

Figure 1. View of Concord Granite Company's Quarries, Concord, New Hampshire, published by Asher & Adams, New York; engraved by G. Wyand after C. Graham, 1875. This view illustrates the daily activities of quarry workers before the introduction of powered equipment. Two men with sledge hammers at the upper left prepare for blasting by alternately striking a drill which a third man rotates between blows. Elsewhere, men working alone or with the assistance of oxen and horses lift and move the heavy blocks using levers, chains, pulleys, derricks, and wagons. Courtesy of the Concord Public Library, F4203.

The Granite Quarries of Rattlesnake Hill: The Concord, New Hampshire, “Gold Mine”

Donna-Belle Garvin

“The visitor to Concord is at once impressed with the magnitude of the granite industry. On every hand are to be seen the great establishments erected for cutting, polishing and finishing the granite for the markets of the world.”¹ By 1900, the work of 44 separate stone companies combined to make granite quarrying (figure 1) and finishing one of the leading industries of the New Hampshire state capital.² With the passage of almost another century, however, Concord granite has become associated in people’s minds with one firm only—the John Swenson Granite Company. After purchasing the Rock of Ages Corporation of Barre, Vermont, its primary competitor, in 1984, Swenson is today North America’s largest quarrier of granite.³

Concord’s granite industry has a long and varied history. From the days of earliest settlement, local people have relied on Rattlesnake Hill for stone. The grindstones for the town’s first mill are said to have been brought in 1729 from this West Concord hillside. And in 1746, the Reverend Timothy Walker, whose farm was in the relatively rock-free floodplain, recorded going “up to Rattlesnake for stone,” probably for the “pasture fence” he built the next day.⁴

Stonecutting as an industry, however, began around 1810, when an experienced stone contractor from Massachusetts began to split out granite for the construction of a state prison in Concord (figure 2). Stuart J. Park (1773–1859) had recently built state prisons of granite at both Charlestown, Massachusetts, and Windsor, Vermont. For the New Hampshire prison, he employed 50 men in the arduous task of splitting stone and, a few years after completion of the prison, taught 40 of the convicts to hew the stone needed to build the state capitol.⁵

Completion of the state house required 37,000 square feet of hammered stone (an estimated 3,000 tons).⁶ As work on the capitol began in 1816, prison officials authorized the erection of a “shed for the accommodation of the Stone hewers for the state”—the first of countless Concord granite sheds.⁷ Despite the fact that granite work had been “almost an unknown art in New Hampshire” until then, the building committee could proudly claim in 1816 that the convicts’

product was “not deficient in beauty, and in strength not exceeded by any work of the kind, it is believed, in the United States.”⁸

Since the prison’s opening in 1812, inmates had been employed at heavy labor in a number of industries, both as punishment and to ensure that the prison would be self-supporting. Prison labor was frequently contracted out to local craftsmen.⁹ As early as 1818, however, a prison review committee recommended “that the employments of the several convicts be simplified and reduced as far as possible to one kind,” that it is “important to pursue that employment which, requires little machinery, the fewest tools, and least expense of stock,” and that “hammering of stone has been far the greatest source of income.”¹⁰

By the summer of 1818 (even before the state house had been completed), stonework from the prison was being advertised in the newspaper by the independent partnership of Gass & Johnson, contractors with the state for prison labor. John Park Gass (1794–1852), Stuart Park’s nephew, had helped train and supervise the prisoners on the state house project. Now he and his partner were selling “mill-stones, underpinning, steps, hearthstones, sills and caps, and stone work of any and every kind” from the prison at short notice.¹¹ By 1825, during the single month of May, 52 prisoners cut 2,421 feet, 9 inches of stone. Prison sales of hammered stone in 1827 totaled \$12,221, a significant amount for the time.¹²

From the late 1810s through the 1830s, much of the granite worked at the prison was intended for the Boston market.¹³ The leading architects of Boston (including Charles Bulfinch, Alexander Parris, Solomon Willard, and Isaiah Rogers) were national pioneers in the use of architectural granite. It is said, in fact, that America’s first full granite cornice—that on Willard’s United States Branch Bank in Boston, erected in 1824—was of Concord granite worked at the state prison.¹⁴ Rattlesnake Hill granite also was shipped from Boston to other ports along the coast and major rivers from Albany to New Orleans.¹⁵

The architecture of stone that characterized New England at this period was made possible largely by the enthusiastic

Industrial Archeology

Figure 2. *New Hampshire State Prison, Concord, constructed 1810, with additions dating from the early 1830s, from a stereograph by Howard A. Kimball, c1870. In many parts of New England, prisons were the first buildings constructed of split stone. Following Massachusetts's example, the Granite State supported its convicts by putting them to work cutting building stone for the nation's rapidly growing cities, thereby setting the stage for an important local industry.* Courtesy of the New Hampshire Historical Society, N440.



canal-building efforts of the era.¹⁶ Much of the granite from which Boston and other cities were built passed down the Merrimack River and through the Middlesex Canal (opened in 1803). This granite came first from Chelmsford, Massachusetts (near what was to become Lowell), and later from Concord as well. Chelmsford granite, much of which was finished at the Massachusetts state prison in Charlestown, was in such demand by 1817 in Boston that “eighty workmen, the last season were not able to answer the urgent calls. . . .”¹⁷

With additional canals to bypass the rapids, the Merrimack was navigable all the way to Concord by 1813. In 1815 the Merrimack Boating Company began regular freight service from Concord to Boston.¹⁸ This timely development enabled the Concord prison contractors to capitalize on the growing need for stone in the larger metropolis. By 1825, Concord’s position resembled that of Chelmsford a decade earlier. According to a Concord newspaper, “there is a greater demand for the granite, wrought at this place, for use, in Boston, than can be supplied.”¹⁹

Boston’s Quincy Market (then known as the New Faneuil Hall Market) was one of the major building projects of its time. Its walls, 556½ feet long, were constructed from 1825 to 1826 largely of Concord granite. Although specific architectural features such as the columns, cornices, and foundation came from Chelmsford, Hallowell (Maine), and Quincy (Massachusetts), respectively, Concord’s involvement in this project helped establish its reputation as a major granite supplier.²⁰

Until the 1830s, Concord granite was obtained by surface quarrying rather than from quarrying ledges (figure 3). The same was true in Chelmsford and other early granite centers. As the result of glacial action, the New England landscape was strewn with boulders, some weighing hundreds of tons. In 1819 a traveler in the upper Connecticut Valley recorded having seen within 40 miles “enough to build several cities.”²¹

In 1823 a single Concord boulder, split into blocks, was sold in Boston for \$6,219. “This single rock made 10,500

The Granite Quarries of Rattlesnake Hill



Figure 3. *Iron wedges, used in an attempt to split a boulder, c1830, still embedded in the stone, Northwood, New Hampshire, 1994. Generally, the granite first quarried for building use was taken from boulders rather than ledges. Sometimes, when attempts at splitting failed, boulders survived intact, retaining evidence to this day of early quarrying activity.* Courtesy of James L. Garvin.

feet of facing stone and ornamental work—and the aggregate weight of all the blocks (smooth hewn) was 550 tons, [the boulder] having lost only 50 tons in being prepared for the market, after it was brought to the prison yard.”²² Landowners and stone splitters even bestowed names on some of Concord’s most remarkable boulders. One family never forgot selling the “Phebe rock” (named for a nesting bird) to Gass & Johnson for \$110 and later learning that it had been sold in the New Orleans market for \$6,000, after being wrought at the prison.²³

Granite work, then as later, involved splitting stone from a boulder or ledge, moving it to the stone sheds or surrounding yards, hammering it to any desired shape and/or surface finish, and transporting it to market. From beginning to end, it was “a story of skill and patient endurance, danger and anxiety, from the time the first blow is struck on a drill to remove [a stone] from the mountain until it is placed in the position designed for it.”²⁴

Simple but effective stoneworking tools have been in use for a long time. According to John Gass, his grandfather John Park (a native of Scotland who moved to Groton, Massachusetts, in 1767) was “the first here [presumably meaning New England] who practiced splitting stone with a wedge.”²⁵ According to this method, a series of small iron wedges are driven methodically between shims into a line of holes drilled into the granite. The increasing strain, distributed evenly across the rock through successive blows,

eventually causes it to split along the plane desired.²⁶ In 1851 Henry David Thoreau described a stone splitter in action: “See how surely he proceeds. . . , how carefully he drives each wedge in succession, fearful lest he should not have a good split!”²⁷

It was in preparing to split and work up the Phebe rock that Concord residents appear to have first experimented with explosives: “The explosion produced a shock like a little earthquake; the huge mass was thrown over, to the amazement and joy of the beholders!”²⁸ Explosives were used to remove inferior stone (called overburden) found near the surface, which experience showed could prove defective in building use. Blasting itself could produce further weaknesses in the granite, however, so it was not employed near desirable building material. Masses of rock detached by blasting were split into rough blocks using the drill and wedge-and-shims (or so-called plug-and-feathers) method.²⁹

The stone split into blocks by the quarrymen was transported to a stone yard or shed. Blocks were manipulated using levers and jacks, hoisted using derricks with pulleys or windlasses, dragged on sledges called stone boats, and/or hauled longer distances on carts pulled by oxen³⁰ (figure 4).

