located in vaults beneath the streets or in the buildings themselves. Con Edison is actively waging a campaign to have these old DC installations converted to 60-cycle AC as soon as possible.

GENERATOR EXCITATION

Conventional rotating electrical generators require magnetism, in addition to rotation, in order to generate electric power. Conventional rotating electrical generators require magnetism, in addition to rotation, in order to generate electric power. This magnetism is produced by means of electromagnets energized with direct current. Therefore, DC generators can provide their own magnetism. AC generators, on the other hand, must have an external source of direct current for their electromagnets. In the era during which the Waterside Stations were built, this source often took the form of a small DC generator driven by some sort of prime mover. The latter might be a steam engine, steam turbine, or even an electric motor. The DC generator was referred to as an "exciter" since it provided the magnetic excitation for the large AC generator, or alternator.

At Waterside, AC motors drove all the original exciters. In order to provide for a source of DC excitation in the rare event of a complete loss of alternating current power to operate these motors, a large bank of batteries was installed. These batteries served a second function as well. The exciters were all 220-volt generators. In order to provide 110-volts for station lighting, the mid-point of the battery bank was tapped in order to form a 110/220-volt, three-wire system just like the underground distribution system that was in use throughout Manhattan. Pairs of coupled 110-volt DC generators, called balancers or "compensators", were used to equalize the load on the two halves of the battery bank so as not to discharge one half more than the other.

Waterside No. 2 had all horizontal turbine units following the late 1930's renovation. In Waterside No. 1, the last of the vertical turbine units were not removed until the 1940's. The Westinghouse Company built all these machines.

WATERSIDE TODAY

Waterside now has three operating turbine-generators with a total capacity of 180,000-kilowatts (180 megawatts). It functions as a "co-generation" plant since it also supplies a significant amount of steam to midtown Manhattan. In the renovated Waterside No. 1 boiler house structure, the two boilers and two Westinghouse hydrogen-cooled turbine-generators that were installed during the late 1940's are still in operation. Each of the boilers is capable of supplying up to 1,000,000 lbs. of steam per hour at 1600-psi and 950 degrees Fahrenheit. The turbines exhaust steam at 200-psi that is sold to steam customers in midtown Manhattan.

In Waterside No. 2, there is now only one operating generator unit. This is an 80,000-kilowatt, air-cooled turbine-generator installed in 1991, and built by the ASEA - Brown Boveri Company. Steam for this unit is still supplied by two of the boilers that were installed during the late 1930's renovation. Each of these supplies 650,000 lbs. of steam per hour at 1250-psi. The turbine unit also exhausts steam at 200-psi into the Manhattan steam system. All three of these turbine-generators are controlled from the computerized Central Control Room that was built at the west end of the Waterside No. 2 turbine room floor in 1992.

The present generating capacity of the Waterside Stations is actually less than in past decades. In 1940, for example, the combined capacity of these two stations was over 370,000-kilowatts. During the past fifty years, some of Waterside's electrical load has been taken over by newer generating stations located in the Borough of Queens, as well as by power transmitted to New York City from upstate New York, Long Island, and New Jersey.

In the fall of 2001, the Consolidated Edison Company celebrated the century of operation of the Waterside Station. A Family Day for employees was held at the station itself, and this was followed by a formal banquet at which printed commemorative booklets were distributed, containing interviews with former Waterside employees as well as factual material on Waterside's history. Waterside will, however, be retired as an active generating station within the next few years. It is increasingly difficult for it to compete with other sources of electric power, from the point of view of efficiency, due to its age.

ACKNOWLEDGEMENT

The author wishes to thank Consolidated Edison Company personnel at Waterside for verbal information, written material and permission to explore the "nooks and crannies" of the station: Ed Foppiano, Brian Horton, Alex Clemente, and Charles Amato (retired).

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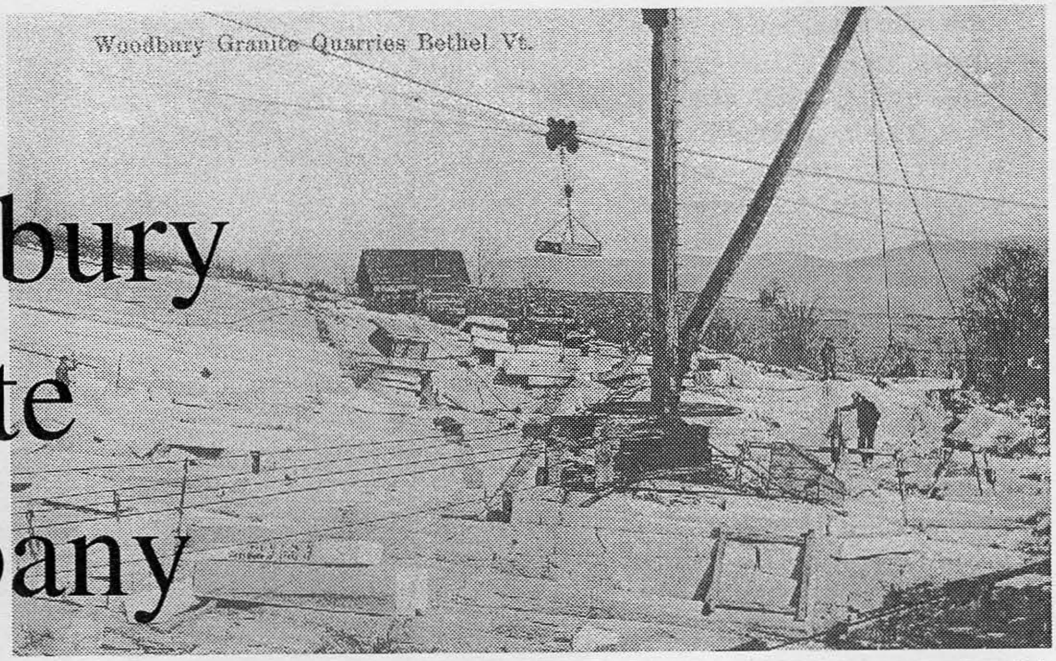
Thomas Blalock

The Woodbury Granite Company



WGC Bethel Quarry Showing Blondin, Boom Derrick and Quarry Drill.

The quarrying and cutting of granite for buildings as a major enterprise in Hardwick and Woodbury Vermont started in 1896 with the Woodbury Granite Co. (WGC) under the new ownership of John S. Holden, Charles W. Leonard and George H. Bickford (Holden's son-in-law). The Woodbury Granite Co was originally established in Woodbury in 1887 as a granite quarrying operation under the ownership of George O. Woodcock, Charles A. Watson and W.H. Fullerton. Soon after Holden, Leonard and Bickford had purchased WGC, a key decision was made to address the market for finished dimension building granite rather than rough quarry cut granite that previously had been the primary product of the Woodbury Granite Co. quarries.

With lower-cost railroad connections to stone sheds and quarries and reliable electric power assured by 1897, the WGC made the decision to locate its sheds in Hardwick. In 1899, Bickford, More Co. was formed to manufacture the finished granite with a manufacturing plant in Hardwick. In 1902, Bickford, More Co and WGC merged to form an integrated company that both quarried and finished building granite to specification. In 1903, WGC opened its Bethel white quarry. In 1907, WGC acquired the water rights of T.T. Daniel at Mackville (a village of Hardwick) – assuring that the power needs of increasing mechanization and increasing business could be met. In 1914, WGC purchased the E.B. Ellis Co. including their sheds in Northfield and quarry in Bethel.

The company grew at a prodigious rate. During the fulfillment of very large contracts, the company even subcontracted work to other Hardwick granite companies as well as companies in Concord NH and Westerly RI. By 1912, WGC had already provided granite for the state capitols of Pennsylvania, Kentucky, Iowa and Idaho. In 1912 alone, it won 117 contracts including 32 banks, 19 schools and 14 post offices. By 1914, WGC had 1400 employees at stone sheds and quarries. By 1917, the Woodbury Granite Co. was larger than the next seven largest Vermont granite-manufacturing companies combined.

