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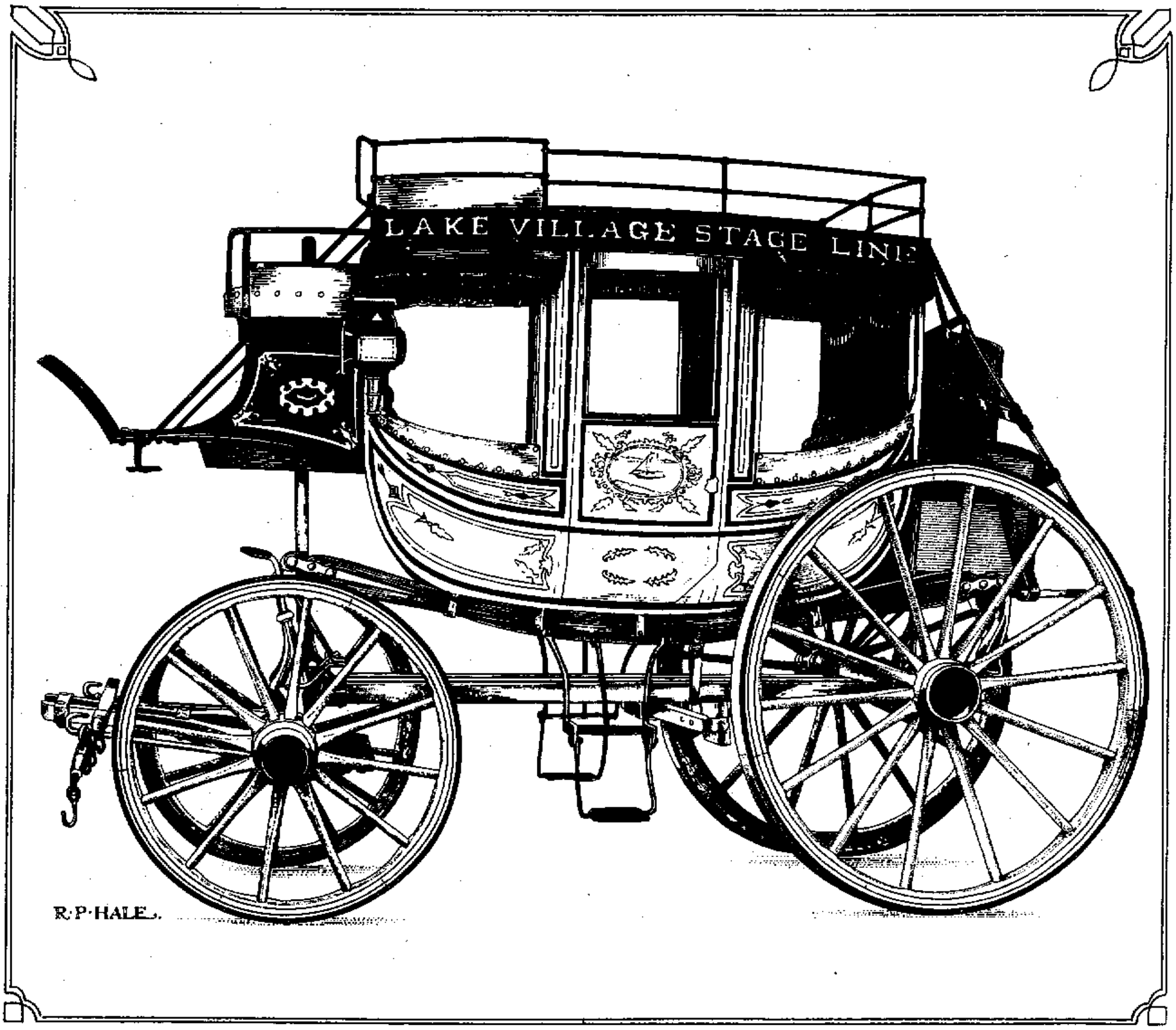

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Small-Scale Brickmaking in New Hampshire

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Brickmaking in New Hampshire began in the 1600s; it ended with the closing of the Kane-Gonic Brick Corporation in Rochester in 1994. Documents and photographs reveal the technological conservatism of New Hampshire brickmaking throughout much of this period. Despite their little-changed methods of production, New Hampshire brickyards achieved relatively high productivity. In the 20th century, the products of such yards were sought out by architects for their traditional handmade qualities.

New Hampshire as a Brickmaking State

During the 19th century, areas of New Hampshire emerged as productive brickmaking centers, and the state's economy profited considerably from brickmaking as an industry. Prior to the advent of the railroad, most brickyards, even those along the coast, primarily served local markets. In 1832, the production of the entire state totaled about 5 million bricks.[1] By 1850, with railroad transportation available in many of the clay-rich areas of the state, brick production had tripled to over 15 million.[2] By 1880, with a fully developed market that included neighboring states as well as home consumption, New Hampshire produced nearly 48 million common bricks, and another 6 million specialty bricks, each year.[3] By that time, some individual brickyards in the Merrimack River valley were making more bricks than had the entire state 50 years earlier.

The Technology of Small-Scale Brickmaking

As carried out with the marine or the freshwater glacial clays of New England, brickmaking is a two-stage process. First, the plastic clay must be prepared and molded. Second, the molded bricks must be fired or baked until they become a ceramic.

Clay as taken from the ground is not suitable for molding. Pure, natural clay is extremely stiff, sticky, and almost unworkable and must be tempered or rendered more plastic. Traditionally, this was accomplished by digging the clay from the clay bank in the fall and allowing it to freeze and thaw, with repeated turnings, over the winter. This was followed by rewetting and mechanical kneading, carried out in the most primitive brickyards by driving cattle or horses over the lumps of clay. This was a slow process, inviting hasty or inconsistent work. Writing in 1792, New Hampshire historian Jeremy Belknap complained that much of the clay used in making bricks in coastal yards was "not sufficiently mellowed by the frost of winter, or by the labour of the artificer."[4]

In better-established or more permanent brickyards, clay was tempered by being pressed under a heavy wheel attached to a rotating boom, or by being fed through a horsepowered pug mill (figures 1, 2). A pug mill is a cylinder or box enclosing a rotating vertical shaft. This armature has projecting lugs or knives that slice through the mass of clay and loosen the compacted, minuscule particles or flakes that constitute natural clay deposits.

