J.R. Brown & Sharpe
Watch Clock Provenance & Company History

- Compiled by Phil Williams in 2012-

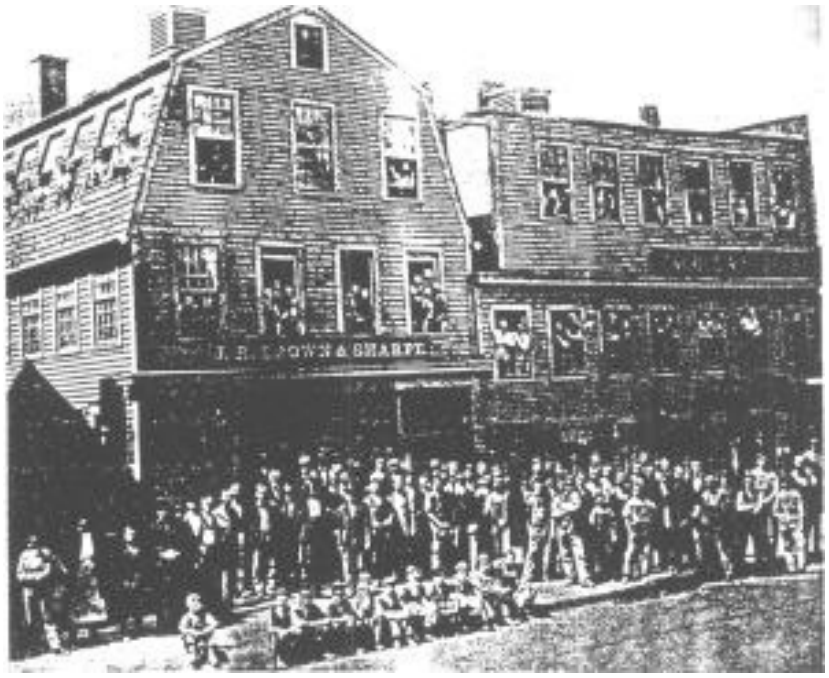

Figure 1. The Brown & Sharpe factory at 115 South Main Street in the 1860's. (David A. Hounshell, "From the American System to Mass Production, 1800-1932", p. 79, Johns Hopkins University Press, 1984)