At the yards, stonecutters worked from building plans and lists of stone needed, hewing each block exactly to the dimensions required. To do this they used points (or chisels) and a special axe called a peen hammer, followed by a bush hammer and other tools to finish the surface. The work of the stonecutter, often called hammering, was described in 1827 as “one of the most tedious operations in the labor of mechanics.”³¹ The goal was to shape each block with a minimum of strokes, and workers tended to devise their own methods of doing so.³²

The first true quarry in Concord was opened not by the prison, but by a local businessman named Luther Roby (1801–1883). Better known at the time as a printer and bookseller, Roby purchased part of Rattlesnake Hill in the mid-1830s.³³ By 1836, he and others incorporated themselves as the Concord and Granite Railway Company.

A decade earlier, just after one of the first granite quarries in New England had been opened at Quincy to supply stone for the Bunker Hill Monument, the nation’s first railway of any type was constructed there to carry granite from the quarry to tidewater. Quincy’s inclined railway made it possible for a single horse to move three wagons of granite weighing 21 tons to the wharf “with ease.”³⁴

Industrial Archeology

Figure 4. *Four yoke of oxen in an unidentified Concord granite quarry, from a stereograph by Howard A. Kimball, c1870. Quarriers preferred oxen because of their calm temperament; they were used with derricks and wagons to hoist and transport granite. Sometimes, however, it was necessary to recruit as many as 40 yoke of oxen from nearby farmers to pull an especially heavy load. Courtesy of the New Hampshire Historical Society, N284.*



Doubtless inspired by this unique railway, Roby and fellow incorporators petitioned in 1836 “to commence and carry on the business of quarrying granite at the New-Hampshire Ledge or Quarry in Concord in said State. And to construct such Railway as may be necessary for the transportation of said Granite from said Ledge or Quarry to the Merrimack river, and to the line of the Concord Railroad Corporation.”³⁵ Although the railroad from the quarry to the river was illustrated by a wood engraving on the company’s stock certificate (figure 5), it is not certain whether tracks were ever actually completed. When the image was reprinted in a gazetteer three years after the company was formed, the railway was still “contemplated.”³⁶

By this time, a new mode of freight and passenger transport was threatening to make river and canal traffic obsolete. Roby himself had invested not only in granite but also in canals, being a leading promoter for the extension of river traffic north of Concord through the construction of a canal around Sewall’s Falls. The coming of the railroad to Concord in 1842, however, quickly ended local canal plans. The

railroad provided efficient transportation year-round, unlike rivers and canals which froze in winter. Ever resourceful, Roby soon was providing granite for the foundation of Concord’s first railroad depot—the largest block being 17 feet long and requiring 40 yoke of oxen to move it.³⁷

For the next several decades, the granite industry was closely linked with the railroad (figure 6). Stone sheds eventually lined the tracks, particularly in the part of town known as West Concord. The quarries were not far away; the distance to be “teamed” was never more than three-quarters of a mile. Coinciding with the switch from water to rail freight was a change in prison employment from predominantly stonework to largely cabinetwork. Only later did the prison itself move to West Concord, for ease in shipping its products by rail.³⁸

By 1874 Roby was credited with having introduced Rattlesnake Hill granite “to the country and making it *the gold mine of Concord*.”³⁹ Roby’s quarry operation—the only one listed in the 1850 census—at that time employed 20

The Granite Quarries of Rattlesnake Hill

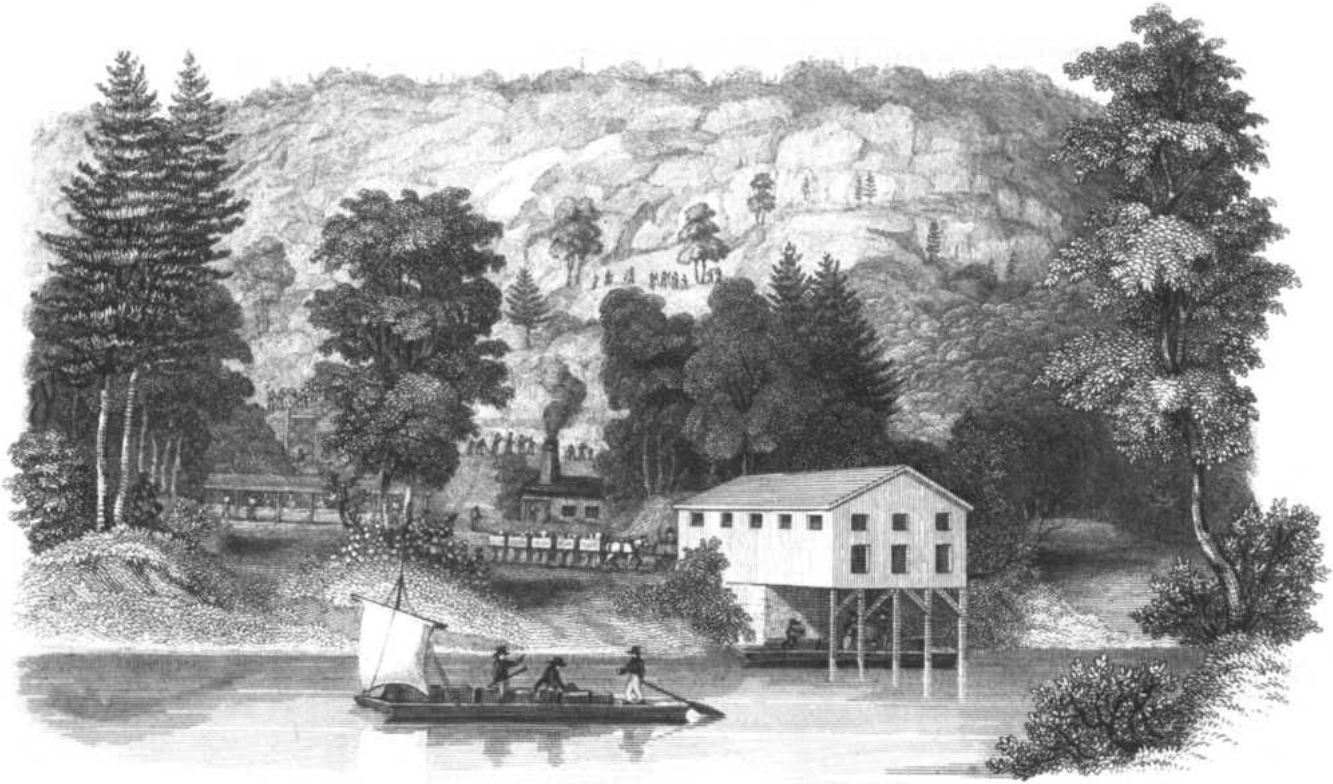


Figure 5. "The New Hampshire Granite Ledge, at Concord, N.H.," from a share certificate for the Concord Granite & Railway Company, engraved by Caleb Deeley, 1837–38. Granite drawn from the quarry by a horse railroad is being loaded onto a Merrimack River flatboat, where it was likely to travel through the Middlesex Canal to Boston. Courtesy of the New Hampshire Historical Society, F2736.

workers. A quarter of a century later, employment in this rapidly growing industry had reached 500, and at least 11 quarries had been opened.⁴⁰

By this time, Concord granite was "the standard by which that from other localities is judged."⁴¹ It had been recognized for some time that Concord granite was unusual in being "perfectly free from those oxides, or other mineral substances, which on exposure to the atmosphere, mar the beauty of much of the New England granite."⁴² The West Concord stone was "indeed one of the most important granites of the United States," according to a noted geologist of the time.⁴³

By mid-century, Concord granite was becoming the building stone of choice for more and more important projects, often to the annoyance of distant stone contractors. "When the quarry-men at Quincy, only six miles distant from Boston, found that preference was given to granite quarried seventy miles away," they were said to have shown "shrewdness characteristic of Massachusetts business men, by securing nearly all the control of these ledges, and the heavy contracts