In the case of many clays, particularly the blue clay that is found in those areas of New England once inundated by still water, sand must be added to the material during tempering in order to reduce its extreme natural stiffness. New Hampshire state geologist C. H. Hitchcock alluded to this fact in his *The Geology of New Hampshire* (1878) when he said of the Merrimack Valley clays found north of Hooksett:

> . . . this clay appears to form a nearly continuous stratum, which has a thickness of from 20 to 30 feet, with its top about 100 feet above the river. It is overlaid by a few feet of sand. The upper part of this stratum consists of a hard and compact *gray clay*. At a depth of 10 to 15 feet this is usually separated, by a thin layer of sand one fourth of an inch to three inches thick, from the underlying *blue clay*, which is soft and plastic when dug from the bank. . . . Except the lower part of the blue clay, which is of inferior quality, both layers are well adapted for brickmaking. Deposits of the same gray and blue clay, the latter always below the former, are frequently found in the south-east part of the state, near the coast. . . .
>
> The brick-makers find a slight difference between the gray and blue clays—the latter requiring more sand to be mixed with it, and shrinking more in burning.[5]

Despite Hitchcock's identification of the river-valley and coastal clays as "the same," New Hampshire's coastal clays are actually marine clays, laid down when the land was inundated by constantly agitated ocean waters and therefore quite uniform in character through the depth of the deposit. These marine clays have been found in some cases to lie in beds more than 40 feet thick.[6] New Hampshire's river-valley clays, on the other hand, are varved clays that were deposited

Figure 1. *Henry Abbott brickyard, Sturgeon Creek, Eliot, Maine (across the Piscataqua River from Dover, New Hampshire), c1885. In the foreground is a field of plowed clay, waiting to be tempered in a pug mill. Three tempering pits are visible; a pug mill, which could be moved among the pits on rails, stands at the center. Firewood, probably delivered by boat, is stored at the rear, behind the mill and next to a scove kiln that is being dismantled after firing. Corbeled firing arches can be seen at the bottom of a kiln under the shelter at the left rear.* Robert Whitehouse photo; courtesy of John P. Adams.

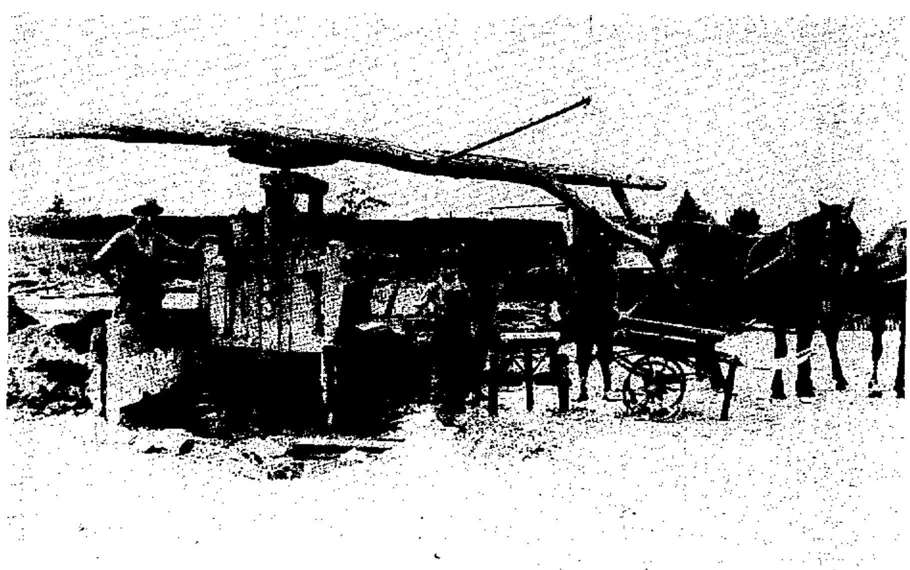

Figure 2. *Pug mill, Elbridge Gage brickyard, Bellamy River, Dover, New Hampshire, c1900. This mill was turned by a team of two horses, hitched to a crude sweep fashioned from a forked tree trunk. The man at the left stands in a tempering pit; those at the right have two-wheeled handcarts for carrying off filled brick molds.* Whitehouse Collection, Woodman Institute, courtesy of Thom Hindle.

in seasonal layers in glacial freshwater lakes that once filled the present-day Merrimack and Connecticut River valleys (figure 3). Varves are layers of coarser grains—even sands—that were carried by running streams during the summer, alternating with layers of fine-particled clays that settled out of quiet, ice-covered winter waters.[7] Brickmakers found little practical difference in the use of marine or freshwater clays, and so New Hampshire developed thriving brick manufacturing industries along its western border in the Connecticut River valley, through its central Merrimack River valley, and throughout the once-submerged coastal plain.

Typically, the muscular power of animals, men, and boys was the only source of energy used in small brickyards (and in some yards of considerable size and annual production) even into the 20th century (figures 4, 5). Horses or oxen were used to plow the clay beds if the clay was not found in the vertical wall of an embankment. After furrowing and weathering, the clay was moved by wheelbarrow or cart to the pug mill or tempering area. The motive power for tempering machinery was again the animal, usually a horse attached to a sweep that turned the pug mill. The molding and carrying of bricks, both before and after firing, were done by laborers. Transportation of the finished bricks was by cart or, in favored locales, by water or railroad.

After clay had been tempered to the consistency of a stiff mortar, it could be molded. This was accomplished in small-scale yards by taking a lump of clay and throwing it into a rectangular wood or metal mold, then striking off the surplus with a straightedge. The molding operation required considerable strength and a degree of skill that developed over the course of molding thousands of bricks.

A brick mold was simply a rectangular wooden frame divided into one or more brick-sized compartments. Molds usually had divisions for more than one brick; with a multiple mold, as many as six bricks would be produced with every filling. Most yards employed boys as "off-bearers" to carry or wheel the filled molds to a flat, sanded yard, and to tip the newly formed bricks onto the ground to begin the drying process. Some brick molds had integral bottom boards; others had no bottoms but were temporarily placed on a flat board during molding and off-bearing.

To enable the sticky clay to drop out of the brick mold, the mold was usually lubricated with water or dusted with dry sand. A brick formed in a wetted mold is called a water-struck brick. Water-struck bricks are characterized by a slick surface that remains after firing. A brick cast from a sanded mold is called a sand-struck brick. The sides of sand-struck bricks retain something of the abrasive grittiness of sand after they are fired and therefore do not possess the shiny surface often seen in water-struck bricks.

Because hand-molded bricks began as lumps of clay thrown into the mold, their bottoms may display hollows or cavities where the clay did not fully fill the mold. Because the excess clay is struck from the mold with a straightedge, the tops of such bricks often display the curved or straight striations or roughenings created by the pulling of the straightedge

Figure 3. *Pug mill, Henry Simpson brickyard, Pembroke, New Hampshire, c1890. The varved (layered) clays of the Merrimack River valley can be seen in the embankment behind the group. The laborer at the left, holding a brick mold, is wearing cutoff trousers common among molders and off-bearers. At the left are haked (stacked) green bricks.* Courtesy of the New Hampshire Historical Society, F4201.

