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The Invention of Machine Twist: the Nonotuck Silk Company, from moths to millions

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Introduction. Cocoons and raw silk; thrown silk and dyed silk; spun silk yarns and fabrics; plain woven silks; lutestrings, sarsenets, satins, serges, foulards, tissues for hat and millinery purposes; figured silk piece goods, woven or printed, upholstery silks; crapes, velvets, gauzes; cravats, handkerchiefs, hosiery, knit goods, laces, scarves, ties, veils, all descriptions of cut and made-up silks; ribbons, plan fancy, and velvet; bindings, braids, cords, galloons, ladies' dress trimmings, upholsters', tailors', military and miscellaneous; machines for the manufacture of silk goods: the American silk industry's proud display "had the post of honor at the east end of the Main Building, on the central aisle" at the 1876 Centennial International Exposition in Philadelphia.[1] The industry had burgeoned after the Civil War: only four of the thirty four silk exhibitors (representing America's two hundred twenty four silk manufacturers and dealers) could trace their origins to the "times which tried the souls of the silk producers and manufacturers."[2] The Nonotuck Silk Company, the unlikely descendant of the 1830's moth-to-cloth Northampton Silk Company, was one that could and did.

Figure 1. Late nineteenth century trade card for the Nonotuck Silk Company.

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[1] Report of the Judges of Group IX (Wool and Silk Fabrics, Including the Materials and the Machinery), Centennial International Exhibition, National Museum of American History, Washington. The machinery was exhibited in Machinery Hall. The judges for silk fabrics and machinery were Elliott Cowdin, NY; Gustav Gebhard, Germany; John Neese, Switzerland; August Behmer, Egypt; Kenzo Hayami, Japan, Louis Chatel, France, and Charles LeBouthillier, Philadelphia.

[2] These and many other valuable data can be extracted from L.P. Brockett, *The Silk Industry in America*, published by the Silk Association of America for the Centennial Exposition, 1876. The quoted phrase appears on p. 67.

After falling twice from the rickety carousel of early nineteenth century enterprises, it seized the brass ring and held on. The key to its success was its manufacture of the first usable "machine twist," a silk thread strong and smooth enough to withstand the unprecedented demands of the newly invented sewing machine. Nonotuck became one of the nation's leading silk thread manufactures and Northampton's largest employer for decades.[3] Yet the details of this key invention have never been spelled out. This paper attempts to fill that gap.

The sericulture years: 1830 - 1850. The story begins, not in 1838 as the trade card suggests, but eight years earlier, when Samuel Whitmarsh**,** a 30-year-old Boston native, bought a large estate near the center of Northampton with the proceeds of a successful tailoring business in New York and built cocoonery for two million silkworms and two greenhouses for mulberry shoots next to his mansion. Raising silkworm was a popular spring pastime in Northampton in the 1820's; Whitmarsh tugged the silkworm from cottage to factory, from hobby to industry. A former linseed oil mill three miles three miles to the north along the Mill River served as his first factory. A few years later, backed by a group of New York and Connecticut financiers, Whitmarsh built a four-story brick one nearby.[4]

Figure 2 (left). The linseed oil mill on the Mill River, later Northampton's first silk mill. (Brockett, *The Silk Industry in America*)
Figure 3 (right). Samuel Whitmarsh's second factory, later the home of the Northampton Association for Education and Industry (Sheffeld, *A History of Florence*)

The new factory hummed with up-to-the-minute machinery. Tourists flocked to see his power loom churn out silk ribbons and vesting. The Northampton Silk Company was incorporated in 1838. But some whispered that the manufacture was mostly a show to persuade the gullible to invest in mulberry trees, whose price increased tenfold in a few short years.[5] The Northampton Silk Company burst with the mulberry bubble. Bankrupt, Whitmarsh withdrew in 1840. Out but not down, he tried, again unsuccessfully, to establish a silk industry in Jamaica a few years later. At the time of his death, in Northampton in 1875, he was planning to raise silk in California.