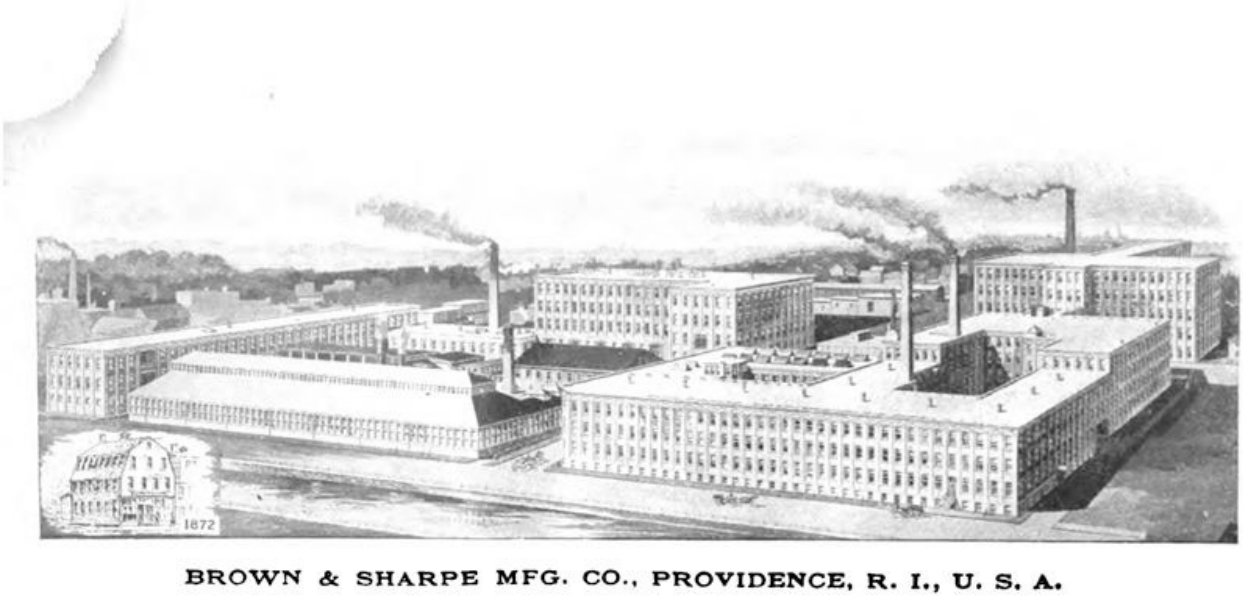

Figure 2. The Brown & Sharpe factory on Promenade Street as shown in the 1904 catalog. Inset is the 115 South Main Street Factory from which the company moved in 1872. Note that the 1904 catalog does not include any clocks.

DARLING, BROWN & SHARPE,

115 South Main St., Providence, R. I.,

MANUFACTURERS OF

U. S. Standard Rules,

PATENT HARDENED CAST-STEEL

TRY SQUARES,

The American Standard Wire Gauge,

And a variety of Tools for accurate measurements.

J. R. BROWN & SHARPE,

115 South Main Street, Providence, R. I.,

MANUFACTURERS OF

SEWING MACHINES,

Revolving Head-Screw Machines, Universal Milling Machines, Tapping Machines,

PATENT CUTTERS FOR GEAR,

Watch Clocks, Yarn Assorters and Reels.

Gears cut, and Index Plates made and drilled to order.

Figure 3. Advertisement from page 163 of the "Gazetteer of the Manufactures and Manufacturing Towns of the United States", 1866. Note mention of "Watch Clocks".

I purchased 2 Brown & Sharpe Watch Clocks from an antique dealer in Lincoln, RI in June 2012. Both clocks did not have the pin-setting mechanism present in the top of the works when I purchased them. Either the mechanism was never placed into the works, or was more likely removed at some point during maintenance on the works. The written desription that accompanied the clocks is as follows:

"If you are a collector or dealer in antique clocks then you probably already know that the Brown & Sharpe Manufacturing Company, which was known for Precision Tools, once made Clocks. They are very rare and most of their Clocks had to do with factories or businesses, and were not "Home Models." Over the last year, I was consigned and have sold six rare examples of Brown & Sharpe, Pin Set, Watchman's Clocks. Tonight, I am listing the last two Joseph R. Brown designed Watchman's Clocks from this rare collection.

In the bottom if one of these very rare Brown & Sharp Watchmen Clocks which reads, **"**This is one of eight early American clocks (Six of them made by Joseph R. Brown) Collected by Henry D. Sharpe and presented to the Brown & Sharpe Manufacturing Company by Mary Elizabeth Sharpe January, 1956"".

Figure 4. The Brown & Sharpe Clocks as purchsed in June 2012 with the older clock on the left.

Figure 5. A note in the bottom of the clock pictured on the left above.

The person from whom I purchased the clocks indicated that he was told that at one time these clocks were used to keep time in the B&S factory in Providence, RI. It appears that Henry D. Sharpe had collected 8 B&S clocks, perhaps facilitated by the factory installing electric clocks. In 1956 (2 years after his death) they were given to the company by his widow (Mary Elizabeth).

According to Wikipedia, in 1964 the company moved from its Providence factory to a new facility in North Kingstown, RI:

"In the aftermath of the changes that swept the company, it came to outgrow its central plant just west of Downtown Providence. In 1964, Brown & Sharpe followed other Providence-based manufacturers out of the city, moving instead to suburban North Kingstown, Rhode Island. These relocations were made possible by the explosion of automobile ownership in the postwar era, which contributed to the rapid growth of Providence's suburbs throughout the 1950s. Given that the company's workers had become more mobile and that the majority of them now lived in these suburban areas, Brown & Sharpe saw an easy opportunity to relocate into a more practical facility. The new plant, christened Precision Park as a nod to Brown & Sharpe's history of pioneering manufacture of precise measurement tools, contained 700,000 square feet (65,000 m^2) of easily-adaptable floor space. Unlike the old Providence facility, Precision Park had just one story, which allowed for the efficient horizontal movement of materials and improved upon the clumsy vertical circulation system employed in its old plant."