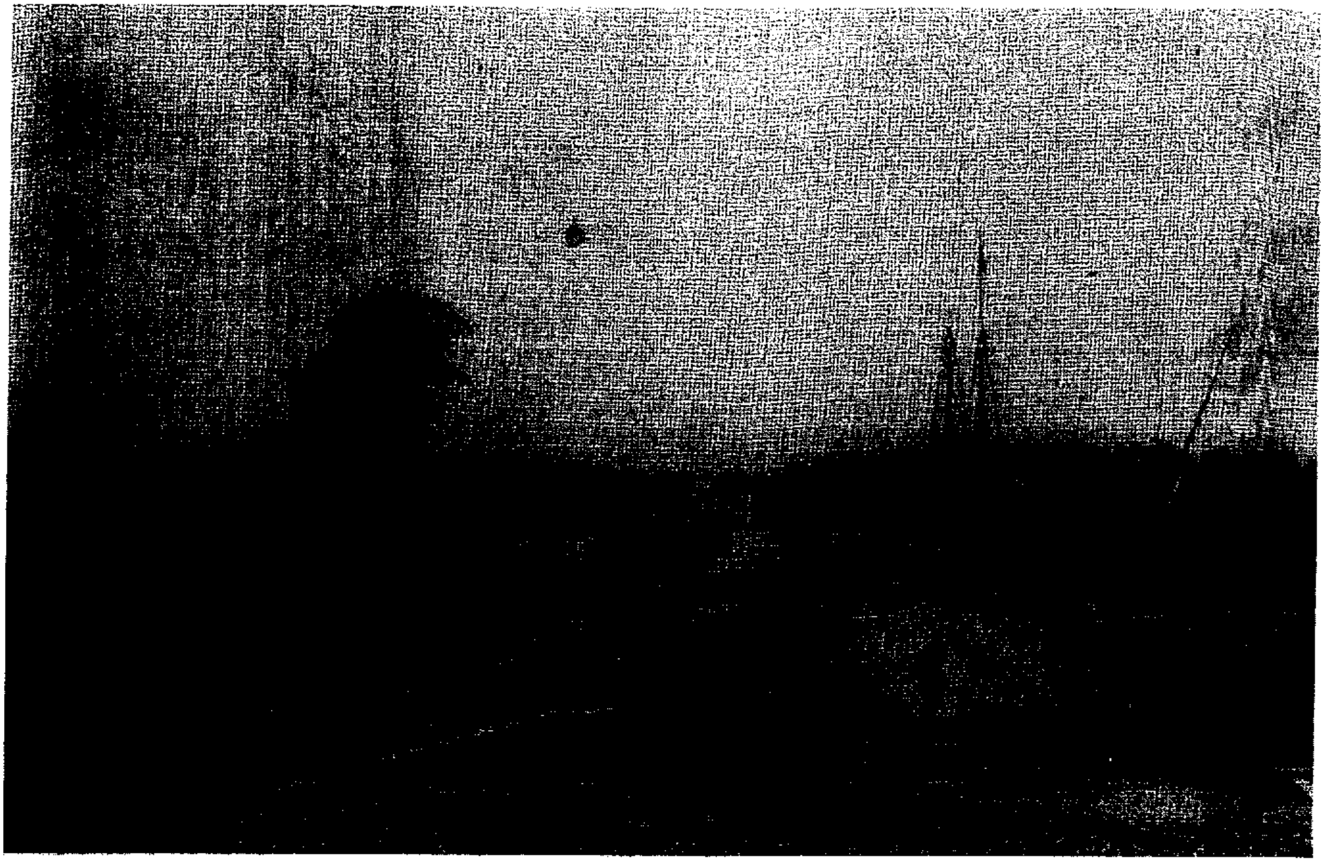

Figure 4. *Henry Abbott brickyard, c1885. The horse in the foreground is drawing a "clay machine," which loosened a thin layer of clay for tempering. At the rear, to the right of the kiln shed, is a two-masted schooner and, far right, the furled lateen sail of a gondola or gundalow, a utilitarian freight vessel of the Piscataqua estuary. In the middle ground, bricks have been laid on the ground to dry and then haked and covered with boards.* Clyde Whitehouse photo; courtesy of John P. Adams.

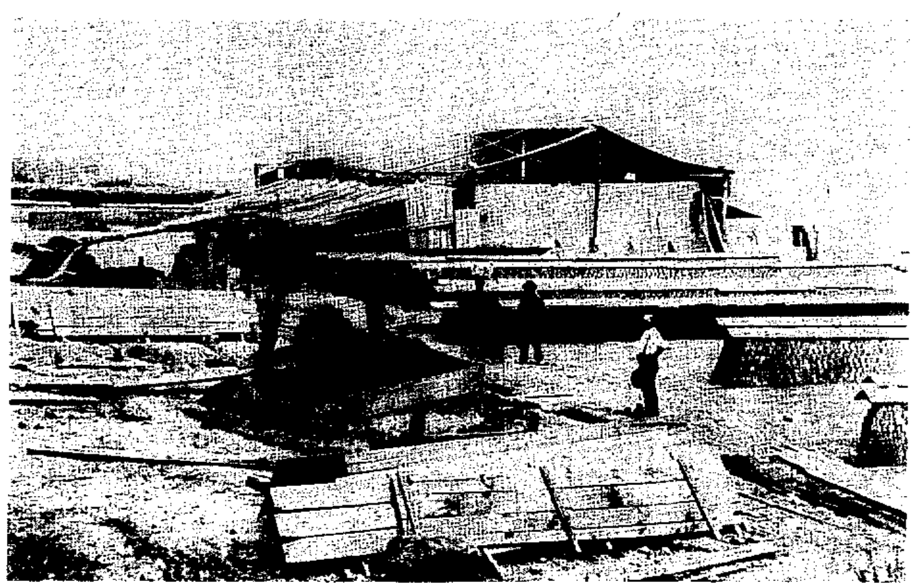

Figure 5. *Elbridge Gage brickyard, c1900. In the foreground, a man with a wheelbarrow is filling a tempering pit; the movable pug mill stands at the pit to his left. In the background, smoke issues from a kiln that is being fired with half of the sheltering shed roof removed; haked green bricks stand at the right.* Whitehouse Collection, Woodman Institute, courtesy of Thom Hindle.

over the upper edges of the mold. These features are invisible in bricks in a structure but are easily seen before the bricks are laid or after they are salvaged from a chimney or wall.

From the 17th century on, brick sizes were regulated by law. The dimensions of brick molds were carefully specified in order that the finished product would be more or less uniform. Before the Revolution, laws in both Massachusetts and New Hampshire specified that molds should be sized so that the finished bricks, after firing, would measure nine inches long, four-and-a-quarter inches deep, and two-and-a-half inches high. These dimensions are close to those of the English "statute" or common brick, and the New England brick laws were clearly based on earlier British regulations. Despite such laws, many New Hampshire brickmakers manufactured undersized products; historian Jeremy Belknap cautioned in 1792 that "in this article, as in many others, a regulation is needed; most of the bricks which are made are deficient in size."[8]

During the 18th century, it was important that bricks be as uniform as possible. Bricklayers of the period, like other tradesmen, were frequently not paid according to their own claims for work done. Rather, if their contract was "by measure," bricklayers had their work measured or "surveyed" by an independent third party, who placed a fair value on the quantity of work performed. The surveyor calculated the number of bricks in a job by measuring the finished wall of a structure; thus, accuracy in estimating the number of bricks laid in a job demanded that the bricks conform as much as possible to standard dimensions.[9]

In fact, however, the size of the finished brick depended on more than the size of the mold. All clays shrink during the firing process, some more than others. Those bricks closest to the fires in the kiln shrink more than those away from the heat, so that the bricks from a single firing would vary considerably in size, even though all might have been dropped from a single mold.