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[3] Agnes Hannay, "A Chronicle of Industry on the Mill River," *Smith College Studies in History*, Vol. XXI, Nos. 1-4, October, 1935 - July 1936.
[4] See Charles Sheffeld, ed., *A History of Florence*, published in Florence, Mass. by the editor in 1895
[5] Brockett, *op. cit*., p. 111-112.

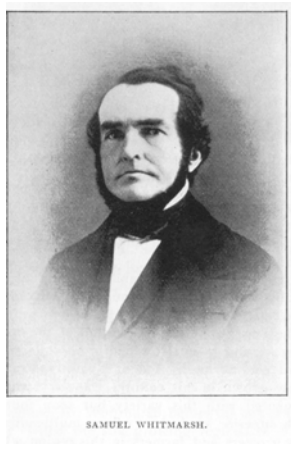

Figure 4 (left). Samuel Whitmarsh (Sheffeld, *A History of Florence*)
Figure 5 (right). Joseph Conant. (Sheffeld, *A History of Florence*)

In the aftermath of the mulberry craze, many New England silk growers and manufacturers renounced sericulture altogether. Some, like the Cheney brothers in Mt. Nebo, Connecticut, continued in manufacture. Some, like Jonathan Cobb in Dedham, Massachusetts, withdrew from the silk business. But the disaster persuaded others that the silkworm's hour had finally come round. "Onward we are summoned to move. Onward we are determined to move. Onward we call upon our intelligent friends to move," intoned the First Annual New-England Silk Convention in September, 1842, the Honorable Edward J. Dickinson presiding. "Difficulties, discouragements, name them not. No enterprise, large in its inception, comprehensive in its designs, widespread, far reaching, and beneficent in its results, can claim an exemption from difficulties, in the infancy of its movements. Of these, our enterprise has met and encountered no measured share. We know, indeed, the worst of the case."[6]

Whitmarsh's company had returned to life in April of that year -- under new ownership and with a very different vision. The small group of abolitionists who bought the mill and water privileges, its outbuildings and orchard, intended to create a utopian community around it. Of the eleven founders of the Northampton Association for Education and Industry (NAEI), two, Joseph Conant and Samuel Hill, relatives by marriage, would play a role in the invention of machine twist a decade later. Conant came to Northampton in 1839 from Mansfield, Connecticut, to superintend Whitmarsh's mill.[7] After the debacle, the trustees leased the company to Conant, who kept the operation going in a low key way. Though elected the NAEI's first president, he withdrew within a year to start his own silk company, J. Conant and Co., also in Northampton. Hill, a native of Rhode Island, manufactured cotton in Connecticut before moving to Northampton in 1841. His

[6] *First Annual Report of the New-England Silk Convention, at its session held at Northampton Massachusetts, September 28, 1842* (Northampton, 1843).
[7] Conant had been a director of the Mansfield Silk Company in Connecticut; in 1837, after that company folded and Whitmarsh's superintendent left, Whitmarsh invited him to Northampton to run the factory.

influence in the Association grew steadily over the years of its brief life. By 1844, the NAEI's membership had reached one hundred and twenty men, women and children. Everyone worked, many in silk, others in housekeeping, lumbering, and farming. Most lived in the factory, taking their meals in a communal dining room on the third floor and sleeping on the thinly partitioned fourth.

The NAEI's complex administrative structure included a Silk Department whose responsibilities were delegated to two, three, and eventually four subdepartments, each with its own director: Silk Growing, Silk Dyeing, Silk Manufacture, and Finishing and Sales.[8] The Silk Growing Department built a new cocoonery, cultivated the neglected orchard, produced several crops of cocoons each season, and seem to have reeled them acceptably, but not in the quantity the other subdepartments demanded.