The Pennsylvania State Capitol Contract

The contract for the Pennsylvania State Capitol was secured by Woodbury Granite Co. in 1903 and called for the delivery of 400,000 cubic feet of Woodbury gray granite - all to be set in place within 24 months. This was a milestone contract for WGC and it's largest up to that time. With only two sheds and a partly operating quarry, the New England costal granite companies were surprised at WGC's winning bid and even more surprised when WGC successfully completed the contract two months ahead of schedule. The contractors, George F. Payne & Son, wrote "We desire to express our great satisfaction at the manner in which you have handled your work, and think we can safely say, so far as the execution of the granite work is con-

Pennsylvania State House - Built in 1905 of Woodbury Gray Granite.

cerned, it was the quickest piece of work ever done." After this, the Woodbury Granite Co's reputation was secure. Other large contracts followed – for example: 1906 - Cook County Courthouse (Chicago) at a cost of $1,000,000; 1907 - Wisconsin State Capitol at $2,000,000, the largest ever awarded up to that time. The successful completion of the Pennsylvania State Capitol no doubt influenced the award of this contract to WGC rather than the E.B. Ellis Co.; 1908 - Chicago City Hall valued at $1,000,000; 1912 - $1,000,000 contract for use of Bethel White granite in the Western Union Building (NYC); and 1920 - AT&T Building (NYC) that required 200,000 cubic feet of Bethel White at a cost of $2,000,000. The full capacity of the plant at Bethel would be needed for three years to complete this work. Building granite was a feast or famine business with many itinerant workers moving to locations where major contracts had recently been signed.

A Vertically Integrated Company

The success of the Woodbury Granite Co. depended primarily on five factors: (1) Woodbury and Bethel granite was available in large, uniform-grain, defect-free blocks that were ideal for buildings and large monuments, (2) The outstanding management and salesmanship of George H. Bickford, (3) The availability of reasonably priced electric power and of railroad connections to both the quarries and stone sheds, (4) The willingness of the company to invest large amounts of capital in efficient machinery at the quarries and stone sheds (through the deep pockets of Holden and Leonard who had substantial investments in oil and textiles), and (5) The company's control of all the elements needed to deliver its product.

The WGC was what we would call today "vertically integrated". It owned quarries in Woodbury and Bethel VT, and water rights and timberlands in Woodbury VT. In Hardwick, the WGC had its own hydroelectric plant, backup steam electric plant, and sawmill. It managed a second electric plant at Wolcott VT. WGC ran power lines to its sheds in Hardwick, Northfield and Bethel and to its quarries – allowing the replacement of manual, horse and steam powered machinery. George Bickford was president of The Granite Trust Co. in Hardwick – the only local bank to allow signed granite contracts as collateral for loans. WGC partly owned and essentially managed the Hardwick & Woodbury RR - the mountain railroad that serviced the stone sheds and quarries. The H&W RR offices were located in WGC's office building and Holden and Bickford were president and treasurer. In Hardwick, WGC had a system of railroad spurs that ran through its sheds and a large stone yard serviced by two traveling overhead cranes. Working with architect blueprints, WGC's draftsmen could produce all the detailed drawings needed during manufacture of the individual building stones. WGC had branch sales offices in New York City, Chicago and Washington DC. Finally, WGC had crews that could travel with the granite and erect a building or monument. Woodbury Granite Co. truly controlled every step of the process. This allowed WGC to meet contract schedules and to estimate costs more accurately, assuring more predictable profits.

Quarry Operations

Woodbury Granite Co. had its major quarry operations on Robeson Mountain in Woodbury VT, producing large defect-free sheets of medium grain "Woodbury gray" granite. WGC's gray quarry was a large operation consisting of four openings and ten boom derricks. WGC also owned quarries in Bethel, yielding "Bethel White" granite - the whitest known granite and also one of the hardest. The WGC quarry operations in Woodbury also included a "Vermont White" quarry and an "Imperial Blue" quarry.

The WGC invested heavily in "modern" quarry equipment. Boom derricks with 100 foot masts and electric hoisting engines were the primary machines for lifting the granite out of the quarry pit and onto RR flatcars. Cableways, trolleys which ran along several thousand feet of suspended cable, were used to move the waste granite to grout piles. Large pneumatic rock drills, which were mounted on channel bars or tripods, drilled deep holes for blasting. Hand-held pneumatic plug drills produced six inch deep holes for splitting wedges. Hollow-steel drills forced water into the drill holes to clean out the holes and reduce the airborne dust. Electric motor driven air compressors and a system of pipes and air reservoirs were employed to power the quarry drills.

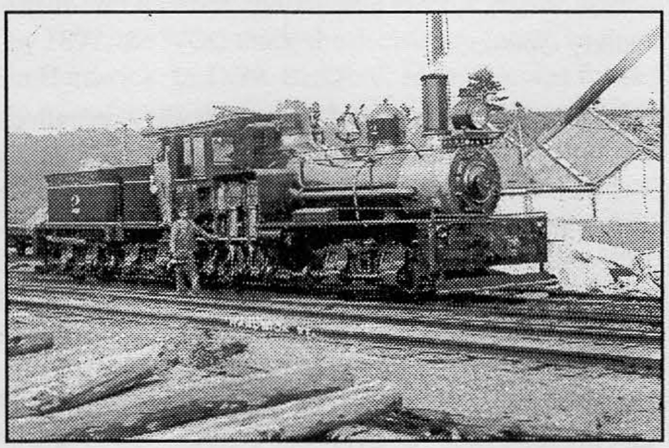
Railroad Operations

The availability of low-cost shipping of granite from the quarries and the finishing sheds was key to the development of the Hardwick and Woodbury granite industry. The Hardwick & Woodbury RR was completed in 1897 between the stone sheds in Hardwick and the quarries in Woodbury and, at that time, was the highest point reached by railroad in Vermont. The H&W RR had two train crews – a main line crew and a yard crew. The main line crew made two daily trips to the Woodbury quarries – hauling 20 to 50 carloads of granite per day. In the opposite direction, coal, iron, lumber, tools and oil were transported up the hill to meet the quarry needs. The railroad had an engine house for three locomotives, a car repair shop, locomotive coal loading chute and 1200-ton coal pit.

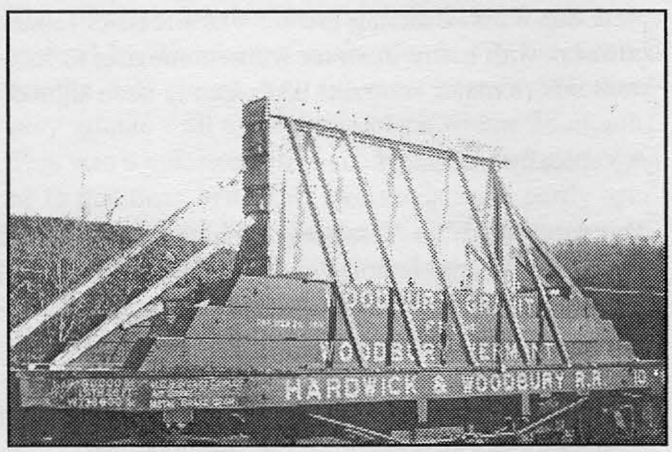
The H&W RR had a number of specialized pieces of equipment. Three Shay locomotives provided the hauling power. These were geared locomotives, originally designed for lumbering operations, in which all wheels were driven - allowing trains to negotiate the 7% grades up Robeson Mt. Well cars were used to carry large stones (up to 13x17x1_ feet) such as mausoleum roof stones. The stone was carried just 8 inches above the RR ties so that bridge and tunnel height limits would not be exceeded. Side and end-dump grout cars were used to haul waste granite up trestles to be dumped onto large grout piles. A small snowplow called a "flanger" was used to plow between and below the rails since the large snowplow plowed four inches above the rail tops. During the peak years, the quarries operated throughout winter even in the face of very deep snow.