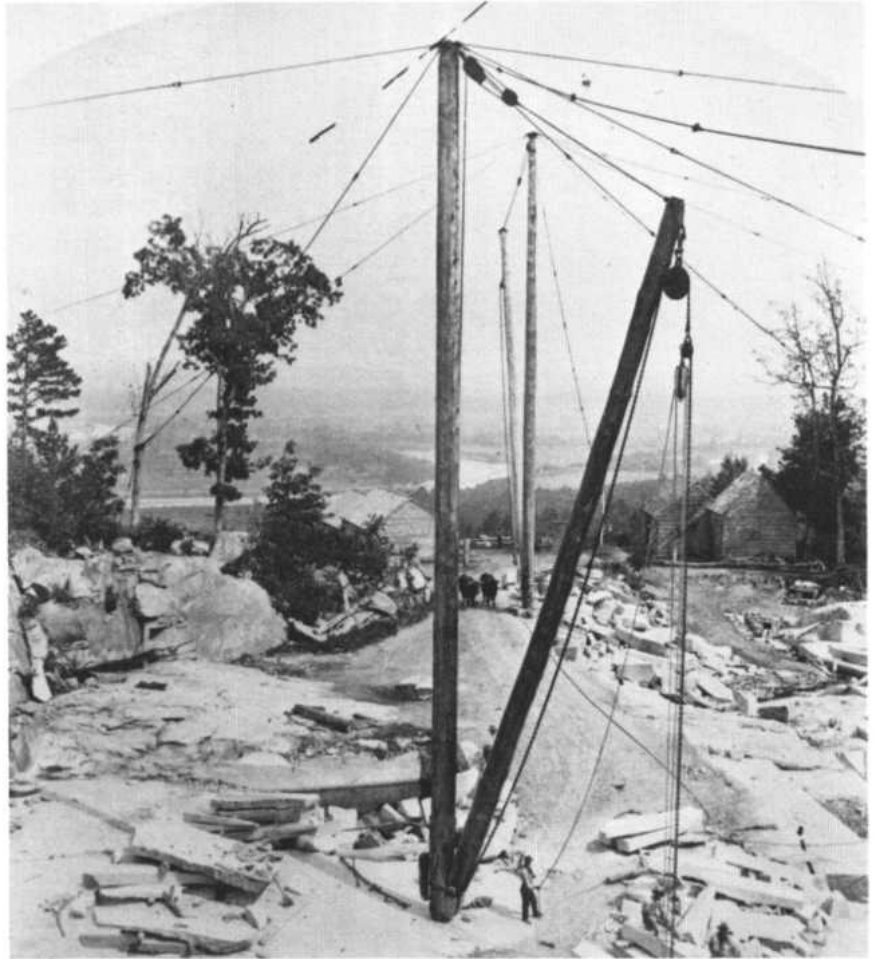
pertaining thereto."⁴⁴ By the time this was recorded in 1874, Concord's granite industry was said to be "largely controlled by people residing in Massachusetts."

The two leading granite quarrying operations by the 1870s were the Concord Granite Company (employing 75) and the Granite Railway Company (employing 100), both headquartered in Boston. Roby's own company had been taken over in 1854 by the New York and Concord Granite Company. The Granite Railway Company was owned jointly with, and took its name from, the original Granite Railroad Company of Quincy, Massachusetts.⁴⁵

By the second half of the 19th century, America had definitely entered the age of granite. This stone was used not only for structures of all types, taller and larger than ever before, but also for a variety of other purposes.⁴⁶ Engineering projects ranging from bridge abutments and dams to waterworks and fortifications depended heavily on granite. The Concord Granite Company, for instance, appears to have been awarded a contract in the 1870s for part of the Brooklyn Bridge.⁴⁷ Streets were often curbed and paved

Industrial Archeology

Figure 6. *The Merrimack River, looking east from Rattlesnake Hill, from a stereograph by Willis G. C. Kimball, c1875. The relationship between quarries and transportation networks was of tremendous importance in the development of the granite industry. Eventually a railroad track extended along the eastern side of Rattlesnake Hill, as did a series of quarries recognizable from a distance by their tall derricks and reinforcing guy lines.* Courtesy of the Concord Public Library; Elwyn L. Page Collection, F4210.



with granite. Paving blocks of granite were introduced in Boston by Solomon Willard in 1840, as an alternative to cobblestones.⁴⁸ Concord granite was described as “hard enough to wear well but not hard enough to become too slippery for horses to travel over.”⁴⁹

The era was also characterized by monument building, especially following the Civil War. As early as 1851, Roby had supplied New Hampshire’s block for the Washington Monument.⁵⁰ Concord granite was described as “of the finest grain, susceptible of the highest polish, and admitting of the best conceptions of the sculptor’s art.”⁵¹ The Ether Monument (honoring the discoverer of anesthetics) in the Boston Public Gardens and the Soldiers’ Monument in Concord, Massachusetts, are the most often cited sculptures of Concord granite. And for cemetery work, granite, “now the favorite monumental stone, [was] displacing marble as completely as that displaced slate.”⁵² Ranging from simple

gravestones and lot borders to mausoleums, granite funerary art became an important part of the “garden cemetery” of the Victorian era. By about 1880, Concord was sending “hundreds of handsome monuments . . . to the wholesale trade in Ohio and other Western States, as well as throughout the East.”⁵³

The most monumental structure erected of Concord granite in any era was the Library of Congress, built between 1886 and 1897, and considered the largest building in the world at the time. Its exterior walls were described as “white granite, the whitest and purest known, from the quarries at Concord, New Hampshire.”⁵⁴ Three hundred men worked for six years to split and finish the 350,000 cubic feet of granite called for by the contract, which exceeded any other to that date in the building trades. The finished product was considered well worth the extraordinary effort: “The color and fineness of [the stone’s] texture give a delicacy of

The Granite Quarries of Rattlesnake Hill



Figure 7. *New England Granite Company Quarry No. 1*, published in *Merrimack County Art Work*, 1893. At left of center, two rows of quarriers coordinate their drilling, apparently oblivious to a large block of granite about to be lifted past them. This quarry was engaged at the time in supplying granite for the Library of Congress, the largest building project anywhere to that date. In 1896 the company employed 85 quarrymen, 154 granite cutters, 40 laborers, 2 machine men, and 12 tool sharpeners. Courtesy of the Concord Public Library, F4197.

expression to every architectural line and detail, which is unequalled by any other granite structure in the world”⁵⁵ (figures 7, 8).

The Library of Congress contract was awarded to the Hartford, Connecticut, New England Granite Company which recently had taken over a major Concord quarry. The new firm was described in a contemporary newspaper as operating at Concord “the most complete plant in the world for cutting granite,” with 12 acres of stonecutting yards and three large sheds each 300 feet long. The library columns were produced using a special lathe turned by electricity.⁵⁶ The granite was transported from Concord to Washington in 2,200 railway cars. The blocks, whether plain or decorated, left the stone shed “in absolute readiness for the position which they are to occupy in the edifice. Each one is

numbered, and is put in its proper place without being changed in any way after its arrival in Washington”⁵⁷ (figure 9).

To promote increased use of—and investment in—Concord granite, a Granite Manufacturers Association was formed in 1892. Thirty-two stonecutting and quarrying businesses joined. Not all the city’s granite quarriers operated their own stonecutting sheds, nor did all the granite dealers own quarries. Dealers frequently offered a wide selection of stone from a number of distant quarries along with that from Rattlesnake Hill.⁵⁸

No less than 31,000 tons of granite were shipped out of Concord by rail in 1896, which was considered a “dull” year. The following season the railroad laid out a branch

Industrial Archeology

Figure 8. *New England Granite Company quarry, c1910. Although Concord granite was noted for its fine texture and lack of imperfections, there were certain natural breaks and planes of cleavage in the rock that quarriers were able to take advantage of in splitting out merchantable blocks.* Courtesy of the New Hampshire Historical Society; George Wesley Perry Collection, F4204.