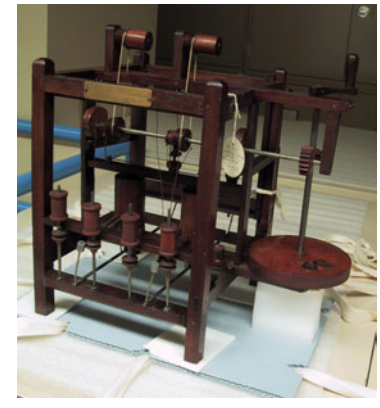

Figure 6 (left). Smith College students Beth Caton and Vanessa Larson reeling silk on their replica of the popular 1830's Piedmont reeler, constructed in the Clark Science Center machine shop for the Northampton Silk Project.
Figure 7 (right). The patent Model for Harrison Holland's Silk Spinner at the Smithsonian National Museum of American History (Maryland storage facilty.)

Like Whitmarsh before them, the NAEI was forced to supplement its own raw silk production with cocoons and raw silk from American and foreign sericulturists. Reeling was the rock on which American sericulture foundered, despite the best efforts of many mechanics. Oliver Paine, the 19 year old Director of the Silk Growing Department, built reeling machines of his own design for the Association and also for sale. But, as Whitmarsh had warned,[9] when it came to reeling, inexperience would always win out.

After reeling, the skeins of raw silk were sent to the Silk Manufacturing Department to be wound onto bobbins and thrown. Throwing -- a standard term the New England manufacturers seem not to have used -- includes doubling (winding two, three, or more strands of raw silk together) and twisting. These steps (which may be combined) may be

[8] I discuss the NAEI"s silk efforts in detail in "The Camel and the Needle: silk in the Stetson letters," in *Letters from an American Utopia: the Northampton Association and the Stetson Family, 1842 - 1846*, K. Buckley and C. Clark, eds, to be published by the University of Massachusetts Press (2003).
[9] Samuel Whitmarsh, *Eight Years Experience in the Cultivation of the Mulberry Tree and the Care of the Silkworm*, Northampton, 1839.

repeated, alternating the direction of the twist each time. The strength and thickness of the thread is determined by the number times the steps are repeated and the number of turns per inch. The NEAI produced thread of two kinds, "sewings" for handsewing and a sturdier “saddlers.”

The NAEI doubled and twisted its silk on Harrison Holland's “Silk Spinner.” Holland, an impecunious inventor, migrated from Mansfield to Northampton with his large family in the mid-1830's. His daughter Clarissa worked in Whitmarsh's mill; perhaps her travails inspired him. He was granted a patent in 1838 for his machine's two novel features: it stopped when a thread broke, and the direction of the twist was easily reversed. But the problems of the 1840's thread manufacturers lay deeper. To make a strong smooth thread, the strands of raw silk twisted together must be virtually identical. But, as an NAEI spokesman pointed out, “when the manufacturer purchases American raw silk in considerable quantity for manufacture, he finds himself in possession not of one uniform kind and quality of silk adapted to his purpose, but of numerous varieties from very coarse to very fine, from very even to very uneven, each variety in small quantity.”[10] Like inexperienced reeling, this lack of uniformity trumped mechanical ingenuity.

The Invention of Machine Twist. Burdened with debt and embittered by internal squabbling, the Northampton Association for Education and Industry dissolved in 1846. Northampton's sericulture years were over. Samuel Hill paid its debtors and resumed silk thread manufacture a few years later, with Samuel Hinckley, a Northampton capitalist, as a silent partner. The newly invented sewing machine promised a vast expansion of the market for thread, but the thread kept snapping. Hill and his associates rose to the challenge of devising a silk thread strong enough to withstand the tension the machine placed on it, and smooth enough to wind its intricate path around bobbins and through eyelets and holes without snagging.