Stone Shed Operations

In addition to the major sheds at Hardwick, Bethel, and Northfield, the WGC facilities included many smaller structures: Blacksmith shops for making and sharpening granite working tools; Machine shops for the construction and repair of specialized machinery; Grinding rooms for sharpening granite working tools; Boxer's rooms for crating finished granite; Carpenter shops for making ladders, staging, bankers, wash stands, etc; Saw mill that produced wood for boxing finished granite and for dimension lumber; Boom derrick engine houses which housed the derrick hoists; Granite crushers with jaws that measured 12x24 inches; Crushed granite storage facility including bins to hold the different grades of crushed granite; Transformer rooms with transformers to step down the voltage for use in the sheds; Air compressor houses which housed the air compressors; Boiler houses which housed boilers primarily used for heating; Gang saw sheds housed these noisy machines which often ran 24 hours per day;



Hardwick & Woodbury RR Shay Locomotive No.2 at the Engine House.

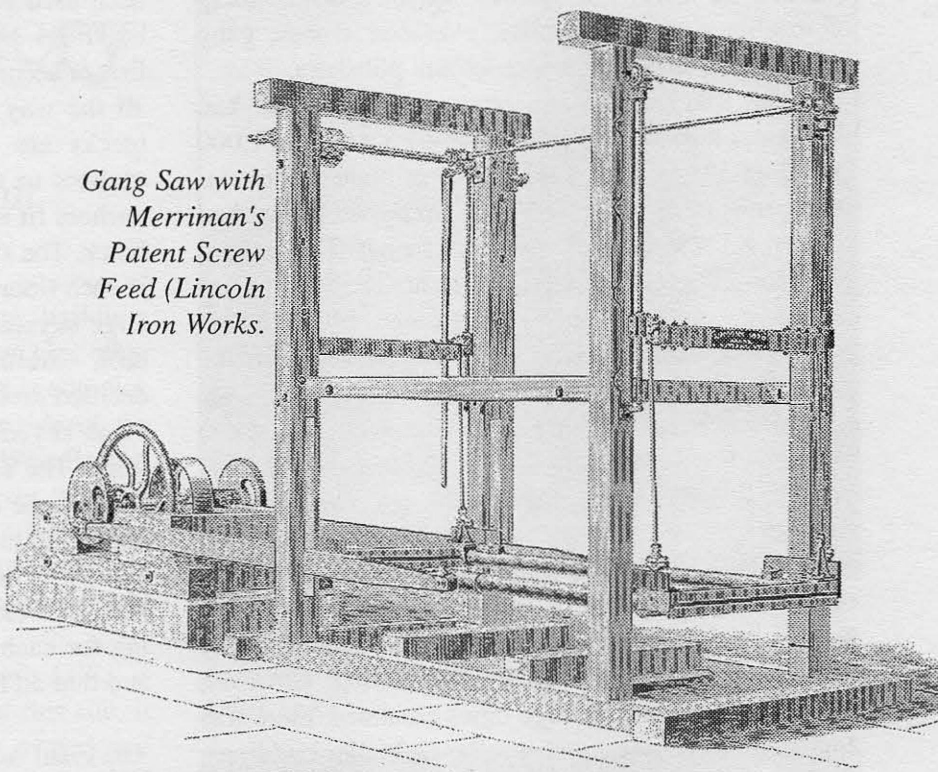


Railroad Well Car - For Transporting Oversize Granite Blocks.

Surfacing machine sheds housing large non-pneumatic surfacing machines that produced enormous amounts of airborne dust; Storage houses for various tools and supplies; and Office buildings that housed management, draftsmen, accountants, estimators, and clerical help.

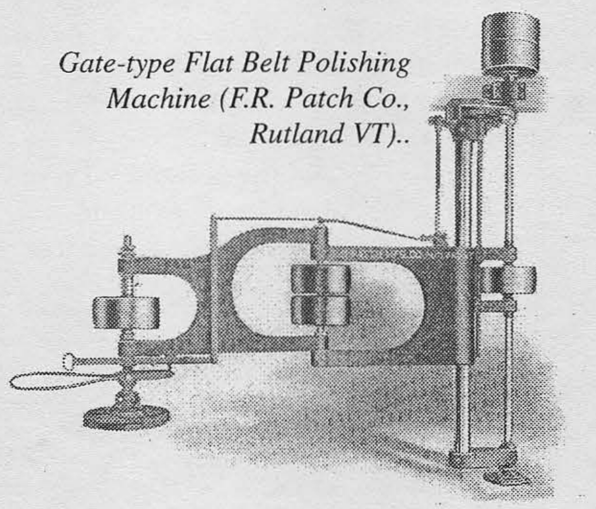
The WGC invested heavily in finishing shed equipment including: Yard derricks similar to the quarry boom derricks; Outside overhead traveling cranes for stone yards; Cableways for moving waste granite; Locomotive cranes to lift and move stone in sheds without overhead cranes and to do yard switching; Transfer cars, like small flatcars, to move stone within and between sheds; Inside overhead cranes; Plug drills; Pneumatic carving tools – small hand-held pneumatic hammers with chisel bits; Pneumatic surfacing machines that were used to create large flat surfaces; Non-pneumatic surfacing machines; Polishing machines that were used to close up the surface - producing a mirror-like finish; Cutting lathes (handling stones up to 35 feet long) that cut columns, urns, vases, etc.; Polishing lathes (handling stones up to 25 feet long); Fluting machines that cut the fluting in columns; Gang saws, with multiple reciprocating blades, that were used to cut quarry blocks (up to 16x6x7 feet) into slabs of various thickness; and Carborundum saws that were used to cut complex shapes such as moldings.

Gang Saw with Merriman's Patent Screw Feed (Lincoln Iron Works.



MERRIMAN IMPROVED SCREW GANG—DOUBLE PITMAN.

Gate-type Flat Belt Polishing Machine (F.R. Patch Co., Rutland VT)..

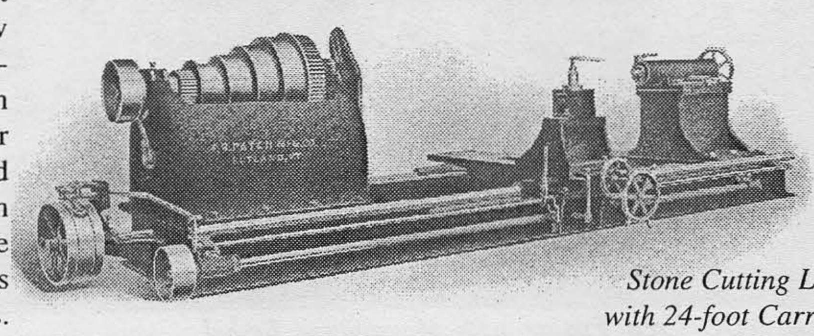


Perfection Polishing Machine

Electric Power Generation

As with railroad transport, the availability of reasonably priced and dependable electric power was important to the development of the granite industry, especially for building granite that had to be delivered in large quantities on tight schedules. Electric power made two new granite-working technologies possible - pneumatic tools and electric motor-driven machinery. The electric motor-driven air compressor, which was more efficient and of higher capacity than its steam-driven counterpart, allowed the widespread use of pneumatic carving tools in the sheds and pneumatic rock drills in the quarries.