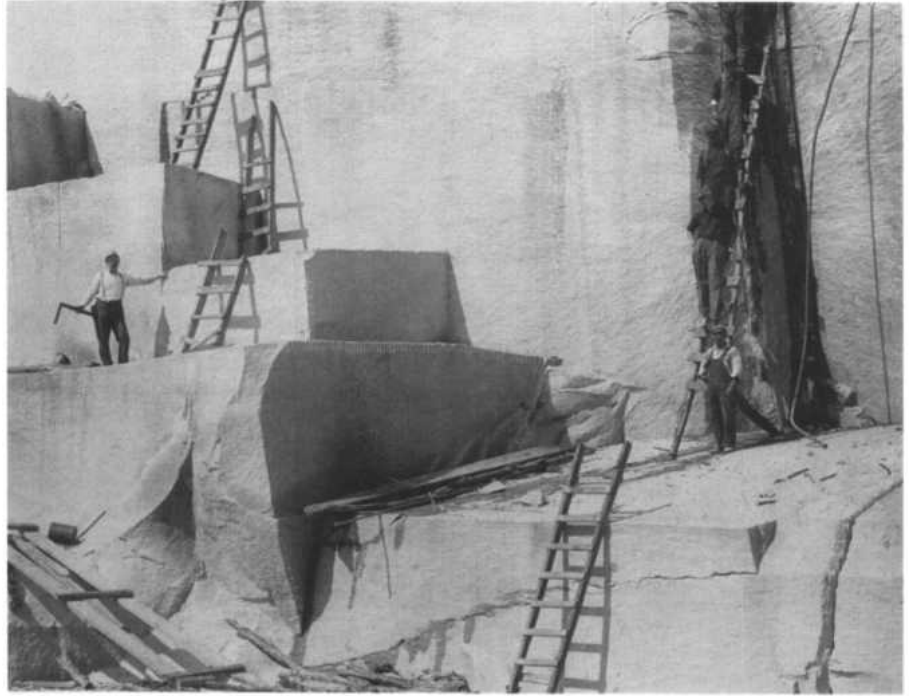
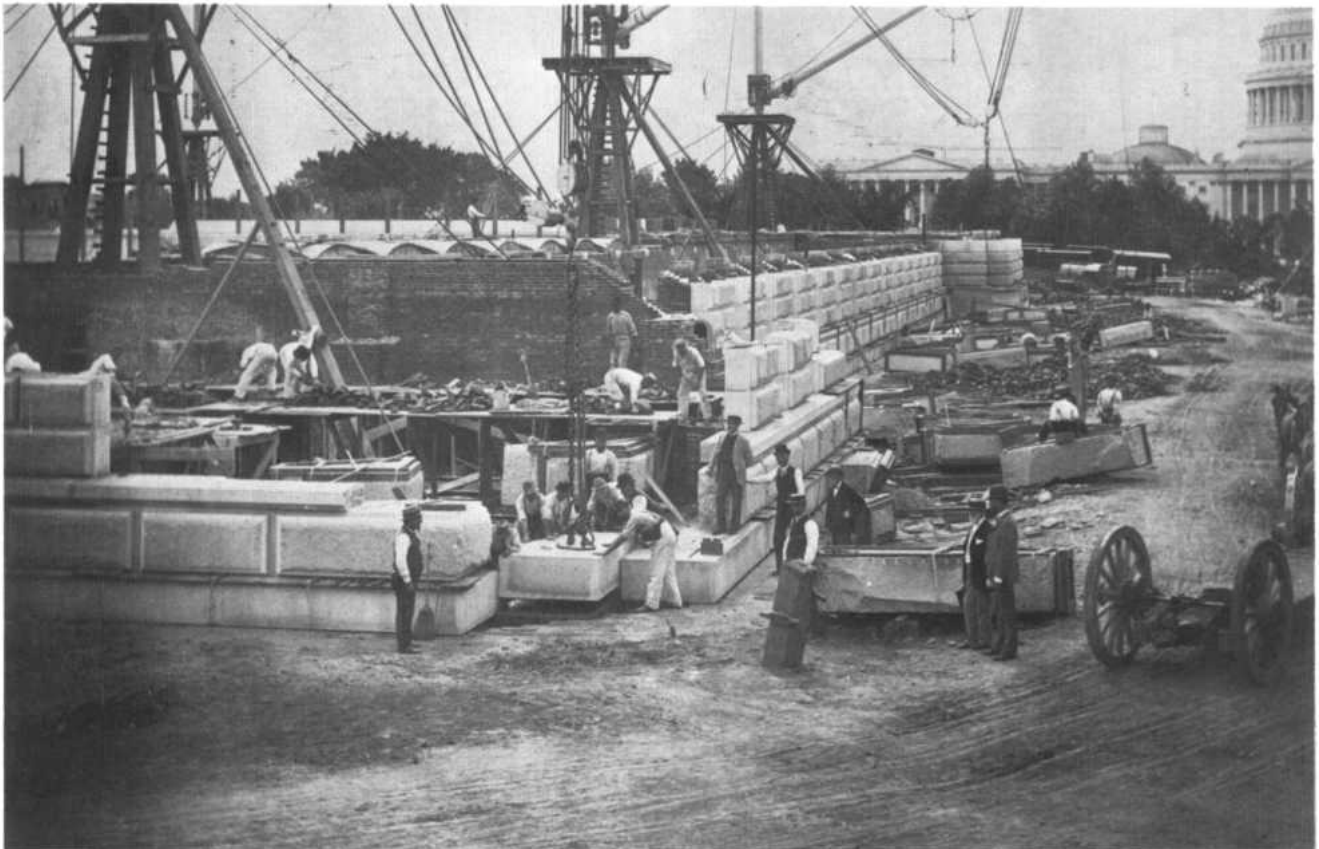


Figure 9. *The laying of the cornerstone for the Library of Congress, Washington, D.C., August 28, 1890. To protect the corners and edges of the stone from being damaged in shipment, each block was boxed at the cutting yards. In this photograph, the wooden strips bound by iron hoops that have protected the granite are being removed so the blocks can be set in place.* Courtesy of the Library of Congress.



The Granite Quarries of Rattlesnake Hill

line to serve the various granite operations more directly. By this time, Rattlesnake Hill could be described as “honey-combed with quarries.”⁵⁹ According to granite association literature, there was “room on Rattlesnake hill alone for hundreds of quarries,” and Concord’s granite supply appeared inexhaustible.⁶⁰

The need for tools and equipment for granite work stimulated the development of a number of related industries in the area. As early as 1829, the state prison warden advertised stone hammers made by the convicts in their blacksmith shop.⁶¹ By the 1870s local machinists and manufacturers were specializing in the production of granite tools, including bush hammers, chisels, derricks, cranes, lifting jacks, and polishing machines.⁶² Turn-of-the-century promotional literature mentioned the local foundries, “where necessary machinery can be readily manufactured,” as one of Concord’s many attractions to prospective quarry owners⁶³ (figures 10–15).

Stone tools required continual sharpening and/or replacement, due to the nature of the material worked. A typical stonecutter, as Thoreau observed in 1851, “wears up one or two drills in splitting a single stone.”⁶⁴ Concord bush hammer manufacturers Nutting & Hayden resharpened tools as a flourishing sideline.⁶⁵ This was “practically a trade by itself, as it requires considerable experience to gain a thorough knowledge of the temper required for the tools to cut the different grades of granite.”⁶⁶



Figure 10. “Drilling Preparatory to Splitting, Concord, N.H.,” from a stereograph by the Keystone View Company, Meadville, Pennsylvania, c1910. According to a 1907 study by Halbert P. Gillette—Rock Excavation—“a good workman can drill and plug 80 holes in 8 hours.” The same study showed that “each man drilled each hole (3/8-in. diam. × 2½ ins. deep) in a trifle less than 5 mins., by striking about 200 blows. . . . Blocks 30 in. long, with four plug holes, were drilled and split . . . in 24 mins. on the average.” Courtesy of the New Hampshire Historical Society, F1168.

As a turn-of-the-century granite manufacturer claimed, “no great improvement over the earliest known methods of dressing granite has yet been discovered, except in circular work, which can be done with the lathe and revolving cutters.”⁶⁷ Attempts to replicate the tedious work of hammering stone with machinery date back to the 1820s, but were never successful. Similar attempts to mechanize the drilling process failed until the introduction of steam and pneumatic (compressed-air) drills in the United States in the 1870s.⁶⁸

Of the 17 stone businesses listed in the 1880 census, three were already employing steam. Steam power was used not only to operate drills, but also derricks and polishing

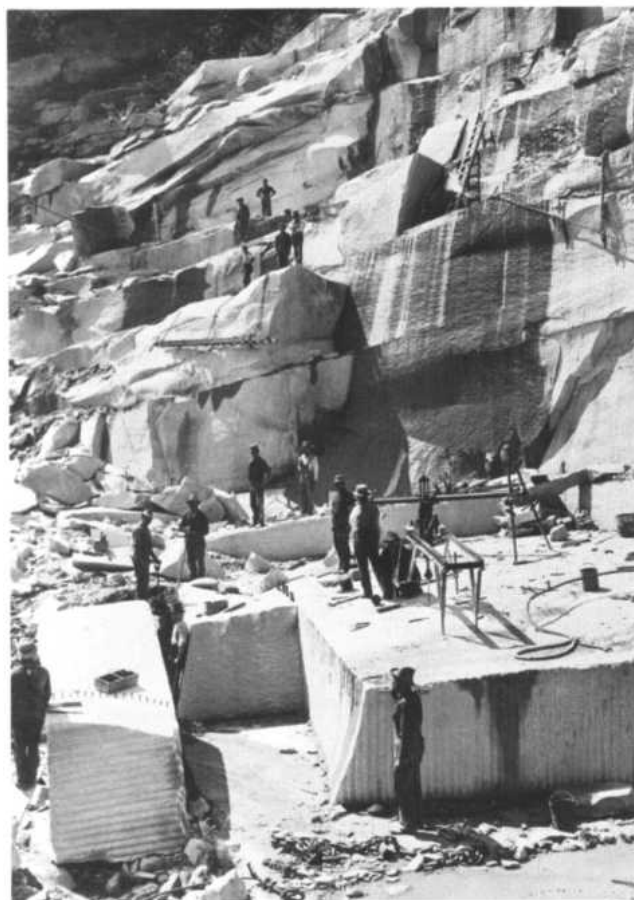


Figure 11. New England Granite Company quarry, c1910. By the turn of the century, steam drills were being used to channel out huge blocks of stone to avoid the risks associated with blasting. After drilling holes on three sides of the stone as closely together as possible and cutting away the core between holes, the block was freed without shattering. However, the hand method using wedges and shims was still the most efficient way to split smaller blocks. Courtesy of the New Hampshire Historical Society; George Wesley Perry Collection, N237.