“The sewing by hand, and the simple needle then [1840’s] in sole use demanded a far less perfect thread than that now required for machine-sewing," explained the judges of the Centennial Exposition's Group IX. “The proprietors of an establishment in Massachusetts, now famous, knowing the difficulties attending the use of silk threads, as then made, upon the newly-invented sewing-machine, devised the plan of twisting the silk in a direction opposite to that of common or skein sewing-silk. Winding a pound of *three-cord* silk, thus twisted, upon spools containing one-half ounce each, they submitted it, in 1852, to Mr. Singer, who was then experimenting upon his newly-invented sewing-machine, with which he met difficulties that he could not overcome.”[11] [Emphasis added.]

Quoting Alfred Lilly, a superintendent at Nonotuck very familiar with this history, the judges continued, “The silk was handed to ‘Mr. Singer with the request that he would try

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[10] W. Adam, quoted in The Silk Question Settled: The Testimony of One Hundred and Fifty Witnesses. Report of the Proceedings of the National Convention of Silk Growers and Silk Manufacturers, Held in New York, Oct. 13 and 14th, 1843 (New York, 1844), p.p. 69-70.

[11] Report of the Centennial Exposition Judges, p. 180.

it. He put a spool upon his machine, threaded up, and commenced sewing. After sewing sufficiently to enable him to judge of its merit, he stopped, and after examining the work it had done, exclaimed, ‘Can you make any more like this? I shall want all you can make’ -- a prophecy literally fulfilled.' The new fabric assumed the name of ‘machine-twist;’ and from that time to the present the amount of silk consumed upon sewing-machines is marvelous. ’” Isaac Singer wrote checks to Samuel Hill for thousands of dollars, inspiring the residents of the mill district to rename it Florence after "the great silk emporium of Italy." (A motion to rename the Mill River the Arno was defeated.)

But how had Hill surmounted the greatest stumbling block, the variation in raw silk? The judges remarked only that "it was by gradual improvements in machinery, and manipulations generally too minute to warrant description, that they succeeded in the result they have now so completely attained, -- that of placing upon spools a definite weight of silk thread, of continuous length, entirely free from slugs, knots, and uneven places, and perfectly adapted to the machine which is to apply it.”

If Hill's company kept records in those years, they have disappeared. But by splicing the pages of Scientific American and the U. S. Government Patent Record we can discern the outlines of the story. It opens in 1850, with a brief announcement in *Scientific American*:[12]

> Messrs. Joseph Conant and Lucius Dimock, of Northampton Mass, have invented a valuable and improved machine for doubling and twisting silk. A great difficulty has always been experienced in doubling and twisting silk to make a fine smooth thread, owing to the fact that the doubling, in machinery heretofore used for that purpose, has always been accomplished by twisting together the threads of separate spools, which are rarely alike in texture. This must make an uneven thread. *This improvement doubles each thread from a single spool* and does it with speed and uniformity. Measures have been taken to secure a patent. (Emphasis added.)

The Conant-Dimock throwing machine was never patented and I have found no other description of it.[13] Later developments suggest that *Scientific American* used the word "double" in the general sense of winding two or more threads together, and that the number was in fact three.

Conant, fifty eight years old in 1850, returned to Connecticut a few years later to found Conantville and build the Conant Mill there. He seems to have played no role in the invention's further development. Lucius Dimock, then twenty five, had opened a machine shop in Northampton with his younger brother Ira, also an inventor, a few years before. As we will see, both Dimocks worked on silk-trebling machines and were stockholders of the Nonotuck Silk Company at its incorporation in 1866. It is possible, then, that Samuel

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[12] "Improved Machine for Doubling and Twisting Silk," *Scientific American*, Vol. 5, April 6, 1850, p. 228.
[13] Joseph Conant and Lucius Dimock received patent 7833 in December, 1850 for another device, "a catch bar for catching and holding all the threads simultaneously and liberating them successively as required."

Hill used the Conant-Dimock machine, or some variant of it, to make the machine twist he sold to Singer in 1852.