When the molded blocks of clay were dropped out of the mold, they lay flat on the ground to begin to dry. After a few days, they were tipped up on their edges to dry further. After this initial drying, the blocks were carefully stacked in rows or "haked," often under the makeshift shelter of boards laid over each row (figure 6). Drying could take days or weeks, depending on the weather. Damp and cloudy weather could slow drying, choking the yard with molded bricks that were too soft to handle.

After drying, the blocks of clay had become "green" bricks, ready for the firing or baking process that would transform them from earth into a ceramic. During the period of drying and stacking bricks for firing, sudden rains were the nemesis of the brickmaker. One New Hampshire newspaper reported in the summer of 1887 that "the late rain storm did some serious damage to the brick makers. Unburned bricks are of such perishable a nature that it is almost impossible to prevent losing a large percentage during an ordinary rainstorm, but such a rain as we had Friday, Saturday, and Sunday caused the loss of much dollars worth of property in the yards."[10]

Special methods were sometimes employed to mold face bricks (bricks exposed on the outer surface of a wall) of high quality. Even in the 18th century, wooden molds were sometimes lined with iron or other metal to provide smoother faces to the bricks as well as to prolong the life of the mold. Bricks with even smoother faces and sharper edges became available in the second decade of the 19th century with the introduction of re-pressing machines. These devices, at first usually hand-operated, forced a green brick into a metal mold under great pressure, compressing the rough product into a perfect rectangular prism.

Among those who evidently pioneered in making re-pressed bricks in New Hampshire were the Shakers at Canterbury. Shaker trustee Francis Winkley noted in 1824 that the village had "made a Brick yard in [the Lake] meddow and halled a building there for its convenience and dug clay."[11] By 1831, when the Shakers built their trustees' office, they faced its walls with re-pressed bricks manufactured, according to Elder Henry Blinn's journal, "at our brick yard."[12] Re-pressed bricks, perhaps bought from the Shakers, began to appear in the walls of nearby private dwellings at about the same time.

Once molded and air-dried, green bricks were ready for firing or "burning." Until well into the 20th century, and indeed until the mid-century in small or rural New England brickyards, bricks were fired or vitrified by the same method used since the 1600s. The green bricks were carefully stacked by hand in a "clamp" or "scove kiln"—a large, rectangular structure with corbeled arches running at intervals through its base, and with innumerable gaps or interstices throughout the entire construction (figure 7). A clamp or kiln of this nature might typically contain from 15 to 30 thousand bricks, occasionally as many as 60 thousand.[13] The outer faces of the pile were "scoved" or covered with an unmortared veneer of hardened refuse bricks from earlier firings and were carefully parged or plastered with mortar made of clay and sand so that fires built in the arches

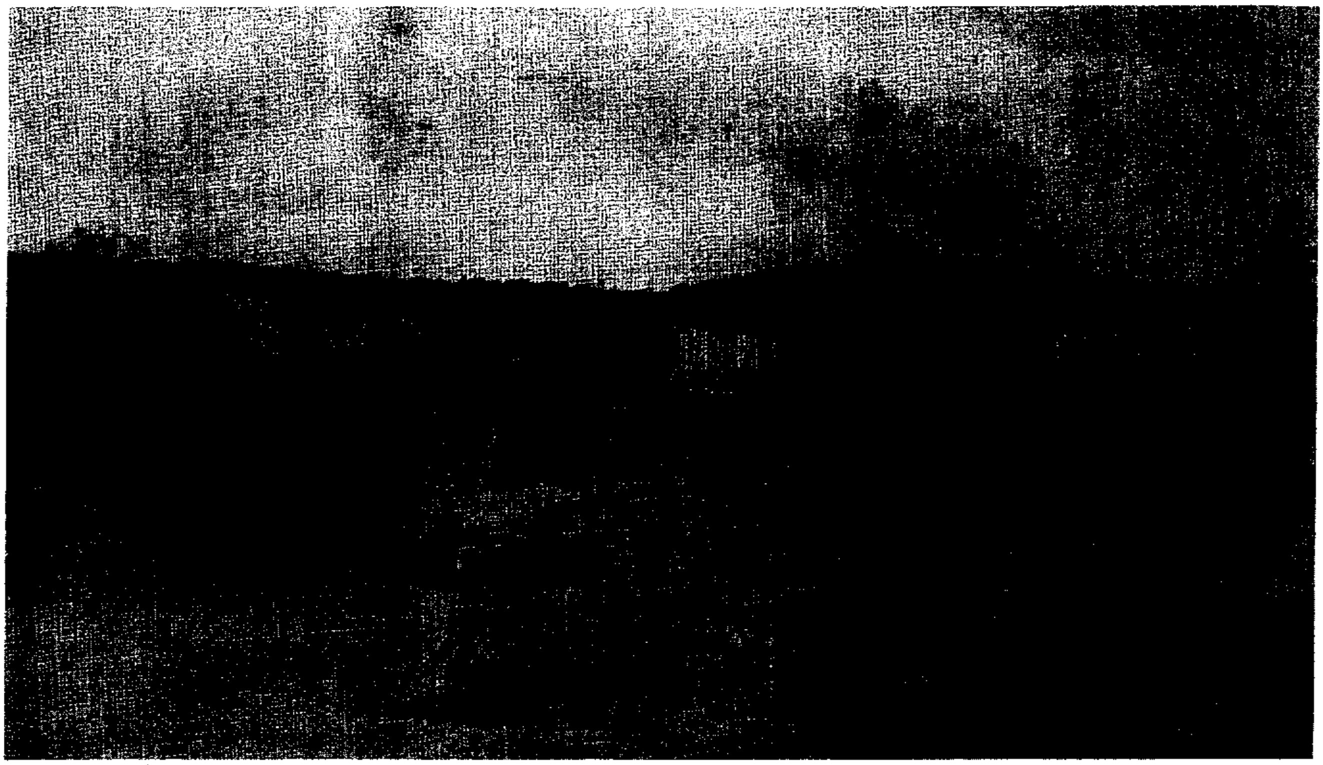

Figure 6. *Densmore Brick Company, Lebanon, New Hampshire, 1886. The pug mill (with three men posed on the counterbalance of the sweep) is at the left, with haked green bricks behind it. The men to the right of the two-wheeled oxcart stand with six-compartment molds among newly formed bricks.* Lebanon Historical Society, courtesy of Robert H. Leavitt.