The seller of the clocks indicated that he was told that the North Kingstown facility maintained a B&S museum where various items made during the history of the company were displayed. This information is consistant with a reference to "historical exhibits" being in the posession of the Brown & Sharpe company made in 1949 by Henry D. Sharpe ("*Joseph R. Brown, Mechanic, and the Beginnings of Brown & Sharpe", Henry Dexter Sharpe, Newcomen Publications, Princeton University Press, 1949*, *page 19)*. The Henry D. Sharpe clock collection was one of the displays after it was given to B&S by Mary Elizabeth Sharpe in 1956. About the mid -1990's, when the company was in some turmoil, some of the historical artifacts (including the 8 clocks) were put into storage. This may have occurred shortly before or after Henry D. Sharpe Jr. resigned as chairman in 1996. The assets of B&S were then sold in 2000 to Hexagon A.B. based in Stockholm, Sweden. After Hexagon assumed control the company was refocused entirely on precision metrology equipment. Having no connection with the history of B&S, Hexagon sold surplus assets that were in the North Kingstown, RI factory. At that time all 8 clocks were purchased by a local individual who recognized their value. The clocks continued to be stored until they were consigned to be sold by the antique dealer in Lincoln, RI in 2011. I bought & restored 2 of the clocks in 2012.

The 2 clocks have the same style of weights, works, and pendulum but appear to be made at different times. One clock appears to be older than the other. The older clock has club-style hands common in the 1850's & 1860's, a top crown, and some damage to the lower left side of the case where it appears someone put a hot lamp or candle too close to the wood case. Impressed in the case by the damage is a

word in script writing that begins with the letter “L” and may be a name accompanied by the date May 19, 1870. This date may be when the clock was made, or based on the proximity to the damage is more likely the name & date of who & when is associated with the damage. The door of the older clock is a simple shaker-style with mitered corners. The bottom of the clock case is attached using hand-cut dovetail joints. According to the 1868 B&S catalog the Watch Clocks were constructed from black walnut, and the older clock appears to be made from this wood. If the clock was built on or prior to May 1870 it would have been constructed when B&S was based at 15 South Main Street, Providence RI.

In part based on the note inside the clock, I would consider the older clock to have been made circa 1860 and certainly from the late 1850’s to the 1860’s. It is tempting to consider that the clock may have been made as early as 1855 since (1) in 1855 J.R. Brown invented a gear cuter that could be used to make gears for clock works among other types of gears, (2) the company history referenced earlier indicates that in 1857 B&S had “2 men on watch clocks”, and (3) in 1853 B&S installed a tower clock in the Rhode Island State House in Newport (*Scientific American,* p. 176, volume 10, issue 22, February 10, 1855) indicating B&S was capable of clock design & manufacturing in the mid 1850’s.

The newer clock has blued steel spade type hands more common in the latter part of the 19th century, no top crown, and an original glass lower panel in the door surrounded by applied molding. I have not seen many of these types of clocks, but this is the only one I have seen with glass in the lower door panel. What appears most common in B&S Watchman’s clocks is a wood panel door with applied molding. The bottom of the clock is attached using Knapp joints. The case appears to be made from cherry or perhaps mahogany. If the clock was built after 1872, which is practically a certainty considering the Knapp joints, then it would have been constructed at a factory on Promenade Street in Providence RI. Since the 1887 B&S catalog does not show Watch clocks, I would consider this clock to have been made circa 1880 (i.e. 1872-1886).

The shaker-style door and dovetail-jointed bottom of the older clock may indicate that it is an early version of the B&S Watchman’s clock (as stated in the hand-written note inside the case). The glass panel in the newer clock may indicate it was a “special order”. The blued-steel spade hands in the newer clock could be original, possibly part of the “special order”, but may also be old replacements. If the hands are old replacements they would likely have been fabricated at the B&S factory.