Three years after Hill's first sale to Singer, the first patent for a machine for "Trebling a Single Strand and Twisting Sewing Thread" was granted to Harold Kelsea of Antrim, New Hampshire.[14] In his patent application, Kelsea explained that his machine consisted of an "endless band M, its hitching heads or knobs N, O and the stationary frame hitching knob, P, as applied together, to the drum rollers and twisting mechanism and made to operate so as *to treble and enchain a strand* ....” (Emphasis added.)

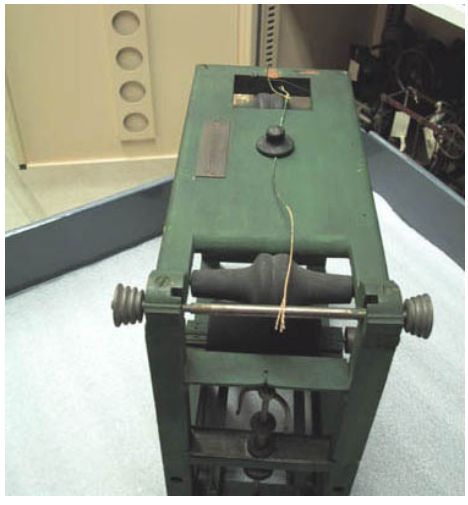


Figure 8. Harold Kelsea’s patent model, National Museum of American History (Maryland storage facility.) The broken cord represents the “endless band” M to which the knobs N and O are attached (only one can be seen); the hitching knob P was mounted on the bare spot at the far end.

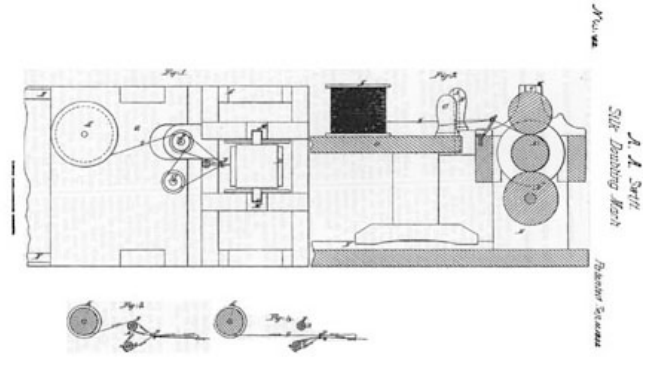
The spool of thread to be trebled was mounted below the hitching head P; the spool onto which the trebled thread was twisted at the other. The thirty foot long band M moved automatically, carrying the diametrically opposed knobs N and O along with it. "In passing downward around the front drum, K, the knob, O, will slip out of the loopings of the strand," explained Kelsea, "leaving them enchained or connected together like two contiguous links of a chain. While the knob O is passing down around the front roller or drum K, the other knob, N, will be coming upward around the back roller L." The attendant stood at the back and crocheted with his fingers: "As soon as it (the knob N) rises, [he] seizes that part of the strand coming directly from the bobbin and loops it around his finger and passes it in the form of a loop upward between the loop on the head N, and from thence carries it back and loops it over the head P, and so he continues this process ...."

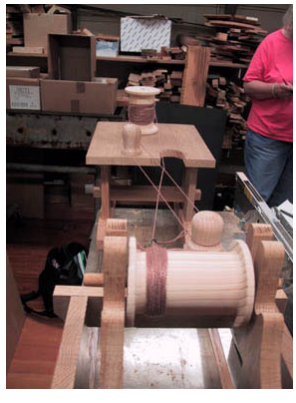
That is, Kelsea's machine, or rather, its attendant, *crocheted* the thread in loops thirty feet long and then the machine twisted it onto a bobbin. Handspinners recognize this as "Navajo plying." Navajo plying produces a tripled thread that is uniform for the length of