Column Turning and Fluting Lathe



Stone Cutting Lathe with 24-foot Carriage (F.R. Patch Co., Rutland VT).

The electric motor provided power for a wide variety of machines, such as hoists, overhead cranes, gang saws, lathes, surfacing machines and polishers.

The Mackville hydroelectric power station had dual water turbines and generators – for a total of 1,000 HP. The turbines were fed by a 4 foot diameter tubular steel penstock. The Mackville steam power station had a 1,250 KVA steam turbine generator set. The set was good for 2,000 HP in electric current. The steam electric plant was used only if less-costly hydroelectric power was not sufficient and scrap wood from the sawmill, when available, was fed to the powerhouse boilers instead of coal. The Pottersville (Wolcott) hydroelectric power station consisted of two 300 KVA generators and two 21" turbines rated at 500 HP each.

Stone Clad Steel Frame Buildings

In early stone-constructed buildings, the stone actually supported the weight of the entire building. However, as real estate values in large cities escalated, there was financial motivation to erect taller and taller buildings. Beyond a half dozen or so stories it becomes impractical to construct stone-supported office buildings both because of the cost of material and labor and because of the loss of usable floor area and limitations on the number and size of windows in the lower stories due to the increased wall thickness needed to carry the much larger compressive forces. The steel framed skyscraper was, and still is, the answer to this problem.

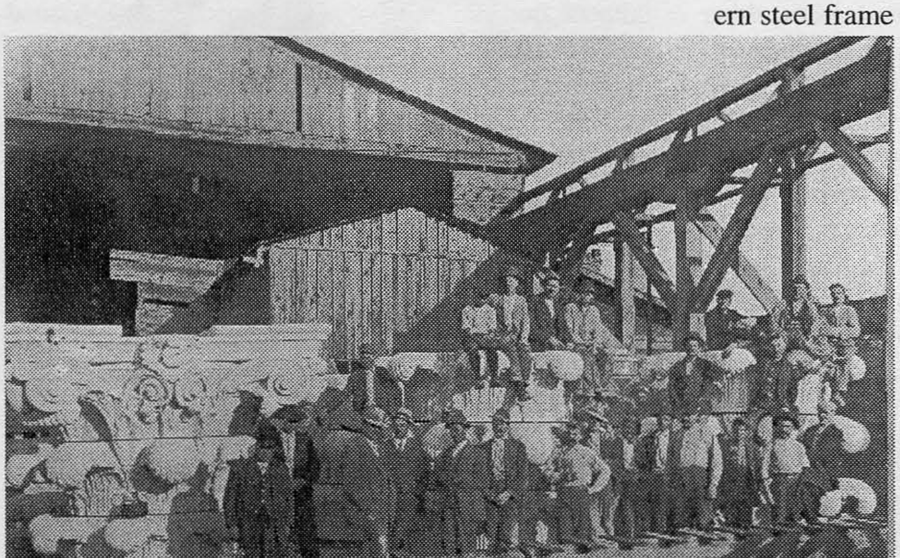
Granite as well as marble and limestone have been used for the facing of higher-quality steel-frame buildings. Some buildings had surface stone up to the first or second story. A few had an exterior stone façade all the way to the top of the building. The surface blocks are 4"-12" thick and are fastened by steel anchors to the steel framework of the building. The anchors fit into anchor holes cut into the sides of each block. The stone façade, or "curtain wall", is supported at each floor by "sidewalk" beams of the steel frame. A large skyscraper requires thousands of stone blocks – each carefully cut to the dimensions specified by detailed architectural drawings. WGC provided setting plans keyed to symbols marked on the back of each stone. The setting plans specified the exact location of every stone in the building. In 1917, WGC was able to deploy up to six simultaneous setting crews. The expediter, who supervised the loading of railroad flat cars, had to check off each of the thousands of stones ensuring for each stone that it matched its cutting diagram and that all the pieces were present.

The Final Act

Due to its hardness and density, granite is the supreme building material. This supreme durability and beauty comes with a high price tag. First, the hardness and density of granite make it more costly to quarry, to transport, to shape and to finish. Then, it requires setters to lay the stone, fitters to fit the stone around the steel beams, and blacksmiths to form and adjust the anchors. The high cost of granite has meant that modern steel frame buildings are now almost always faced with glass, enameled metal panels or thin (one inch thick) stone veneer panels.

The Woodbury Granite Co. is an excellent example of the successful application of a wide variety of specialized tools and technology to satisfy a market – in this case, granite facing for public buildings. After a brief flirtation with the monumental granite market, the Woodbury Granite Co. vanished, having gone out of business in 1935 - unable to compete the with less expensive alternative building materials and burdened with labor strikes and the increasing costs of transportation and electric power.

Paul Wood



Proud WGC Crew Posing with Magnificent Bethel White Corinthian Capitals.

Research Query

Thresher Mill
West Barnet, Vermont

Thresher Mill originally consisted of a number of buildings that included a wood-working building, sawmill, cider mill, blacksmith, and tannery, plus other various out-buildings. What still exists of this complex is a single mill building along the south side of the Stevens River in proximity to a dam near West Barnet, about 3 miles west of the Connecticut River (about 7 miles south of St. Johnsbury). The mill, in its various configurations and uses, has been in continuous use since 1836 under a variety of owners, buildings, and products.

The current mill, also known as "Ben's Mill," is what has survived a long history of use at this site. It got this name from Ben Thresher, who owned and operated the mill when it became the subject of a 1978 documentary video for PBS entitled "Ben's Mill." The mill today consists of a single 1872 building that incorporates a 2_ story gable-roofed, wood-framed carriage and woodworking shop; a 1-story shed-roofed, wood-frame cider mill added ca1885 to the shop's west gable end; and a 1_-story gable-roofed, post-and-beam frame blacksmith shop wing built ca1840 and moved to the east gable end of the mill ca1880. The mill retains its historic woodworking, machining, cider making, and blacksmith machinery and tools as well as shafting, belting, turbine and related hydraulic system used to power them.

The mill is the sole survivor among numerous small mills that once drew water power from the Stevens River and its tributaries in the self-sufficient community of Barnet in the 19th century. It continued to operate by water powered turbine until 1988, when the dam washed out during a spring freshet. The last owner, Hiram Allen, donated the mill for use as a working museum which it is today - the Ben's Mill Trust Limited, Inc, and today stands proudly in the roll call of American History on the National Register of Historic Places.

I got involved in the mill when I was approached by Elizabeth Dugger, Grants Writer for the Ben's Mill Trust at a 2002 Historic Preservation Conference in Rutland, Vt. She was referred to me as the person who could answer a question regarding a feature at the mill — a ground-level concrete structure covered with what appeared to be forge slag and an adjacent concrete feature with a metal stovepipe coming out of it. Thinking at the museum was that this was the remains of an old forge and that iron was once made here, but from photos she showed me, it didn't appear to be so. Yet, there was all that cinder and a scorched section of mill siding.

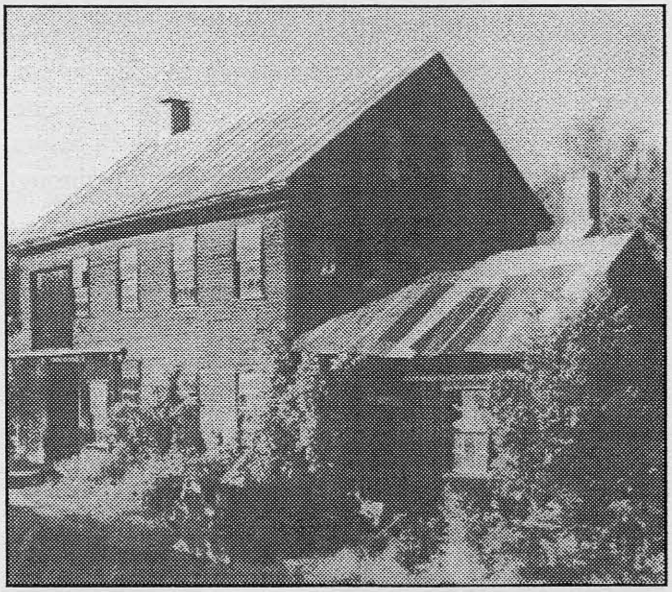


Figure 1. Thresher Mill, as it appeared in the 1980s while still in operation. Project area is behind trees at right end of blacksmith addition (courtesy Ben's Mill Trust, Inc.).