The clocks were not in working odrder when I received them. In addition, they were lacking the original keys for the locks in the doors. The finish on both clocks appeared to be original but dry. The original finish was retained and the cases hand rubbed with Howard “Feed-N-Wax”. In September 2012 the clock works were

cleaned, rebushed as needed, and lubricated. New weight cords and new suspension springs were installed in both clocks, and new keys were fabricated for the doors. The restoration of the clock works and key fabrication was completed by Paul Grandinetti (NAWCC 149230) at his shop "The Village Timekeeper" in Glen Rock, NJ.

Noteworthy is the difference in the wood joinery used to attach the bottom of the clock cases. Below follows a discussion about the Knapp joint used in the newer clock and the dovetail joint used in the older clock:

Dating Antiques? Check the Joinery
By Fred Taylor (10/02/08)

Editor's Note: The age and period of antiques can often be determined by the simplest details. Fred Taylor examines drawer joinery and Mr. Knapp's ingenious invention.

One of the first things to be looked at when trying to determine the age of a piece of older or antique furniture is the type of joinery used in its construction. Knowing the history of the technology of various periods goes a long way toward explaining clues about the age of furniture, and none is more important (or accessible) than the joint used to secure a drawer.

Mostly what we see are dovetails of a sort. The interlocking dovetail joint came into general use in the William and Mary period in the late 1600s and very early 1700s, and for the first time, allowed the construction of reliable drawers, a device with extremely limited use or convenience until then. Before this innovation, most furniture consisted of simple boxes called coffers or some type of open-shelving arrangement and cabinets with shelves behind doors, such as the old court cupboard.

As useful as the dovetail joint started out to be, it did have a serious drawback—it was hard to make by hand, and of course, everything of that period was made by hand. By the end of the 18th century, some progress had been made in furniture technology. Rotary saws were on the horizon, and all nails were no longer made one at a time by a blacksmith. The early 1800s saw lots of advancement in woodworking machinery, and by the Civil War, mechanized furniture factories were on line, but the dovetail drawer joint was still a holdup.

While the joint had been refined and perfected, it was still too difficult to be made by a machine. Some progress had been made by the use of jigs to help guide the hand-powered saws in their cutting, but essentially, the dovetail was the last holdout of handwork in a machine era.

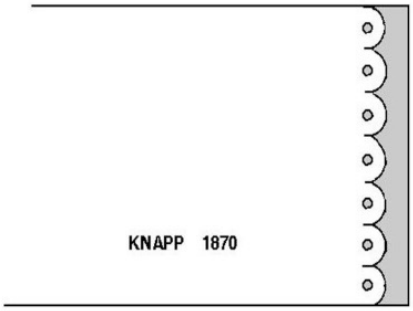

Illustration: The perfect Knapp joint looks like this, an obviously machine-made feature that looks nothing like drawer joinery before or since.

Several inventors were hard at work on the problem in the 1860s, and most concentrated on trying to duplicate the handmade dovetail using a machine—that is until Mr. Charles B. Knapp of Waterloo, Wis., applied himself to the task. He did some creative thinking and

Other B&S Watch Clock Examples

Figure 6. Another one of the eight Henry D. Sharpe B&S clocks sold by the Lincoln RI antique dealer in 2011 / 2012. The case hase been refinished, and the dial is paper rather than paint (possibly a replacement dial). This door style (wood lower panel with applied molding) appears to be most common for this type of clock.

Example of a B&S Watchman's Clock From Grant MacLaren:

My father, Thomas F. MacLaren, worked for Brown & Sharpe for his entire professional life. He began as an apprentice shortly after coming to the U.S. as a farm boy from Merigomish, Nova Scotia. When he retired, he was General Sales Manager, having opened the B&S branch in California, managed the Chicago office and then returned to the home office in Rhode Island.

Just before, and soon after retiring, he acquired two B&S "Watch Clocks." These clocks are described in a B&S catalog dated March 1, 1877:

"The **Watch Clock** is to be used in Banks, Manufactories, Railroad Station Buildings, Lumber yards, and other places, where a watchman is employed, and serves to show whether he is attentive to his duty.