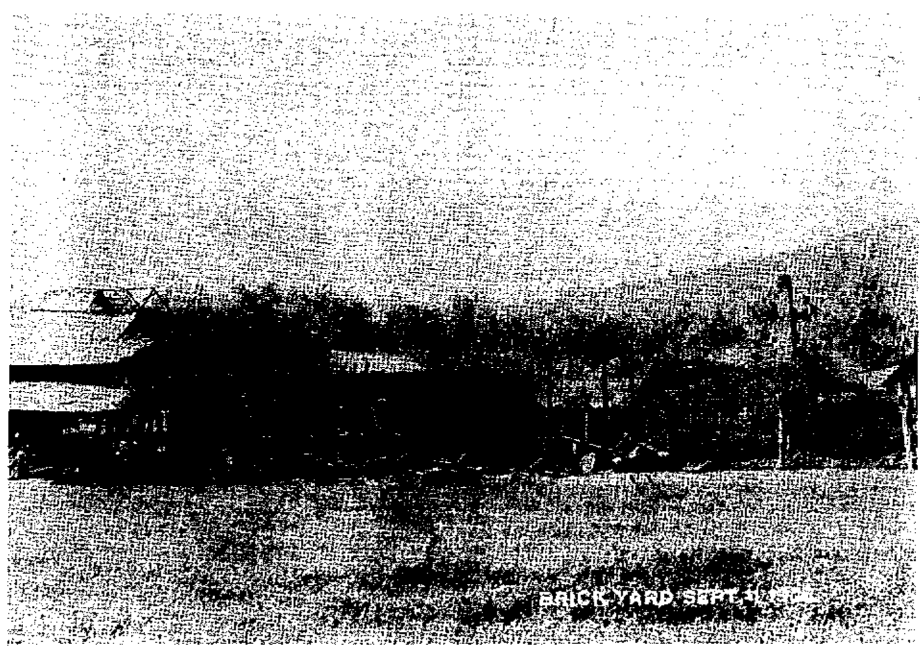

Figure 7. *Densmore Brick Company, from a photograph dated September 11, 1906. Taken shortly after the accidental burning of part of the kiln shed, this picture shows a fully scoved kiln at the left and a second kiln, in the process of being built or dismantled, at the right.* Lebanon Historical Society, courtesy of Robert H. Leavitt.

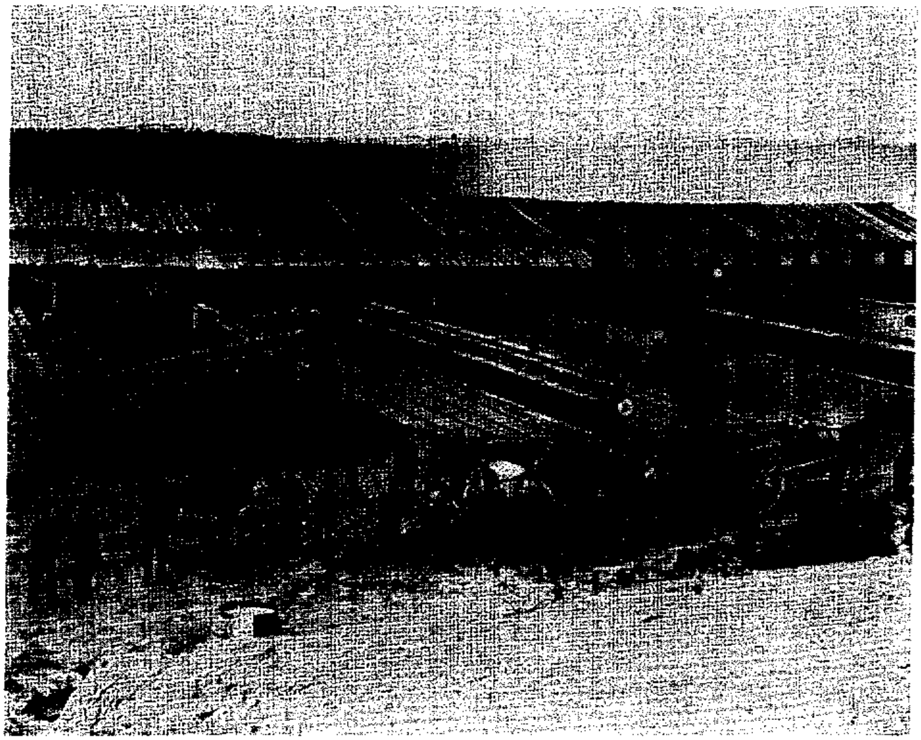

Figure 8. *Brickyard, Pembroke, New Hampshire, c1890. This panoramic view shows a pug mill at the left, rows of newly molded and baked bricks behind the group of employees, and cordwood being delivered by wagon to the kiln shed at the rear. At the right, where steam is issuing from a burning kiln, wooden shutters have been placed against the shed to break the wind and thus help control the draft.* Pembroke Historical Society, courtesy of David M. Richards.

would suffuse their heat through the entire mass, with the hot gases exiting through the top of the pile. The top was also covered with refuse bricks.

The stacking and burning or vitrifying of bricks in such a kiln was a skilled art. Building the clamp from green bricks might take several weeks. Heavy rains remained a hazard during this period. For this reason, most New England brickmakers built high, wood-framed structures to shelter the kilns, covering the roofs with boards that could be removed as necessary during the firing (figure 8).

Firing and cooling a clamp of bricks could require well over a week, and during that time the brickmaker had to exercise judgment and vigilance. With wood as a fuel, the temperature of the fires could vary depending on the dryness and the species used (figure 9). Photographic evidence suggests that most brickyards stored their wood outdoors in four-foot lengths; thus, protracted rains that wetted the fuel increased the cost and difficulty of burning the bricks.[14]

The draft of a kiln could be affected by prevailing winds, and had to be regulated by making or closing openings in the clay covering of the clamp and by placing shutters made of battened boards along the windward side of the clamp. The kiln might heat unevenly, resulting in overburned or underburned bricks, and this too had to be compensated for by adjusting the draft. The entire clamp slowly shrank as the bricks were vitrified, and the brickmaker had to keep the subsidence of the pile as even as possible. The final color of the bricks depended in part on the character of the local clay and on the amount of oxygen fed to the fires, so the brickmaker also had to learn to gauge the reaction of his clay to varying conditions of draft at various stages of the burning.