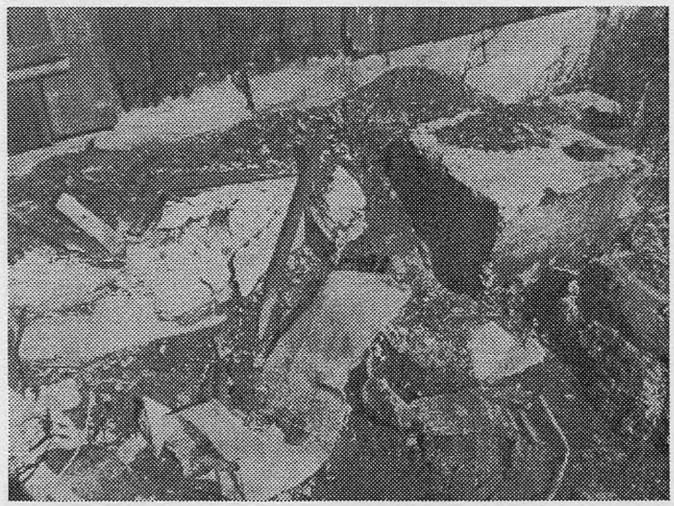


Figure 2. The site, as it appeared on May 19, 2003, after some surface clearing but before any excavating. The area had been the receptacle for all manner of refuse from the smithy, including hot cinder, from the looks of the scorched wooden siding. Feature 1 is at left; Feature 2 is at right.

For one week each in May and July 2003, I assisted Amanda Mallon, Museum Archeologist, in clearing the site of overburden and partially excavating the site, which consists mainly of a square-shaped concrete-lined pit (Feature 1) and a large concrete block associated with it and which has a stove pipe running through it (Feature 2).

Feature 1 is about four feet square overall at the top, but is difficult to measure as the top half of the of the walls are uneven, cracked, and/or broken. Horizontal measurements at the bottom (floor) of the excavated pit are 42 inches north-south by 44 inches east-west. The south wall leans inward at about 30 degree from the vertical and, as the excavation proceeded, the threat of this wall caving into the pit was alleviated by a wood brace. The back (west) wall is directly against the east (downstream) ca1880 foundation wall of the mill building. We also discovered that, by design or coincidence, Feature 1 is within an inch of being exactly mid-way between the north and south walls of the mill. And what appeared to be forge slag in the photographs turned out to be cinder from the blacksmith hearth, which is located just above and inside the mill. The smithy had been discarding cinder out the window where it accumulated along the mill foundation wall and charred some of the wood siding (and fortunately, didn't set the mill afire).

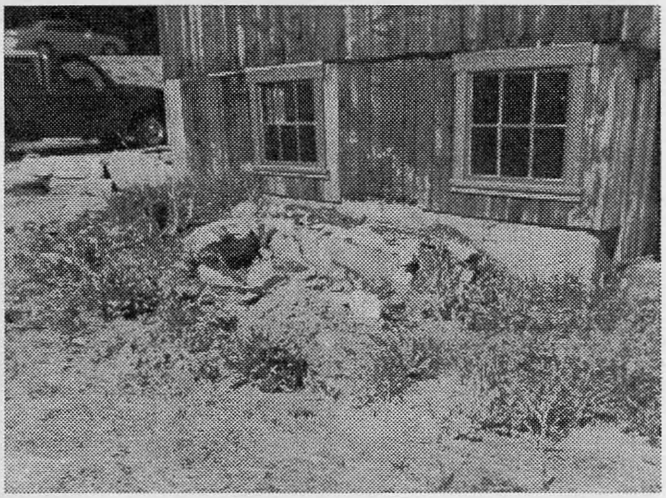


Figure 3. Overall view of the site location, at east end of the blacksmith end of the mill. Note height of scorch marks on the siding, indicating size of cinder pile that had accumulated.

The side walls of Feature 1 are made of poured concrete. The north, east, and south walls vary from 8 to about 12 inches thick; the back wall, against the mill foundation, is 15 inches think. The insides of the walls are somewhat smooth, still retaining horizontal lines from the boards in the construction form; the outside of the concrete walls are rough and uneven, probably the result having used the sides of the construction trench as the outside form.

Feature 2 is a 21_ -inch wide by 38_-inch long by 24-inch high solid block of concrete, laying with its longest length perpendicular to Feature 1. At the north end of this block, a short section of horizontal 8-inch diameter sheet metal stove pipe angles under the block and ends atop the north wall of Feature 1. At first thought, the pipe appears to have provided ventilation to whatever was going on inside Feature 1. Excavations around the base of Feature 2 showed it sat precariously atop loose stones, encouraging us not to deep too deep (or too close), and not leave the excavations open more than necessary. The block sits 18 inches from, and not physically attached to, the mill foundation

Figure 4. Mandy excavating Feature 1 on the second day of the project. Note south wall of Feature 1 leaning into the pit behind her.

Figure 5. Excavation around Feature 2 showed the heavy concrete block sat precariously atop loose, shifting stones, deterring us from further excavating around it.

wall. It is also not physically attached to Feature 1, but is situated such that the bottom of the horizontal section of stove pipe at that end essentially lays atop the north wall of Feature 1. Nothing inside the pipe gave information as to its use.

In addition to the large quantity of cinder encountered in and around both features, hundreds of rusted or corroded iron nails, rods, plates, tools (axe head, saw blade, pick head), castings, carriage hardware (sections of carriage springs, wheel rims, etc) and many other miscellaneous pieces of iron were also recovered - typical of what one would expect to find in proximity to a blacksmith shop. Much glass was also found - mostly broken window glass - and old and recent beer bottle glass. Artifact density slowly decreased with depth of excavation, both inside and outside the features. All dirt excavated was passed through a quarter-inch screen; all artifacts were bagged.

As Feature 1 was excavated, the instability of the south wall forced us to stop digging at about 40 inches deep in that third of the pit. The northern two-thirds of the pit was excavated to 50 inches below the top of the walls when a stone floor was revealed. Near the bottom of the northeast corner of the pit, a 10-inch wide by 12-inch long, badly rusted iron plate of unknown utility was uncovered and removed,.exposing an iron handle on the other side.

Under the plate was a 2d-inch I.D. iron pipe extending upward about 6 inches into the pit from the north wall, 4 inches above the floor. Angle of the pipe is about 1 inch per foot, appearing to provide a drain from the pit to the river, some 16 feet away. A tape measure pushed inside, however, stopped at about 6 feet (change direction? blocked by debris?). The other end of the pipe could not be found at the river's edge. During the preceding days, much heavy rain had intermittently fallen, and the pit, being the lowest spot in the immediate vicinity, usually filled with water. We noticed that as the excavation proceeded, water drained quicker as we dug deeper into the pit - possibly drained by the iron pipe?

The floor of Feature 1 is of two layers (possibly

Figure 6. The nature of the floor of Feature 1. A piece of floor stone removed showed that the piece of 1_-wide by f-inch thick wood continued its 19d-inch length under floor stones, and that a second layer of flat stones lay under the top layer. No other floor stones were removed, leaving the thickness of the floor unknown.