[14] Patent No. 13,267, July 17, 1855, Antrim, New Hampshire. Kelsea did "not claim the combination of doubling, twisting and reeling mechanism, whereby a strand may be doubled, twisted and reeled so as to be made into a skein," which suggests that a machine performing those operations may have been patented earlier, but I have been unable to find one.

each loop, but with bumps where the loops overlap. If the Conant-Dimock machine was a forerunner of Kelsea's, we can understand the judges' remark that "although, in this first experiment of machine-twist, the invention was complete, the manufacturers still found great trouble in its production; for the machine required a thread which, to be moved automatically, must be absolutely perfect, like the machine itself."[15]

While deftly performing this sequence of operations at the back of the machine, Kelsea's attendant also had to oversee the twisting and winding at the front. Just a few weeks after Kelsea received his patent, Anson Swift and Samuel Hill received another for "Machinery for Trebling a Single Thread." In this version, the attendant stayed in place.[16] The machine consisted of two parts, a stationary piece (E) and a carriage (G) that rolled back and forth on thirty-foot-long rails. The looping process resembled Kelsea's, except that the carriage G drew out the loops as it rolled away from E, and the trebled thread was wound onto a bobbin as G rolled back (the patent application does not mention twisting.) The attendant still made and manipulated the loops by hand, but he no longer had to dash from one end of the machine to the other.





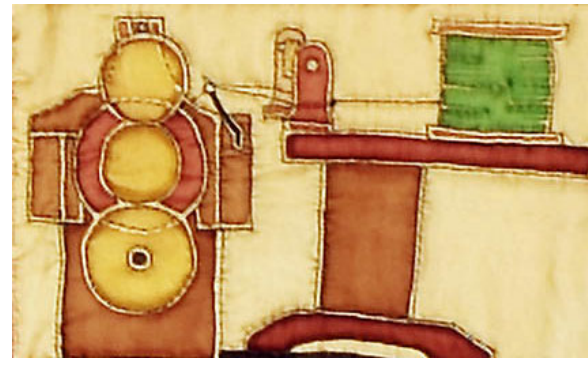


Figure 9 (top). Patent drawing for the Swift-Hill Machine.
Figure 10 (lower left). The Swift-Hill trebling machine, recreated from the patent drawing by Smith students Crystal Allen and Shawna King for the Northampton Silk Project. Here the carriage G is at its greatest distance from the stationary part E.

[15] Report of the Centennial Exposition Judges, p. 97

[16] A. A. Swift, August 30, 1855 , "Machinery for Trebling a Single Thread," Patent 13,562, also assigned to Samuel Hill.

Figure 11 (lower right). The Swift-Hill trebling machine, as rendered in Sally Dillon's Northampton silk history quilt, *Northampton Silk on Silk*. Here E and G are close together, as in the patent diagram.

Lucius Dimock reentered the story of machine twist a few months later, this time with his brother Ira. "In the machinery which constitutes the subject of this invention the trebling is effected as in some other machinery for the same purpose," they wrote in their patent application for "Machinery for Trebling Single Threads.[17] "This invention consists in certain improvements for effecting the above operation *without any manual aid* and saving much of the delay which is usually necessary to effect the unhitching of the loops." (Emphasis added.)

But, with or without an attendant, and no matter how long the loops, "enchained" thread would never be "entirely free from slugs, knots, and uneven places." The crucial breakthrough came two years later with Ira Dimock's " Machine for Sorting Silk or Other Thread According to its Size,"[18] which cut to the heart of the problem, the variation in raw material. "The principal feature of my invention consists in certain means whereby a thread or threads of silk . . . is so directed on to a bobbin or other winding apparatus that it will be distributed or arranged upon different parts of said bobbin or apparatus according to its size or thickness," he explained. "My invention further consists in certain means of controlling the winding of the [sorted] thread or threads on a series of bobbins or spools .... so that all of one thickness will be wound upon one bobbin or spool, and all of another thickness on another."