The process of burning a clamp of bricks began with a gentle fire, which drove off the moisture in the green bricks and warmed the entire clamp. This step was necessary to prevent the bricks from exploding due to steam generated within them during the later and hotter stages of the firing. As the smoke issuing from the top of the pile turned from white water vapor to a darker hue, the brickmaker knew that the water had been driven out of the clay and that he could safely intensify the heat by adding fast-burning fuel and adjusting the draft at the arches. The temperature was gradually raised to a point between 1,500 and 2,000 degrees Fahrenheit, bringing the bricks in the lower part of the kiln to an incandescent heat. Typically, the fires were alternately fed and slackened, and the drafts adjusted, so that the upper-

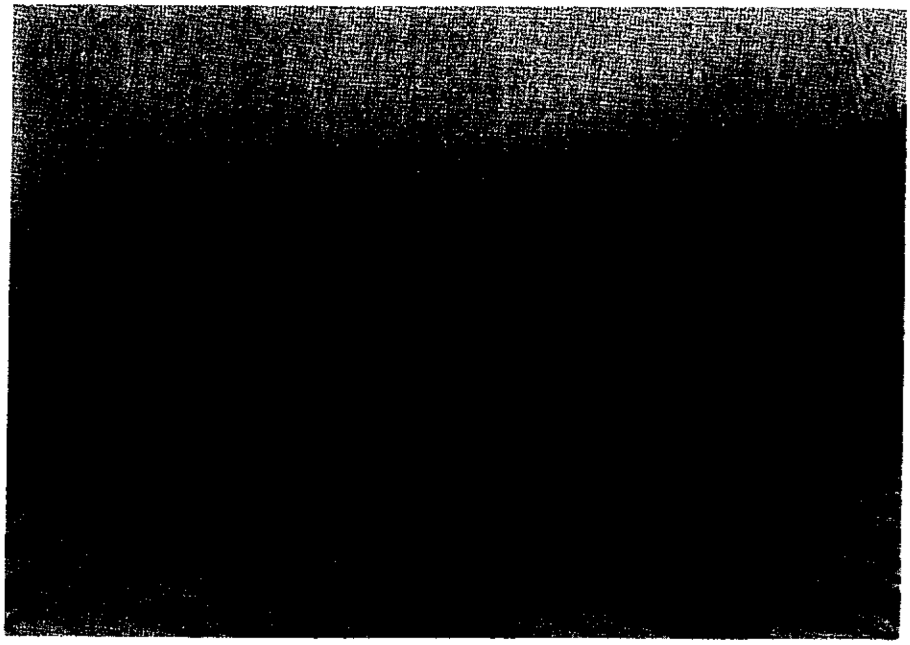

Figure 9. *Densmore Brick Company, from a photograph dated June 9, 1906. Taken to show the burned brick shed and collapsed kiln, the photograph also shows a portion of the yard's cordwood supply at the right. The green bricks at the left are drying on wooden pallets under roofed racks rather than on the ground or in hakes.* Lebanon Historical Society, courtesy of Robert H. Leavitt.

most bricks would gradually heat as much as possible; eventually, flames would appear in the flues at the top of the kiln.

After the firing was complete and the kiln was slowly cooled over a period of several days, the entire pile was taken apart by hand and the bricks sorted for various uses. Despite the best skill of the brickmaker, the bricks near the fires would inevitably be more vitrified than those at the top of the kiln. The bricks that made up the corbels of the arches would normally be burned black and would often be twisted and even fused together by the intense heat. These were called arch or clinker bricks. Other bricks from the lower part of the kiln would normally retain their true shape, yet would be found to have acquired a green or black glaze because of salts found in the clay and the wood fuel. The bricks in the mid-region of the kiln would be the characteristic bricks of the burning, taking on a color that reflected the properties of their clay and their method of firing. Even here, however, individual bricks would normally display a range of hues resulting from their direct exposure to hot gases or from their protection from those gases by adjacent bricks in the stack. The bricks at the top of the kiln, the coolest region, would normally be underburned, light in color, soft, very susceptible to crumbling in damp conditions, and therefore unfit for use where exposed to the weather or to the moisture of a cellar. These were called "samel" or "salmon" bricks, and, when made of the common iron-bearing clays of New England, are indeed of a pink or salmon color.

The Manufacture of Bricks in New Hampshire

The production of bricks even in the clay-rich regions of New Hampshire was limited in scale well into the 19th century because of the difficulty of transporting large quantities of brick from the point of manufacture to distant markets. Of all brickmaking regions in New Hampshire, the seacoast was clearly the most favored in terms of transportation (figure 10). In that area, the best clay beds lie alongside or near tidewater, permitting the easy loading and moving of great quantities of brick by water. Indeed, some bricks had been shipped from this district to the British West Indies during the 18th century. Belknap noted in 1792 that "the manufacture of bricks . . . may be extended to any degree. . . . Bricks might be carried as ballast in every vessel which goes to ports where they are saleable."[15]

Away from the coast, however, transportation was more difficult, and bricks had to be made as close as possible to the place where they were needed. In the 18th century, when brick houses were unknown in inland New Hampshire, brick production was limited to the needs of chimney stacks. In such a situation, the homeowner himself might assist in the process of making the bricks needed, calling in an experienced brickmaker only for the more arcane process of building and firing the clamp.

Such a procedure is documented in the diary of Matthew

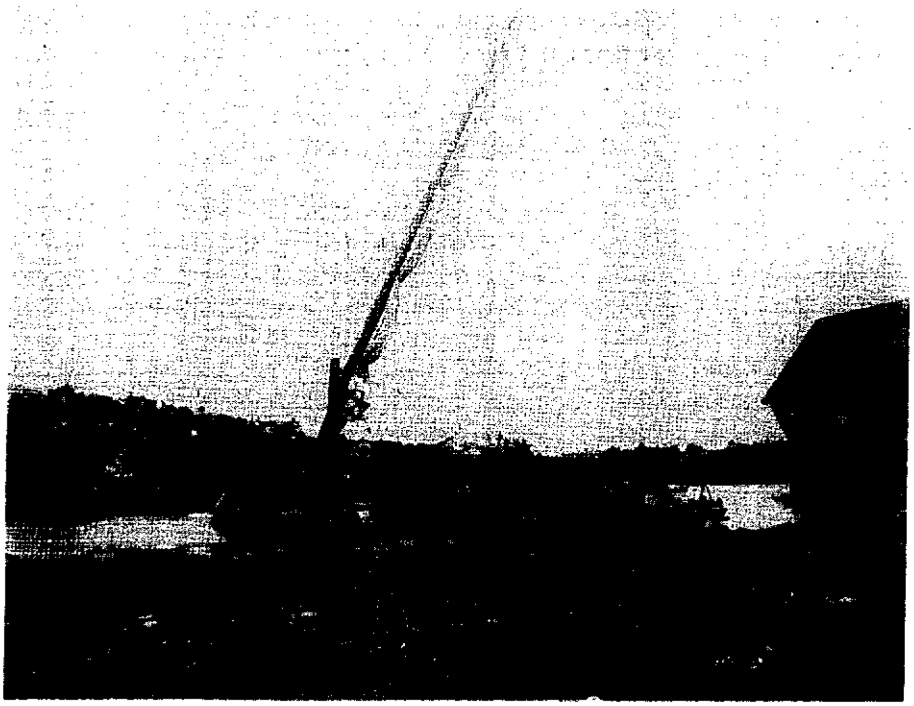

Figure 10. *Gondola laden with bricks, Lamprey River, Newmarket, New Hampshire, c1895. Gondolas or gundalows were lateen-rigged, shallow-draft barges that carried most waterborne freight of coastal New Hampshire. They were commonly used to deliver firewood to tidewater brickyards and to transport bricks to local markets.* Donald Howcroft photo; courtesy of John P. Adams.