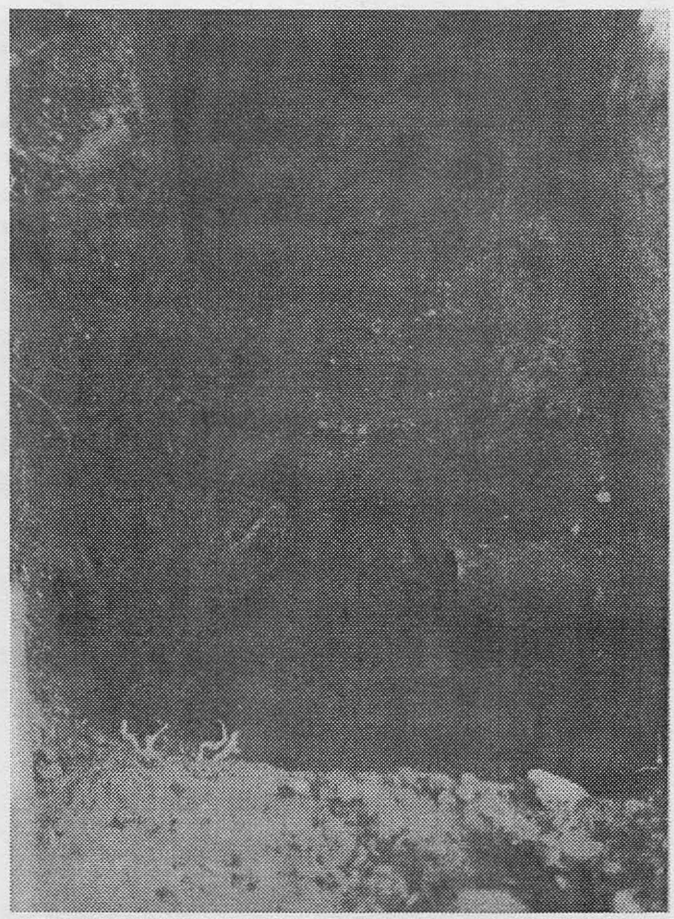


Figure 7. The 2d-inch I.D. iron pipe extending 6 inches into the pit from the north wall, about 4 inches above the floor. If a drain pipe, why not level with (or slightly lower than) the floor?

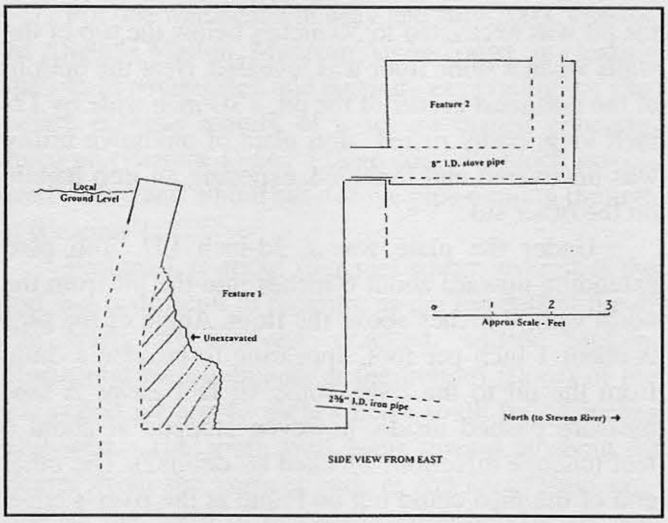


Figure 8. A side view sketch of the features after excavating was completed. View is from the east, looking toward the mill foundation (behind the features); north is to the right.

more) dry-laid, flat, 1-inch thick stone. Not wishing to destroy this feature until it was known exactly what it was, excavation stopped on reaching the stone floor. Prying with the tip of a trowel, the floor was noticed to continue under the north wall (i.e., the floor didn't butt against the side wall), as if the wall was built atop a previously existing stone floor? As a ca1847 tannery once stood at this side of the mill, this floor might be the floor of that mill? But if so, it still doesn't explain the function of the site. The stone floor was found to be porous when a bucket of water (about 2_ gallons) poured into the pit and observed to drain through the floor within a minute. The floor of the pit is below the level of the dirt floor inside the mill (basement under the forge floor), and no connections (holes, iron bars) can be found connecting the site with anything inside the mill.

Many scenarios for the purpose of the site have been proposed and considered :

1. A quench pit (usually are wide, narrow, and shallow; not large and deep, and not outside exposed to freezing winter weather).

2. An outhouse (with the vent pipe, sounds plausible, but why such a massive concrete base?)

3. Something associated with the ca1847 tannery (sweat pit?).

4. A leach pit (oral tradition of some unknown use of cedar trees in the area, possibly for making camphor?).

5. Water storage, in case of fire (with river so close by?).

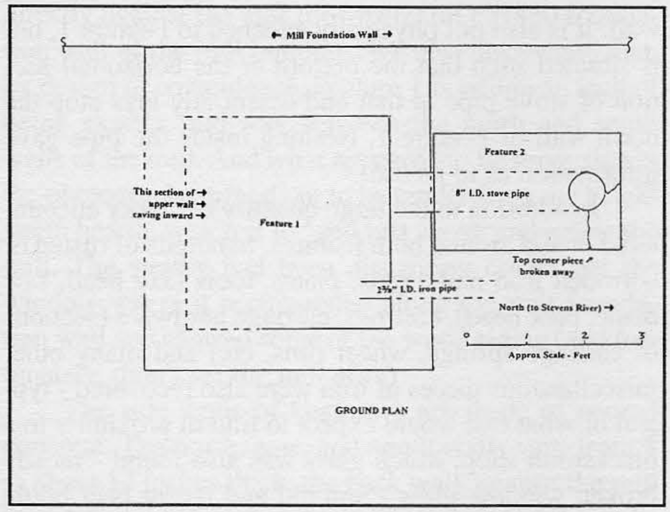


Figure 9. A ground plan sketch of the features; north is to the right.

6. Ice storage (possible, but this side got a lot of sunshine while we were there).

7. Apple storage (cider mill was on the opposite end of the mill).

8. Chimney base (this was my first thought because Feature 1 is exactly in line with the brick chimney opposite and inside the blacksmith shop end of the mill. Might have been an auxiliary chimney for an outside smithy?).

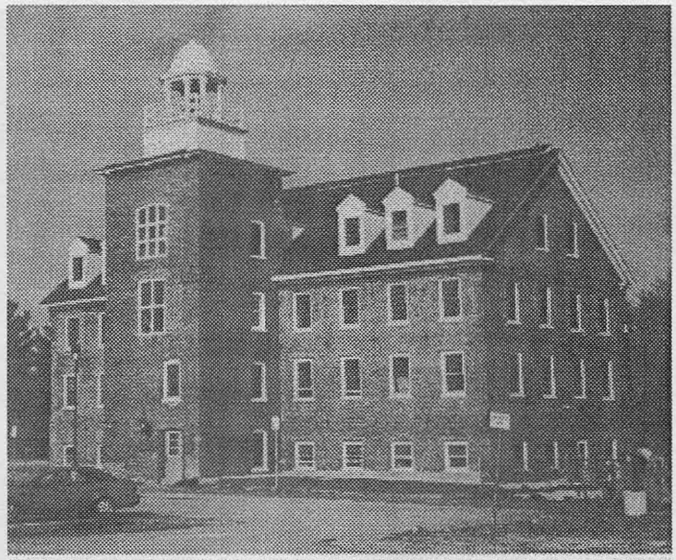
A local resident familiar with farming processes was stumped. Yet, the "forge" use still persists among the locals, possibly due to all that cinder seen by everybody around (and inside) the site. Forges are not, to the experience of this writer, built into the ground. A forge hearth would usually be built on a massive base, able to support not only the weight of the forge structure and its chimney, but also the weight of the iron being smelted inside it. None of the cinder found was bloomery slag; none of the inside concrete walls of the pit were burned or scorched; no whole or pieces of firebricks or refractory stones were found; no charcoal (but much anthracite, which was used in the smithy) or pieces of iron ore were found.