From that time on, inventors applied their talents to sorting. "For these [sewing] machines it is very important that the thread should be of uniform size," *Scientific American* reported in 1862, "and great efforts have accordingly been made to accomplish this result . . . most of these efforts have been directed to the more careful assorting of the raw silk in parcels of uniform size; and several machines have been invented to facilitate the operation."[19]

And so the single-strand silk trebling machines passed from the scene and were quickly forgotten. Let us pause, belatedly, for a moment of respect. "Illustrations of the solidarity of the industries are perpetually recurring," noted the Centennial Exposition Judges of Group IX. "The American invention of the sewing-machine was the inauguration of the sewing-silk manufacture of America, in the forms and proportions which it now holds."

The Nonotuck Silk Company. The Nonotuck Silk Company -- Nonotuck was an Indian name for Northampton -- was incorporated in 1866, with Samuel Hill (president), Samuel Hinckley, and the Dimock brothers among the seven stockholders. Hill retired in 1876; Ira Dimock succeeded him and led the company for the next forty years.

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[17] Lucius Dimock, of Hebron, and Ira Dimock, of Mansfield, Patent 14,856, May 18, 1856
[18] Ira Dimock, Patent 21556, September 21, 1858
[19] "Improved Silk-Assorting Machine," *Scientific American*, Vol. 6 NS No. 5, Feb. 1, 1862, p. 65

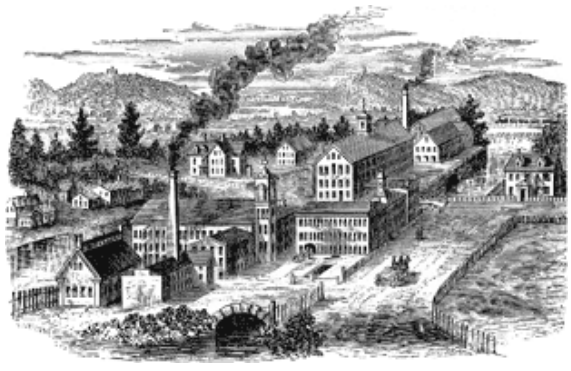

Figure 12 (left). The mills of the Nonotuck Silk Company, circa 1876. (Brockett, *Silk Industry of America*)
Figure 13 (right). The company's first stockholders. (Sheffeld, *A History of Florence*)

Northampton's silk industry became, as the New-England Silk Growers had dreamed, an enterprise "large in its inception, comprehensive in its designs, widespread, far reaching, and beneficent in its results." In the second decade of the 20th century, high above Broadway and 42nd Street in New York, an electric kitten tumbled amid spools of thread that did not knot; the Nonotuck Silk Company's kitten logo and homonymic slogan were recognized marks of quality. In a merger, the company adopted its own brand name, Corticelli. But after two decades of tumbling, the kitten finally failed to land on its feet. Another merger, rayon, changing fashion, labor unrest, and the Great Depression closed the Northampton area mills in 1932.

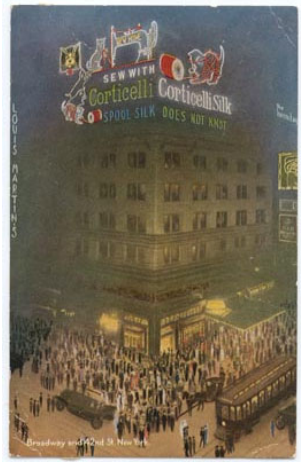

Figure 14 (left). Nonotuck Silk Company postcard showing the company's electric sign at 42nd St. and Broadway, New York. Circa 1912.
Figure 15 (right). The Nonotuck Silk Company's Florence headquarters in 2002.

Acknowledgment: I am very grateful to Barbara Janssen, of the National Museum of American History, for her encouragement, for valuable information, and for allowing me to photograph patent models in the NMAH Maryland storage facility.