Patten, a Scots-Irish settler in Bedford. From July to September of 1782, Patten records bringing many loads of clay to his property. Beginning in September, we find him preparing beds on which to "make mortar" (temper the clay), and fashioning wooden brick molds. Thereafter, for more than a month, Patten and his family molded and haked (stacked) thousands of bricks as part of their routine farm labors. On October 5, "it Rained a considerable heavy rain [and] we lost several hundred [green bricks] with it[;] we made none after this faull." On October 22, "Master Richardson came to set and burn the Brick."[16]

Three years later, Patten and his family, together with several partners in the enterprise, were again busy molding bricks, being careful this season to cover them against rain. In October 1785, Patten's diary entries describe the process of firing that season's production of green bricks: "Alexander and I workt the brick Kiln burning and geting wood and Alexander sit up all night helping to tend the kiln." After nine days of firing, "They finished burning the brick since the Killn was set aburning[;] accounting a night equal to a day I have done 21½ days." About a month after the firing of the kiln, "James, Alexander and I with the other partners began to open the brick kiln and heak by [pile] the brick." Out of this effort, Patten's share of the production of this clamp was 9,145 bricks.[17]

This is probably the way in which many New England chimney bricks were made in the 1700s. The clay might be dug from someone else's clay bed and hauled to the place it was needed. The unskilled labor would be contributed by the farmer and his family. An experienced brickmaker would be called in to set and burn the clamp when sufficient bricks had been molded. An intelligent and observant jack-of-all-trades like Patten might attempt the entire process himself at a later time after learning the secrets of the professional brickmaker.

Even as late as the 1820s, the citizens of Hooksett (which was destined to become a leading center of brick production after the arrival of the railroad) relied on the old partnership method of making the bricks they needed: "The first brick made in town was about the year 1820, at the Ayer brickyard. At that time it was not a special industry, but different individuals united together to make [bricks] for home use. In the year 1828 a kiln was made, which was used to [make bricks to] build the town-house, and the town voted to cut wood from off the town lots to burn the same with."[18]

Such occasional forays into brickmaking differed considerably from the routine of a professional but part-time brickmaker. The account book of Sterling Sargent of Pembroke and Allenstown covers the period from 1813 to the

1850s and records the work of a man who founded a dynasty of brick manufacturers in Allenstown.[19] Two of Sargent's sons, Philip and Warren, became leaders in the industry after it attained the scale made possible by rail transportation. But Sterling Sargent's involvement with brickmaking was on a much more occasional basis, interspersed with farming, lumbering, and many other activities.

Sargent's account book reveals many things about his work as a brickmaker. First, he worked at the business only sporadically, usually in the spring and autumn. Second, as early as 1816, Sargent sold common bricks at prices ranging from $3.50 to $4.50 per thousand, with $4.00 probably representing an average price; he sold "soft" bricks for $2.50 and "hard" or "best" bricks at $5.00 or more per thousand. Third, he often worked at making bricks or scoving kilns for other people, evidently on their property, much like the "Master Richardson" who had helped Matthew Patten burn his first kiln. In such cases, as when he worked for James C. Emery in the mid-1830s, Sargent spent much time teaming clay to brickyard sites. Between 1834 and 1836, Sargent hauled enough clay for Emery to make 280,000 bricks.

In burning one kiln in 1816, Sargent noted that he made 13 "beds of Morter," which required eight-and-a-half days to prepare. This suggests that Sargent, like Patten, tempered his clay in beds, probably by treading it with cattle, rather than using any form of mixing machinery; in 1819 he credited someone with "your oxen to tread a bed of morter." The 13 beds yielded 56,711 green bricks, for an average of 4,362 bricks per bed. After burning, 55,350 bricks "was counted out of the kiln." This appears to represent a loss of 1,361 bricks, or a little more than 2 percent of the total number molded. This loss was probably due to over- or underburning, though possibly it resulted from rain damage while the green bricks were drying. Rain could pose a danger up to the time of burning; in one instance in 1841, Sargent spent a day "taking out washed brick from [the] kiln and setting in new ones."

By 1832, when a survey of the manufactures of the United States was compiled by the Secretary of the Treasury, we find that three principal areas of New Hampshire had achieved predominance in the manufacture of brick. These were the coastal region, including Portsmouth, Exeter, Newington, Seabrook, the Hamptons, and Epping; the Merrimack River valley, including Allenstown, Pembroke, and Hooksett; and the Keene area, including Marlborough, Troy, Richmond, and Westmoreland.[20] All of these areas had been inundated for extensive periods by seawater or by glacial lakes that had permitted the slow deposition of clay at the end of the ice age. Each of these regions also reveals a high incidence of brick architecture in the years after 1800, and each maintained a highly productive brick industry into the late 19th and early 20th centuries—continuing, in one or two cases, almost to the present day.

The report of 1832 gives some hint of the scale of brick production in New Hampshire in that year. The seacoast communities, as far inland as Plaistow and Epping, together produced 2,305,000 bricks. The average manufacturer employed only two or three men, and worked at brickmaking only two to four months out of the year. Bricks sold, on average, for $4 per thousand. Even with the possibility of water transportation (which eventually became important to seacoast brickmakers), all the products of these yards were sold locally. The Merrimack valley, including Allenstown and Hooksett, produced 1,271,000 bricks per year, selling virtually all of them in the immediate area. The five towns of Keene, Marlborough, Troy, Richmond, and Westmoreland collectively produced 1,410,000 bricks, all for local consumption.

Brick prices remained remarkably constant throughout the first half of the 19th century. When the building committee members of the New Hampshire Asylum for the Insane purchased nearly a million bricks for the walls of their new hospital in 1842, they were able to buy the bricks at an average cost of about $4.12 per thousand, delivered to the building site, and to have them laid at an additional cost of $2.25 per thousand.[21]

Once the railroad arrived in an area where extensive clay beds had formerly encouraged local production, the scale of brickmaking operations often changed dramatically, making the figures reported in 1832 seem insignificant. This was especially true in places like Hooksett or Plaistow, where the nearby and rapidly growing manufacturing cities of Manchester, New Hampshire, and Haverhill, Massachusetts, created an almost infinite demand for bricks. In Hooksett, early demands placed on local clay beds were small and in no degree suggested the scale of operations that would appear there later in the 19th century. An 1885 history of Merrimack County notes:

> About the year 1810 the late Captain Rice Dudley, of Pembroke, who had worked at brickmaking in Massachusetts some, prospected, in company with Samuel Head, the clay-banks now worked by Jesse Gault and W. F. Head [in Hooksett]. Mr. Dudley prophesied that the banks would be developed some time, but Mr. Head scouted [dismissed] the idea, for the reason that it would be difficult to transport them to market. Since that time the clay-banks have been utilized; a railroad, with its side tracks, has been extended up near the kilns, and it is no uncommon thing to see twenty-five cars of brick loaded in one day.[22]