Thoughts anybody? Contact me at vrolando@sover.net or 17 Ledgely Drive, Shaftsbury Vt 05262. Winner gets a bucket of cinder.

Victor R. Rolando
Shaftsbury, Vermont

Penstocks

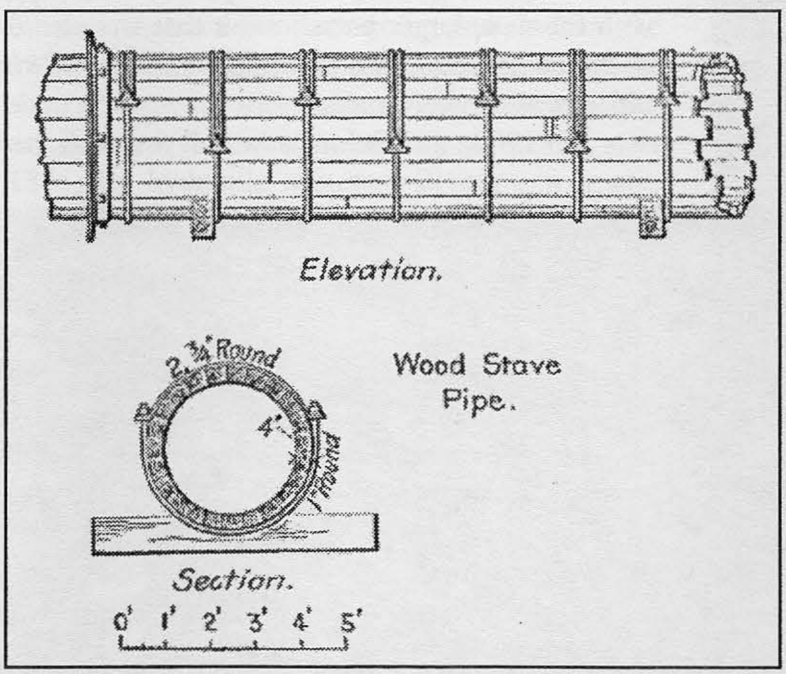
in Belmont, NH



The Gilmanton Mills building in Belmont, NH, c. 2002.

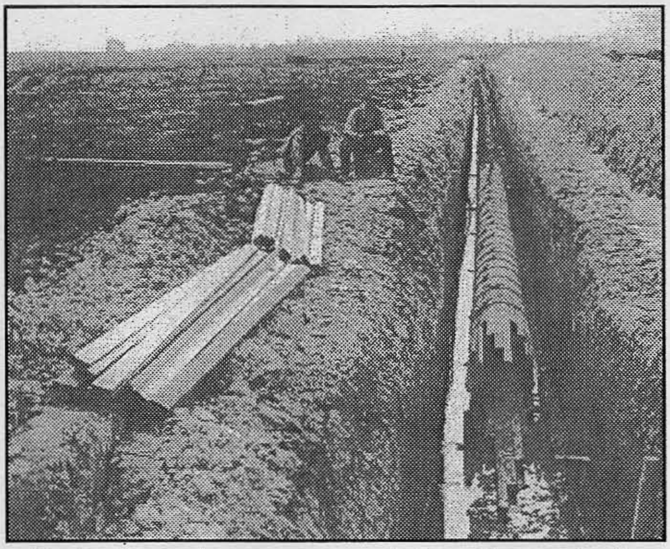
In August, 2003, Victoria Bunker, Inc., a New Hampshire archeology and cultural resource management firm, completed a Phase I archeological survey in the town of Belmont, New Hampshire. Of interest to industrial archeologists is that the survey recognized the remains of a sequence of water supply systems that had once been applied to power the historic Gilmanton Hosiery Mill that had operated under several names from 1853 until 1969. The hosiery mill became the town's primary employer by the early 20th century. The mill has been rehabilitated for modern commercial use and has been nominated to the National Register. Initially the mill manufactured cotton sheeting, then, in 1864, with the installation of knitting machinery developed by Walter Aiken of Franklin, NH, and others, was switched to the manufacture of hosiery under contracts with the Union Army. The mill produced knitted products until its closing in 1969.

The remains of dams, canals and penstocks trace the changing power infrastructure adopted by the mill owners. Two significant features noted by the survey are the remains of penstocks that illustrate that the mill management applied new technologies as they became available. The remains include a long series of partially buried in-situ hoops of an c. 1892 wood-stave penstock and portions of a c. 1910 riveted iron plate penstock. Historical information indicates that the penstock installations coincided with mill machinery changes and dam relocation. They carried water over the nearly three-quarter mile distance between a dam on the Tioga River to the mill's turbine.

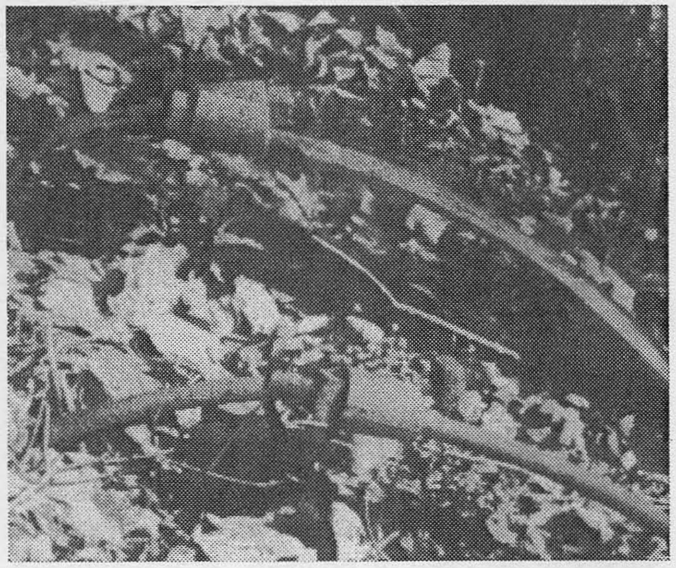


Wood-stave penstock construction detail appearing in Engineering News, *May 1897, p.300.*

At the time of its installation in 1892, the wood-stave penstock represented the best technological option to carry water over a long distance at high pressure. It was to serve the mill for nearly 20 years. The wood penstock replaced a shorter, sprawling canal system that had been installed in 1852. The penstock



Typical wood-stave penstock installation in the 19th century. See website www.sewerhistory.org.