Industrial Archeology

Figure 12. "Concord Granite Co. Looking North between the Sheds," from a stereograph by Howard A. Kimball, probably 1880s. By the turn of the century, Concord had 44 stonecutting yards where rough granite from the quarries was finished to serve a variety of purposes. The largest of these cutting plants employed 150 men and boasted 900 feet of sheds. Workers tended to specialize, whether in lettering, molding, carving, or plain work. Railroad sidings connected cutting yards to main lines. Courtesy of the New Hampshire Historical Society, F4207.



Figure 13. Interior view of William H. Perry's stone shed, Concord, from an advertisement published in Granite State Scenery, 1899. A native of Cornwall in England, Perry advertised his granite works as "equipped with all modern scientific appliances," including pneumatic tools and electric compressor motors. Even though the sides of the sheds were kept open as much as possible, granite dust filled the interior and was eventually identified as the cause of the chronic and pervasive lung disease silicosis. Courtesy of the New Hampshire Historical Society, F4206.



Figure 14. Wood engraving of a bush hammer, from an advertisement for Nutting & Hayden, 1890. The bush hammer, a series of steel plates bolted together and used for dressing stone, was a specialty of Concord tool manufacturers Luther M. Nutting and Henry W. Hayden, in business together from 1888 to 1908. This ingenious tool, with cutting blades that could be readily replaced, was outmoded in the first decades of the 20th century by the pneumatic surfacing machine. A surfer operator could do the work of 12 men with bush hammers. Courtesy of the New Hampshire Historical Society.



The Granite Quarries of Rattlesnake Hill



Figure 15. "Concord Granite Co., West Side of Carving Shed Looking North," from a stereograph by Howard A. Kimball, probably 1880s. "It may seem to an onlooker that it is a simple thing to chisel a line or bush hammer a stone, but care and skill are necessary from the time the stone is placed on [blocks] until it has passed inspection . . . and the paint mark, with the letter or figures of its position in the building, as shown on the plan, is placed on it by the person in charge"—Josiah B. Dyer, 1899. Courtesy of the New Hampshire Historical Society, N441.

machines. By 1880 some of the larger manufacturers were proudly advertising their "steam polishing works," capable of producing a "beautiful smooth surface."⁶⁹ The days of heavy reliance on steam, however, were limited. By 1913 one firm, Henneberry & Halligan, employed two 12-ton derricks driven by a 30-horsepower electric motor.⁷⁰

Of the 33 quarrymen, 34 stonemasons, and 7 granite polishers listed in the city directory as residing in West Concord in 1881, all but a few bore English names. Ten of the 12 exceptions appear to have been Irish. Fewer than two decades later, however, West Concord's population could be termed "quite cosmopolitan; the granite industry employing native Americans, Irishmen, Englishmen, Scotchmen, Scandinavians, Italians, Armenians and French-Canadians."⁷¹

Particularly noteworthy were the Scandinavian stonemasons. In the 1890s, "Swedes were to be found in practically all of the thirty-two stone sheds in Concord." Before long, several companies were owned and/or run by natives of Sweden. Some, but not all, had learned stonemasonry in the quarries of their northern homeland, where wages both for quarrymen and stonemasons were less than a quarter of those paid in America. Many specialized in paving-block production⁷² (figures 16, 17).

In 1883 John Swenson, born in Falkenberg, Sweden, purchased from Charles E. Ballard "one polishing building with the engine shafting . . . one building used for an office with desk in same, . . . one large square, two iron bars, one grindstone, two shovels and one derrick with the ropes and guy connected therewith."⁷³ With this simple transaction the John Swenson Granite Company started. Today, four generations later, it is practically the only heir of Concord's distinguished stone quarrying tradition (figure 18). By the 1950s it could be said that "from a modest beginning as one of the many small monumental sheds along North State street in 1890, this company has become one of the leading producers of building granite in the country"⁷⁴ (figures 19–21).

In the early 1890s there were 20 active quarrying operations in Concord, more than ever before or since. The last decade of the century also witnessed a peak in numbers of stonemasons/dealers (44 companies) as well as of granite polishers (nine companies). The Concord granite industry employed more than 1,000 men at this time, with some of the larger firms employing 65 to 75 each.⁷⁵

By 1910, however, the number of quarriers had dropped by half. And by 1920, only one-quarter of the quarriers and

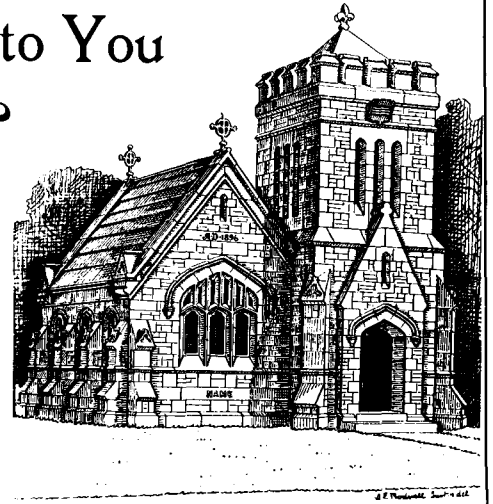
Figure 16. Advertisement of Ola Anderson in a promotional brochure of the Concord Granite Manufacturers Association, 1898. Anderson was one of Concord's first Swedish-born granite manufacturers, having become a partner in a quarry around 1880. By 1896, he and his own quarry were handling all kinds of jobs, "from a piece of edgestone to a fifty-story modern building," according to Stone Trade News. Courtesy of the New Hampshire Historical Society, F4200.

Did it ever occur to You to Try My Granite?

If so, you know that it is considered the best in Concord for all purposes. If not, then send me your orders and be convinced that it is not excelled by any other granite on the market for

**Monuments, Buildings,
Bridges, Curbing and Paving.**

My granite has been used for some of the finest statuary and carved work in the country. I am ready to figure on any kind of work in granite. References furnished if desired. I have



**Paving on hand, ready for Immediate Delivery. Rough Stock
supplied in dimension, random or grout.**

OLA ANDERSON,

**Granite Manufacturer, Quarrier and Dealer, North State Street,
CONCORD, N. H.**

Figure 17. Pavement stonecutters, probably 1913. Paving blocks were quarried from the waste that remained after splitting building stone. By the end of the 19th century, New England was producing 60 million paving blocks annually. On the average a paving cutter could produce 100 stones per day. Granite manufacturer Ola Anderson, who lost his right arm in a quarry accident, appears here to the right of center wearing a bowler hat. Information courtesy of Reino Elgland and William P. Jones; photograph courtesy of New Hampshire Historical Society; gift of Thelma Colgan, F4209.



The Granite Quarries of Rattlesnake Hill



Figure 18. This monumental sculpture, representing ancient and modern history, was designed for the New Hampshire Historical Society's 1910 building by Daniel Chester French and was carved (except for the owl finial) from a single piece of Swenson granite. This Kimball Studio photograph shows the finished work still on blocks in the Swenson shed, where it had been carved in stone, based on a plaster-of-Paris model provided by French. Courtesy of the New Hampshire Historical Society, F1713.