This notable demand had already given rise to brickmaking on an impressive scale when Hitchcock described the upper Merrimack valley in his *The Geology of New Hampshire*. Hitchcock noted that the clay beds first discovered by Captain Rice Dudley about 1810 had proven to be "a nearly continuous stratum, which has a thickness of from 20 to 30 feet," extending four miles north from Hooksett village on the east side of the river.[23]

By 1878, according to Hitchcock, Natt and William F. Head of Hooksett were making about 5,000,000 bricks annually, with a market value of $6 to $10 per thousand. The Heads employed about 60 men in their brickyard operation and sold their product not only in nearby Manchester but, thanks to railroad connections, also in Nashua, New Hampshire, and Lowell, Lawrence, and Worcester, Massachusetts. Jesse Gault, whose Hooksett yard utilized the same stratum of clay first detected about 1810, was then employing 40 men to manufacture between 3,000,000 and 4,000,000 bricks each year. Another six manufacturers in Hooksett, Suncook village, and Pembroke employed an additional 60 men in their yards, and their production, according to Hitchcock, averaged "about 80,000 brick yearly to each man employed." Among these were Philip and Warren Sargent, sons of Sterling Sargent. The younger Sargents had transformed their father's sporadic operations of the early decades of the century into an operation that employed 20 men and manufactured some 1,600,000 bricks each year.[24] Both brothers built impressive brick houses from their own bricks, emulating the mansion of Governor Natt Head, co-proprietor of Head's brickyard in Hooksett.[25] Equally impressive was the productivity of Plaistow, near Haverhill, Massachusetts, on the lower Merrimack River. By 1880, thirteen yards there employed about 125 men to produce more than 11,000,000 bricks a year.[26]

Among tidewater communities, Dover had long been a principal focus of brick production, beginning shortly after 1800 when Portsmouth, just downriver, began to rebuild itself in brick after three devastating fires consumed the old wooden heart of the port town.[27] Dover's own need for bricks grew considerably as the Dover Manufacturing Company complex began to develop in the early 1820s. A map of Dover published in 1834 by G. L. Whitehouse indicates 10 brickyards along Dover Neck and Dover Point in that year; others stood across the Piscataqua River in Eliot, Maine.[28] John Scales's *History of Dover, New Hampshire* (1923) lists well over 30 brickyards along Dover Point, including one yard established in 1840 by Samuel Horne and still operating in 1923, having manufactured since 1865 "more than 40,000,000 brick of first class quality."[29] The Boston market, supplied by cargo vessels, was especially important to Dover manufacturers.

One of the most prominent Dover brick manufacturers, David Gage, worked for more than 20 years at two sites but turned his business over to his son Moses in 1858. Thereafter, Gage "devoted his time to the manufacture of a machine which he invented to make water-struck brick"; this machine "revolutionized the method for the soft-mud branch of brick making," and Gage twice renewed his patent for the device.[30]

Despite the growth of the brick industry, most yards required a relatively low capital investment. The average amount invested in New Hampshire brickyards in 1880 was $1,851 per yard, and much of this investment may have represented the purchase of extensive woodlots for fuel.[31] Some of the smaller yards had been established at a cost of only $125 or $150. But other brickmaking operations represented investments of close to $10,000, and even $15,000 in the case of the Head brickyard in Hooksett. A few owners had invested in steam engines by 1880, probably to turn pug mills rather than to power more sophisticated brick machines.[32]

Typically, the earliest brick machines did not radically alter the method of molding and firing bricks; they simply added some mechanization to the slow operation of the traditional pug mill and to the laborious process of filling brick molds (figure 11). New Hampshire brickmakers favored the "soft mud" process, buying machines that used clay as wet and plastic as that used in hand molding. Such machines merely pressed the pugged clay into molds, easing one of the most arduous of brickmaking operations. The rest of the brickmaking process proceeded much as before.

Brickmakers in other parts of the country, meanwhile, were producing vast quantities of bricks with ever more sophisticated machines that used the "stiff mud" process, extruding a column of clay that was cut into bricks by wires. These same manufacturers frequently adopted advanced drying and firing methods to produce bricks that were never touched by a human hand.[33]

Despite this formidable competition, many New Hampshire brickmakers enjoyed a steady demand for their commonplace products, both in New Hampshire and in neighboring states. Such prosperity offered little incentive for modernization, specialization, or expansion. In 1898, Hooksett brickmaker William F. Head, perhaps the largest brick manufacturer in New Hampshire, dismissed inquiries by potential customers with the comment that "we don't make pressed brick."[34]

Figure 11. *Samuel Holt brickyard, Concord, New Hampshire, c1925. By the early 20th century, a number of New Hampshire brickyards had steam- or electric-powered pug mills and soft mud machines, here housed under the sheds in the foreground. Such yards often had drying racks with off-bearing conveyor belts or cables that delivered pallets of freshly molded bricks to laborers who placed the pallets in the racks. The kiln shed is seen beyond the racks, with cordwood stacked at the far right.* Courtesy of the New Hampshire Historical Society, F4098.

The low overhead of New Hampshire yards allowed such manufacturers to sell at prices that were remarkably consistent with those of decades earlier. In 1898 Head wrote to one customer that "we can furnish you with a good lot of up & down [run of the kiln] brick for $5.00 per M, Light-Hards for $4.00 per M, Topping for $7.00 per M. [and] Face brick for $8.00 per M . . . on [railroad] cars at Hooksett, N.H."[35]

Throughout the first half of the 20th century, several New Hampshire manufacturers found that their most traditional product, the water-struck brick fired in the scove kiln, gave them a special advantage among increasingly sophisticated competitors. While American brick manufacturers in general were developing more uniform products, produced in vast quantities by a variety of advanced machines and kiln types, New Hampshire companies were often sought out by architects who wanted the texture and color variation of "colonial" bricks. Several New Hampshire brickmakers advertised "Harvard" bricks that matched those used in the 18th- and 19th-century academic buildings of Harvard College. As long as the colonial revival movement remained strong in New England, favored by well-to-do customers and guided by knowledgeable architects, the traditional brick of New Hampshire was prized for the very qualities that linked it with the earliest American brickmaking methods.[36]

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12. Historical Record by Elder Henry Blinn, MS 763 (Canterbury: Canterbury Shaker Village Archives, n.d.), p. 248.
13. As brickyards grew larger in response to greater demand, scove kilns gradually increased in size. Scove kilns fired by gas or oil in the 20th century frequently contained half a million bricks or more.
14. *Dover Enquirer,* July 29, 1887 (n. 10 above).
15. "Port of Piscataqua, Colonial Customs Records, 1770–1775," copy, Portsmouth [N.H.] Athenaeum; Belknap (n. 4 above), p. 161.
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