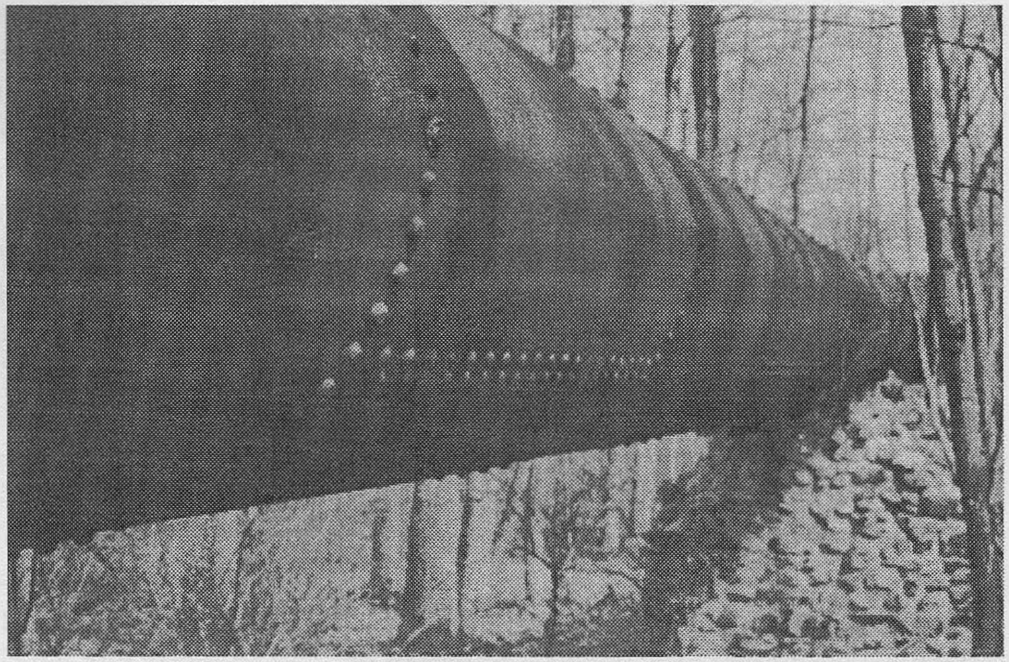


Hoop cinching devices.

allowed the mill owners to build a new dam further upstream and provide an increase in the velocity head at the turbine. The 24-inch diameter wood-stave penstock, which may be thought of as a large, very long barrel, had a cost advantage in that it could be installed by unskilled workers, and it had a mechanical advantage in that it could operate as a siphon and would conduct water under high pressure. Iron hoops with nut-and-bolt cinching devices resisted the outward pressure on the wood pipe. As a rule with wood stave installations, when the anticipated pressure increased, the spacing between the hoops was decreased. The observed in-situ hoops at the dam end of the run have a uniform 12" spacing over a distance of about 3/8 mile. It is not known if this spacing was maintained along the entire 3/4-mile length. It is interesting to note that specially designed cylindrical power saws having origins in the cooperage industry that was centered in southwestern New Hampshire and eastern Massachusetts were instrumental in creating a wood penstock industry. Wood staves, which could be produced cheaply with the new, larger barrel saws that were introduced about 1890, also saw application for sewer pipes, water towers and silos.

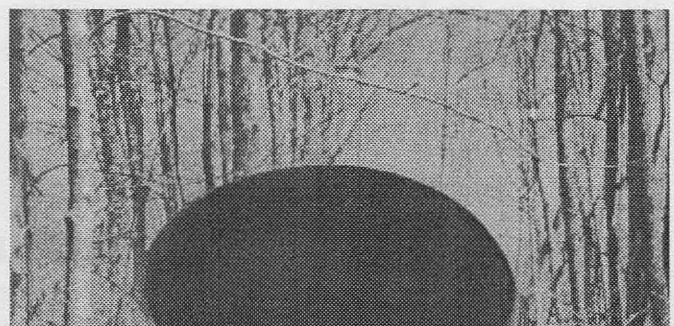
By 1909, the Belmont wood penstock had

In-situ *iron hoops are all that remain of the Belmont wood-stave penstock..*



A riveted iron plate penstock replaced the wooden one in 1910.

develop severe leaks, causing a decline in its efficiency. It was then that the wood penstock was replaced with a riveted iron plate, 40-inch-diameter penstock. Like the wood-stave penstock, the riveted-plate penstock became economically attractive only when technology allowed for inexpensive field installation. American builders of iron structures had used rivets (short, solid bars with heads) for connecting flanges to plates and for the construction of sea-going vessels from the 1850s, but the majority of rivets were driven in the shop or shipyard with large, cumbersome machinery, which at first was powered by steam and, after 1865, by hydraulic systems. Riveting was also accomplished "by hand" with hammers in some applications such as boiler making, but hand riveting required highly skilled workers and was physically demanding. It was not until after 1900, following the introduction of the Chicago Pneumatic Tool Company's Boyer long-stroke hammer and the Fairbanks, Morse and Company's gasoline-engine driven air compressor, that it was economically attractive to accomplish field riveting of steel plate to form long, large-diameter pipe. The new iron penstock was laid along the same route as the wooden one which was not entirely removed.



Portland concrete mortared cobble piers support the iron penstock in a low area.

Abandoned by the mill, the Town of Belmont has left in place the penstock remains, including a section of the iron pipe penstock supported by concrete-mortared cobble piers. It is interesting to note that the concrete and cobble supports for the penstock represent a construction technology typically applied in New Hampshire between 1905 and the early 1920s as engineers were adopting Portland cement. The piers appear crude by today's concrete construction standards, but one must remember that concrete technology was in its infancy at the time and was likely mixed by hand.

The iron penstock served the mill into the mid-20th century. As the mill's belt-pulley driven knitting machines were replaced with electric-motor powered machines, its water turbine was used to drive a 15 KVA, 60 HZ, 3 phase generator.

The penstock remains can provided useful information about industrial history in Belmont. While there are historical documents providing information about the sequence of ownership and products of the Gilmanton Hosiery Mill and inventories providing production machinery lists, there has been little engineering information located by researchers. Analysis through industrial archeology using the measurements of the extant water supply components can answer many technical questions. For example, were the water power potentials at a given time sufficient for additional machinery or limiting? Or, could water power potential have been a factor in the change in mill ownership? With the extant remains and the application of hydropower engineering formulas, there is the opportunity to calculate the mill's power utilization and efficiency over time and compare the water power energy potential with applied machinery needs.

Dennis Howe
Concord, NH

Call for Papers

Society for Industrial Archeology 33rd Annual Conference

The SIA invites proposals for papers and poster sessions to be presented at the Annual Conference on Saturday, June 12, 2004 at Providence, RI. Poster sessions may be works in progress. Presentations on all topics related to industrial archeology are welcome, especially those related to New England's rich proto-industrial and industrial heritage. Papers about bridges for the 21st Annual Bridge Symposium, co-sponsored by the Historic American Engineering Record (HAER), are also encouraged. All papers and poster sessions should offer interpretation and synthesis of data.

Presentation Formats: Proposals may be for individual papers, themed papers filling 90-minute sessions, or organized panel discussions (formal commentator optional) for 90 minute sessions.

Proposal Formats: Each proposal must include: 1) title; 2) an abstract with a detailed discussion of points/findings/conclusions to be presented in hard copy and electronic format (Word or WordPerfect); 3) résumé for the presenter(s), including postal address, telephone/fax, and e-mail; 4) a list of visual-aid requests (computers will not be provided). A panel organizer should submit all paper proposals as a group, accompanied by a title and a brief description of the theme or purpose. If any of the items are missing, the proposal will not be considered. Each invited presenter is then responsible for submitting electronically a concise, one-page or less summary of their presentation to be published in session abstracts. The summary will be due by April 16, 2004.

Space will be available on a first come first served basis to display posters on current research in industrial archeology in one of the conference rooms. Poster presenters must submit an abstract along with a request for reserved floor space or tabletop space. Posters can not be attached to the walls but may be displayed on easels. Posters should be focus on visually displaying graphics and photographs of the work and have accompanying text labels. Poster presenters should be available at their display during the day to discuss their work with conference attendees.

Deadline: February 6, 2004. Send paper copies of all proposals to: Mary E. McCahon, 332 E. Union Street, Burlington, NJ 08016; (215) 752-2206; mmccahon@LCE.us.

Call for Papers

Symposium on New England's Industrial Architecture

The University of Massachusetts, Lowell, and Lowell National Historical Park will sponsor a one-day symposium April 23, 2004 on New England's Industrial Architecture. In addition to historical investigations, papers may also address issues of preservation and structural engineering.

Abstracts of no more than 300 words should be submitted by January 31, 2004 to: Marie Frank, Dept. of Cultural Studies, 850 Broadway, UMass, Lowell, MA 01854 or Marie_Frank@uml.edu