Figure 19. A traveling crane at the Swenson stonecutting sheds, photographed by the T. M. Knight View Co. of St. Louis, Missouri, c1910. Workers gather while a postcard photographer documents the completion of an ornamental crocket, probably for a church spire. Until recently, the Swensons specialized in building stone, the First Church of Christ Scientist in Boston and the Waldorf Astoria Hotel in New York being among their first major contracts. Courtesy of the New Hampshire Historical Society; gift of Judith F. Mason, F4205.

one-third of the dealers active in the 1890s remained in business. The growing popularity of steel and reinforced concrete for building construction and of macadam and asphalt for paving were largely responsible for the setbacks experienced by the granite industry. The use of granite was now limited to facings and veneer for architectural work and curbing and crushed stone for roadwork.⁷⁶

Difficulties with labor relations also plagued the granite industry. In 1892 a six-month strike by Concord's stonecutters delayed construction at the Library of Congress. On June 1, headlines proclaimed "All the Men of the New England Granite Company Idle"; it was only one in a long series of disagreements over contracts between the granite manufacturers of Concord and the Concord branch of the Granite Cutter's National Union.⁷⁷

Among the many occupational hazards faced by granite workers was a chronic lung disease called silicosis, caused by particles contained in granite dust. The Swenson company played a pioneering role in protecting workers from this dread disease. The first step was the installation of dust-gathering machines in the stonecutting plant in 1923. During the 1940s an experimental therapy using aluminum dust as an antidote was introduced and, eventually, free chest X-rays were offered semiannually to all workers.⁷⁸

By World War II, the Swenson company had outlived its last local competitor of any size. The Granite State Quarry Company had advertised in 1924 as successor to the New England Granite Company. When this operation closed in 1941, it could boast a long and distinguished record of architectural achievements—including the Library of Congress.⁷⁹ By mid-century, Swenson was shipping granite from Concord to every state in the union, as well as to England, Canada, Puerto Rico, and Hawaii. In 1949 Swenson granite was selected as the cornerstone material for the New York headquarters of the newly formed United Nations.⁸⁰

Diversification and, more recently, globalization have been the company's primary objectives over the past half-century. As early as 1950, only 20 percent of the stone worked at the Swenson plant originated in Concord. Along with the company's own "Swenson gray granite," advertising fliers pictured a pink granite from Maine, black from Canada, dark gray from Quincy, and even rose red from Sweden. Through the decades, the company purchased a number of quarries in Maine, Vermont, New Hampshire, and Quebec, culminating in 1984 with the purchase of its largest North American competitor, the Rock of Ages quarry of Barre, Vermont. Today Swenson distributes a wide range of granites throughout Europe and Asia via affiliated companies.⁸¹

Industrial Archeology



Figure 20. "Swensons' Granite Works, West Concord, N.H.," photograph postcard by A. S. Currier, second quarter of the 20th century. By 1945, the John Swenson Company was the sole survivor among the 44 granite companies operating in Concord at the turn of the century. In the cutting yard below the quarries, a railroad car is being loaded for shipment. Courtesy of the New Hampshire Historical Society, F4208.

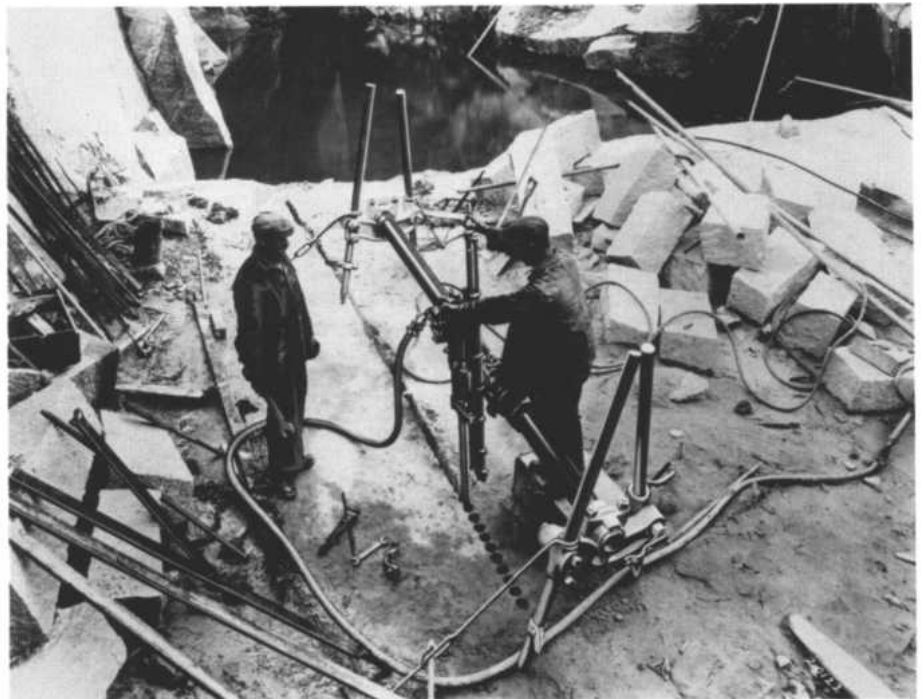


Figure 21. "Leyner Ingersoll . . . on quarry bar broaching between drill holes at the John Swenson Quarry, Concord, N.H.," second quarter of the 20th century. With a quarry bar, "a dozen or more holes can be cut by simply sliding the drill along the bar and without moving the entire machine"—George P. Merrill, 1903. Today, 5,000° F flames from liquid-oxygen channeling torches burn through the granite, reducing drill work. Courtesy of the New Hampshire Historical Society, F4202.

The Granite Quarries of Rattlesnake Hill

With the development of the interstate highway system in the 1950s and 1960s, curbing became the leading product of Concord's surviving granite manufacturer, and the truck replaced the railroad for long-distance shipment. In the 1970s, under the leadership of the fourth generation of Swensons, the company deliberately terminated its production of building stone in order to focus on curbing and monument work. In the 1990s, Swenson supplies about 60 miles of curbing annually, along with granite posts, benches, steps, and other landscape items produced at its Concord plant.⁸²

Improvements in technology during the last half-century have resulted in significant workforce reductions. Today Swenson employs 35 to 40 men, who split granite from the quarries by burning channels four inches wide and 12 feet deep, using 5,000°F liquid-oxygen torches introduced in the mid-1950s. Also in the 1950s, one of the newest machines used at Swenson's was a wire saw "capable of slicing giant slabs of granite like butter."⁸³ Today, computer-controlled, diamond-tipped rotary saws (10 to 11½ feet in diameter) are also used to "slice" stone.⁸⁴

Yet granite is still sometimes finished by hand hammering. And in the production of curved curbing, time-honored hand-splitting techniques (employing simple wedges) continue in use today and are basically the same as those introduced nearly two centuries ago by Stuart J. Park when building the first state prison in 1810. However, "the cheerful click of the stone-cutter's hammer" that could be heard in the 1870s is today drowned out by the roar of channeling torches, pneumatic drills, and other powerful machinery.⁸⁵ The numerous granite sheds on every side that immediately impressed the visitor in 1900 have all but disappeared, and 40 individuals alone carry on the occupation of thousands before them (figure 22).

Notes

1. *The New York Industrial Recorder: An Illustrated Record of American Achievements in Commerce, Manufacture, Science, and Art—Special Number Descriptive of and Illustrating Nashua, Manchester, and Concord, N.H.* (New York: New York Industrial Recorder, 1900), p. 32.
2. Concord City Directory, c1900.
3. "Swenson Is North America's Largest Quarrier of Granite," *New Hampshire Business Review*, May 17–30, 1991, p. 19.
4. Joseph B. Walker, ed., *Diaries of Rev. Timothy Walker* (Concord: Ira C. Evans, 1889), p. 11; and Nathaniel Bouton, *The History of Concord* (Concord: Benning W. Sanborn, 1856), p. 545.
5. *Report of the Agents Appointed in June, 1810, to Superintend the Building of a State Prison* (Concord: State of New Hampshire, 1811), pp. 2–3; William N. Hosley, Jr., "The Founding of the Vermont State Prison in Windsor, 1807–1810," *Vermont History* 52, 4 (1984):243–252; Frank Sylvester Parks, comp., *Genealogy of the Parke Families of Massachusetts* (Washington, D.C.: by the author, 1909), pp. 199–200; *New-Hampshire Statesman* (Concord), March 4, 1854.
6. John Farmer and Jacob B. Moore, *A Gazetteer of the State of New-Hampshire* (Concord: Jacob B. Moore, 1823), p. 43; and "Report to Governor and Council, Nov. 23, 1816," in *Journal of the House*, November session, 1816, p. 163.
7. Directors' Minutes, State Prison Records, Secretary of State, Record Group 4, New Hampshire Division of Records Management and Archives, Concord.
8. *New-Hampshire Statesman* (Concord), March 4, 1854; and "Report to Governor and Council" (n. 6 above), p. 163.
9. "The type of work involved in cutting stone also fit in with the prison's purposes. The work was in many ways a punitive experience, but it was also ideally suited to keeping large numbers of men employed all day long and the repetitive nature of the work made it easy to supervise large groups of inmates." Timothy Dodge, "Hard Labor at the New Hampshire State Prison, 1812–1932," *Historical New Hampshire* 47, 3–4 (1992):121–124, 144.
10. *Report of the Committee Appointed [June 27, 1817] to Investigate the Affairs of the State Prison* (n.p., c1818), p. 23.
11. *New-Hampshire Patriot* (Concord), August 11, 1818; and Bouton (n. 4 above), p. 493.
12. Timothy Dodge, "Crime and Punishment in New Hampshire, 1812–1914," 2 vols. (Ph.D. diss., University of New Hampshire, 1992), 2:418, quoting "Report of Stone Cut May 1825 to M. C. Pillsbury Warden NH State Prison," State Prison Papers, New Hampshire Division of Records Management and Archives, Concord, and the *Manufacturers' and Farmers' Journal and Providence and Pawtucket [R.I.] Advertiser*, June 28, 1827.
13. Petition from John P. Gass to the General Court, June 6, 1825, New Hampshire Division of Records Management and Archives, Concord; and Jacob B. Moore, *Annals of the Town of Concord* (Concord: by the author, 1824), p. 72.
14. Talbot Hamlin, *Greek Revival Architecture in America* (London: Oxford University Press, 1944; reprint ed., New York: Dover Publications, 1964), pp. 104 ff.; and Arthur W. Brayley, *History of the Granite Industry of New England*, 2 vols. (Boston: National Association of Granite Industries of the United States, 1913), 1:22, 24.
15. "Report of the Warden of the State Prison to the Hon. the Legislature of the State of New Hampshire," in *Journal of the House*, June 1836, pp. 193–198; and *Plain Truths, Addressed to the People of N. Hampshire, Concerning Their State Prison and the Management of Its Affairs . . . July, 1829 to September, 1834* (n.p., c1835), pp. 4, 14. Evidence provided by the latter suggests that the stone the prisoners worked was quarried by local residents.
16. Brayley (n. 14 above), 1:23.
17. Wilkes Allen, *The History of Chelmsford* (Haverhill, Mass.: P. N. Green, 1820), p. 42; and Harold Kirker, *The Architecture of Charles Bulfinch* (Cambridge, Mass: Harvard University Press, 1969), p. 213 and passim.
18. "The Merrimack as a Maritime Way," *Granite State Magazine* 3, 5 (1907):215–221.
19. *New-Hampshire Patriot & State Gazette* (Concord), June 27, 1825.
20. Edward Francis Zimmer, "The Architectural Career of Alexander Parris" (Ph.D. diss., Boston University, 1984), p. 470, citing *Columbian Centinel* (Boston), October 5, 1825; "The Merrimack as a Maritime Way" (n. 18 above), p. 219, quoting Reuben Butterfield Sherburne, clerk of the Boston and Concord Boating Company (which succeeded the Merrimack Boating Company in 1823); *Portsmouth*

Industrial Archeology

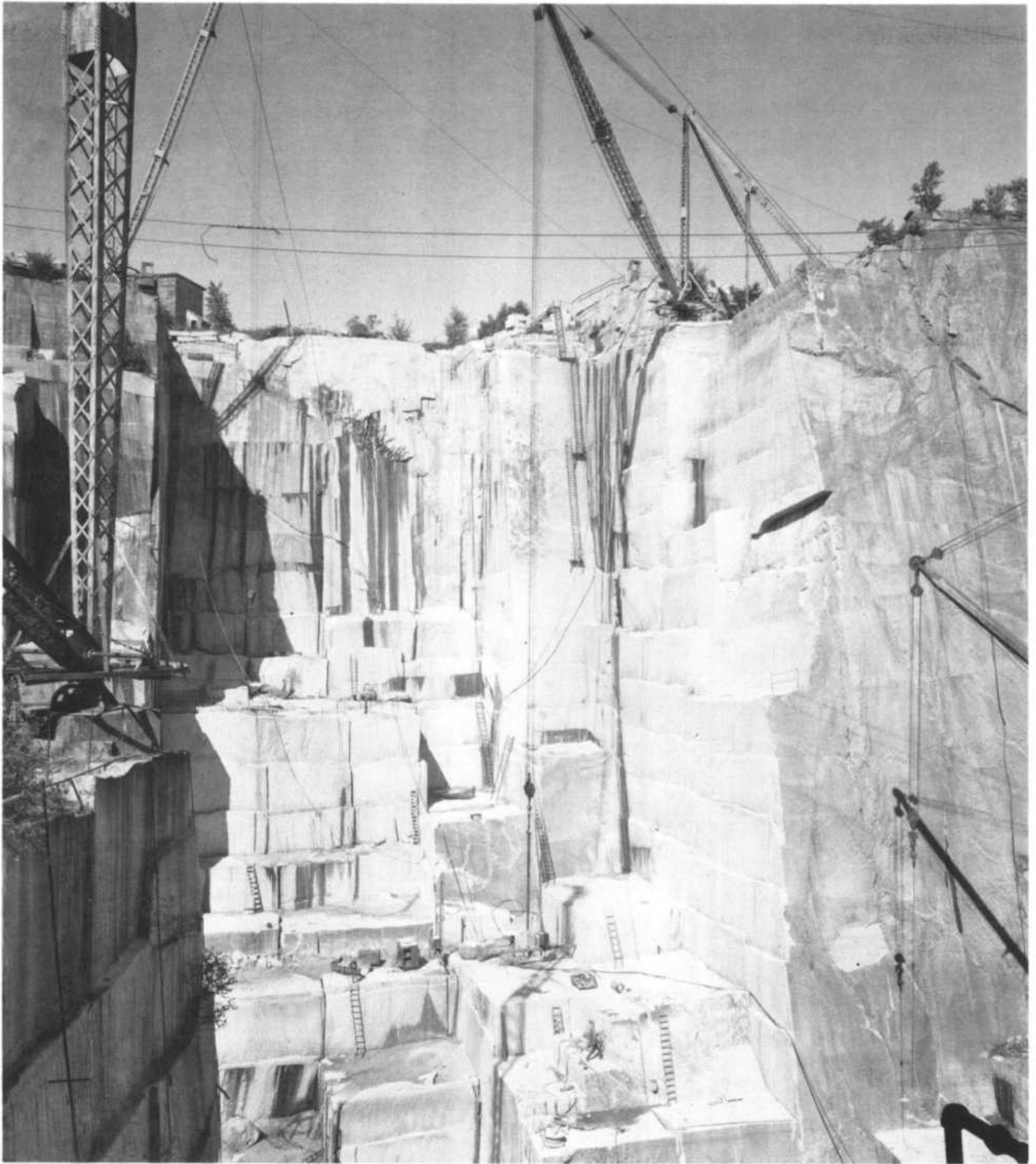


Figure 22. *The Swenson Quarry, located in the vicinity of the earlier Concord Granite & Railway Company quarry, 1988. This photograph documents the tremendous change in the granite industry since the early days of surface quarrying. It is not surprising that the granite ledges of Rattlesnake Hill have long been considered inexhaustible. Around the turn of the century, it was widely reported that local artesian-well drillers found solid granite extending down at least 1,400 feet. Courtesy of Gary Samson.*

The Granite Quarries of Rattlesnake Hill

- Journal of Literature and Politics*, August 26, 1826 (on Chelmsford); and the *Rhode Island American & Providence Gazette*, June 1, 1827 (on Hallowell).
21. Benjamin Silliman, *Remarks Made on a Short Tour between Hartford and Quebec in the Autumn of 1819* (New Haven, Conn.: S. Converse, 1820), p. 386.
 22. Theodore Dwight, Jr., *The Northern Traveller, and Northern Tour*, 5th ed. (New York: Goodrich & Wiley, 1834), p. 292.
 23. Bouton (n. 4 above), p. 545.
 24. Josiah B. Dyer, "New Hampshire Industries, Quarrying and Stone-cutting: Second Paper," *Granite Monthly* 27, 4 (1899):207–208.
 25. *New-Hampshire Statesman* (Concord), March 4, 1854.
 26. Donald Armistead, "Plug and Feather: A Simple Tool Yet Very Effective," *Chronicle of the Early American Industries Association* 47, 2 (1994):43–45.
 27. *The Journals of Henry David Thoreau*, September 11, 1851, cited in *Chronicle of the Early American Industries Association* 39, 1 (1986):16.
 28. Bouton (n. 4 above), p. 545.
 29. Harley J. McKee, "Brick and Stone: Handicraft to Machine," in *Building Early America: Contributions toward the History of a Great Industry*, ed. Charles E. Peterson (Radnor, Pa.: Chilton Book Company for the Carpenters' Company of the City and County of Philadelphia, 1976), p. 75; and Dyer (n. 24 above), pp. 210–211.
 30. McKee, p. 75; and Harley J. McKee, "Early Ways of Quarrying and Working Stone in the United States," *Bulletin of the Association for Preservation Technology* 3, 1 (1971):44–45 and passim. See also William W. Wheildon, *Memoir of Solomon Willard: Architect and Superintendent of the Bunker Hill Monument* (Boston: Monument Association, 1865), pp. 243–249 and appendix, for a description and illustrations of early granite-moving devices.
 31. Dyer (n. 24 above), pp. 212–213; McKee, "Brick and Stone," pp. 77–78; and *Rhode Island American & Providence Gazette*, August 24, 1827.
 32. Dyer, pp. 213–216.
 33. Edward J. Gallagher, "Luther Roby, Early New Hampshire Publisher," *Historical New Hampshire*, September 1946, pp. 11–12 and passim; and *Daily Monitor* (Concord), January 8, 1881, and February 23, 1883. References were made in Concord at an earlier time to quarries. This term, however, could be applied to any area from which stone was obtained.
 34. William Churchill Edwards, *Historic Quincy, Massachusetts* (Quincy, Mass.: by the city, 1957), pp. 120–132, quoting an unidentified contemporary account.
 35. New Hampshire, *Laws*, November 1836, chap. 101.
 36. John Hayward, *The New England Gazetteer* (Boston: by the author, 1839), see under "Concord, N.H."
 37. Gallagher (n. 33 above), pp. 13–14; and Bouton (n. 4 above), p. 546.
 38. C. H. Hitchcock, *The Geology of New Hampshire*, 3 vols. (Concord: Edward A. Jenks, 1878), 3, pt. 5, "Economic Geology": 71; and Donna-Belle Garvin, "Concord, New Hampshire: A Furniture-Making Capital," *Historical New Hampshire* 45, 1 (1990):28, 44–45. In 1932 a stone plant again became one of the prison industries, after almost a century of inactivity in this trade. Dodge (n. 9 above), p. 142.
 39. Alonzo J. Fogg, comp., *The Statistics and Gazetteer of New-Hampshire* (Concord: D. L. Guernsey, 1874), p. 111.
 40. Hitchcock (n. 38 above), pp. 71–72. For further information on the Roby quarry and others during the 1850s, see John B. Giles, "Early Granite Trade of Concord," *Stone Trade News* (Concord), November 1, 1896, pp. 4–5.
 41. George F. Bacon, *Concord and Its Points of Interest* (Concord: Commercial Club, 1890), p. 23.
 42. Hayward (n. 36 above).
 43. George P. Merrill, *Stones for Building and Decoration*, 3d ed. (New York: John Wiley & Sons, 1903), p. 76.
 44. Fogg, comp. (n. 39 above), pp. 110–111.
 45. 1870 Census, Industrial Returns, New Hampshire Division of Records Management and Archives, Concord; Concord City Directory, 1878–85; *The New York and Concord Granite Company, Incorporated in March 1854* (New York: S. T. Callahan, 1854), pp. 5–7 and list of officers; and *History of the Granite Railway Company, Including Granite Quarries at Quincy, Mass., and Concord, N.H., with the Charter and By-Laws of the Company and a List of Its Officers* (Boston: Alfred Mudge & Son, 1870), pp. 14–17. A manuscript book of the "New York and Concord Quarry Company," dating from 1854 and recording stone dimensions, is part of the collections at the New Hampshire Historical Society, Concord.
 46. Daniel J. Boorstin, "Inventing Resources: Granite for a New Stone Age," in *The Americans: The National Experience* (New York: Random House, 1965), pp. 16–20.
 47. *Daily Monitor* (Concord), November 15, 1879.
 48. Brayley (n. 14 above), 1:168–169.
 49. "Illustrated Sketch of the Leading Industry of Concord, N.H.," *Stone Trade News* (Concord), October 15, 1896, p. 6.
 50. *New-Hampshire Patriot & State Gazette* (Concord), January 9, 1851.
 51. *New York Industrial Recorder* (n. 1 above), p. 32.
 52. George F. Bacon, *The Leading Business Men of Concord and Vicinity* (Boston: Mercantile Publishing Co., 1890), p. 63.
 53. *Daily Monitor* (Concord), November 15, 1879.
 54. Helen-Anne Hilker, *Ten First Street, Southeast: Congress Builds a Library, 1886–1897, an Exhibit . . .* (Washington, D.C.: Library of Congress, 1980), p. 48, quoting Librarian of Congress Ainsworth Rand Spofford; and *Recollections of West Concord: A Bicentennial Project of the West Concord Villagers* (n.p., 1976), p. 63, quoting unidentified contemporary source.
 55. James G. Batterson, "New England Granites," in *The New England States*, ed. William T. Davis, 4 vols. (Boston: D. H. Hurd & Co., 1897), 1:442; and T. P. Sullivan, "Concord Granite Trade of Modern Times," *Stone Trade News* (Concord), October 15, 1896, p. 7.
 56. *Concord, N.H.: A Reprint from the Boston Daily Traveller, October 26, 1891* (n.p., c1891), p. 11; *New York Industrial Recorder* (n. 1 above), p. 32; Batterson (n. 55 above), 1:445; and "Illustrated Sketch" (n. 49 above), p. 10.
 57. *New Hampshire Republican* (Concord), November 1, 1890; and Sullivan (n. 55 above), p. 7.
 58. Brayley (n. 14 above), 1:149; and Bacon (n. 52 above), passim.
 59. *Granite State Scenery in and about the Capital City* (Concord: The Concord Street Railway, 1899), p. 51; and *Concord, N.H., Granite: Views of Buildings and Monuments Erected in Various Parts of the Country of Concord Granite* (Concord: Commercial Club and Granite Manufacturers of Concord, 1898), intro.
 60. *Concord, N.H., Granite: Views*, inside back cover.
 61. *New-Hampshire Patriot and State Gazette*, August 24, 1829.
 62. James L. Garvin and Donna-Belle Garvin, *Instruments of Change: New Hampshire Hand Tools and Their Makers, 1800–1900* (Canaan, N.H.: Phoenix Publishing for the New Hampshire Historical Society, 1985), pp. 57, 111.
 63. *Concord, N.H., Granite: Views*, intro.
 64. *Journals of Henry David Thoreau* (n. 27 above).
 65. *New York Industrial Recorder* (n. 1 above), p. 27.
 66. Dyer (n. 24 above), p. 217.
 67. Batterson (n. 55 above), 1:444–445.

Industrial Archeology

68. *Rhode Island American & Providence Gazette*, August 24, 1827; and McKee, "Brick and Stone" (n. 29 above), pp. 81–82.
69. *Daily Monitor* (Concord), November 15, 1879; and Concord City Directory, c1880, advertisements. Polishing machinery was first introduced in this country in 1869 at Quincy. Brayley (n. 14 above), 1:84.
70. Brayley, 1:150.
71. *Granite State Scenery* (n. 59 above), p. 51.
72. Thorsten Kalijarvi, "The Stonecutters of Concord, New Hampshire," *American Swedish Historical Museum Year Book* (1946), pp. 77, 82; *Recollections of West Concord* (n. 54 above), pp. 59, 68–69; and "Granite and the Tariff," *New Hampshire Republican* (Concord), October 25, 1890.
73. Purchase agreement, quoted in Larry Martel, "King of the Hill," *Premier*, July 1993, p. 35; and Leda Hartman, "Coaxing Up the Granite," *Concord Monitor*, November 12, 1987.
74. Ralph J. Levi, "Concord Granite Industry Famous throughout World," *Concord Daily Monitor and N.H. Patriot*, August 1, 1953.
75. Concord City Directory, 1893–1900; James O. Lyford, ed., *History of Concord, New Hampshire*, 2 vols. (Concord: by the city, 1903), 1:637; and *New York Industrial Recorder* (n. 1 above), passim. From 1895 to 1900, *Stone Trade News*, a semi-monthly periodical intended to serve all branches of the American stone industry, was published in Concord.
76. Concord City Directory, 1890–1920; Ralph Jimenez, "Men of Stone: The John Swenson Granite Co. Has Cut It for a Hundred Years," *Concord Monitor*, October 4, 1983; and Robert E. Sullivan, "More About the Old Quarries," *Concord Monitor*, 1987.
77. *Concord Evening Monitor*, June 1, 1892. See also Batterson (n. 55 above), 1:445, concerning the effect of labor difficulties on the New England granite industry.
78. Levi (n. 74 above).
79. Concord City Directory, 1924; and *Recollections of West Concord* (n. 54 above), p. 67.
80. Reg Abbott, "Concord Granite Stone Goes into U.N. Structure," *New Hampshire Sunday News* (Manchester), October 23, 1949.
81. Henry F. and Katharine Pringle, "The Cities of America: Concord, New Hampshire," *The Saturday Evening Post*, October 22, 1949, p. 60; *Swenson Granite: Specified by Leading Architects and Engineers Everywhere since 1883* (Concord: John Swenson Granite Co., c1950); and "Swenson Is North America's Largest Quarrier" (n. 3 above), pp. 19–20.
82. Jimenez (n. 76 above); and "Swenson Is North America's Largest Quarrier," p. 19.
83. Levi (n. 74 above). Although a granite sawing machine was first introduced in this country in 1877, sawing did not become an accepted way of finishing stone until the early 20th century, after considerable experimentation with abrasives. Brayley (n. 14 above), 1:85–87; and Merrill (n. 43 above), p. 413.
84. For information on, and photographs of, the latest granite-working technology, see Hartman (n. 73 above); Lucky Bourque and Jim Lamora, "Granite: Mr. Carl Johnson, Concord's Last Stonecutter, Recalls," in *Traditions Worth Preserving* (Concord: Concord High School, 1979), pp. 11–17; and "Solid Granite: John Swenson Granite Co.," *New Hampshire Crossroads*, program 738 (Durham: New Hampshire Public Television, 1988).
85. *Daily Monitor* (Concord), November 15, 1879; and "Solid Granite" (n. 84 above).