"The clock has a time dial, independent of the pin circle, which may be used as a standard timepiece for the whole establishment.

"From the pulls at the top of the clock, wires are lead off to the different rooms in the building where the watchman is required to visit. Every half hour the wires in *all* these rooms are required to be pulled in order to draw back the pin, which, by the motion of the pin circle about the dial, presents itself at that time directly over XII."

Some prices shown are:

- One clock for one room: $50
- One clock for five rooms: $54
- Wires and fixtures: $1.50 for each room

Figure 7. Mr. McLaren with his B&S Watch Clock, plus front & back of works on seatboard

Brown & Sharpe Company Timeline

- **1833** Partnership is formed between David Brown and his son Joseph. Firm is called David Brown & Son, located at 60 South Main St. in Providence; making and repairing clocks and watches.
- **1848** Lucian Sharpe begins his apprenticeship with Joseph R. Brown
- **1853** Joseph takes on Lucian as a partner. Firm is renamed J. R. Brown & Sharpe. Tower clock manufacured and installed in the Rhode Island State House in Newport.
- **1855** The company begins producing the vernier caliper
- **1861** Introduction of the Universal Milling Machine which is the first machine to cut twist drills; is also used in the making of rifle barrels for the Union Army during the civil war.
- **1868** The business is incorporated as Brown & Sharpe Mfg. Co. having 14 employees.
- **1872** Company relocates to Promenade Street in Providence.
- **1875** First Universal Grinding Machine is produced.
- **1876** Joseph R. Brown dies
- **1898** Company grows to 1,500 employees as it increasingly specializes in the machine tool industry.
- **1899** Lucian Sharpe dies, replaced by Henry D. Sharpe, who resists expanding beyond its machine tool origins.
- **1932** Machine orders fall during the great depression; work force shrinks to 1,300.
- **1941** The International Association of Machinists and others organize workers. Strikes occur in 1942, 1943 and 1944.
- **1943** Employment tops 11,000 workers.
- **1951** A 13 week strike shuts down the company.
- **1956** Company expands internationally, opening a plant in England. Other European plants are acquired in the coming years.
- **1964** Company moves to a new building on Frenchtown Road in North Kingstown.
- **1970** Machine Tool orders are down 58 percent, company lays off 700 employees.
- **1975** Engineers stage 7-week strike.
- **1980** Company reports profits of $14.5 million on sales of $227.5 million, with 4,400 workers in Rhode Island, Michigan and North Carolina as well as four foreign countries.
- **1981** Machinists stage one of the longest strikes in American History.
- **1991** Company stops making its signature machinery, citing years of losses from foreign competitors; lays off 270 workers.
- **1996** Henry D. Sharpe resigns as chairman.
- **1997** Company lays off about 140 workers in its European plants.
- **1998** Thermo Electron's off to buy Brown & Sharpe for $15.50 a share is rejected.
- **1999** Company lays off 230 workers at four plants in the United Kingdom.
- **March 2000** Financial losses mount; Frank T. Curtin is replaced as chairman, president and CEO by Kenneth N. Kermes.
- **April 2000** Company reports losses of $42.9 million on sales of $322 million. It has 2,400 employees, including 450 in Rhode Island.
- **July 2000** Unable to resolve its problems with creditors, company considers putting itself up for sale or merger.
- **November 2000** Company announces sale of main business to Hexagon A.B. of Stockholm, Sweden.

According to the note in the older clock of the 2 that I purchased, it may have been made by Joseph R. Brown. His bio from the American Precision Museum in Windsor, VT:

Joseph R. Brown (1810-1876)

After an apprenticeship in Pawtucket (RI), Brown began to produce small tools in Providence, and was briefly involved in a partnership with his father to produce and repair clocks and watches. When his father went west, Brown stayed behind and continued the shop alone, eventually taking on a local boy, Lucian Sharpe, as an apprentice.

Brown developed an automatic linear dividing machine and was able to develop and produce a small caliper that depended on main and vernier scales cut on the dividing machine. His reputation for accuracy brought a contract to build the Willcox & Gibbs sewing machines. That in turn required machine tools. He improved the turret screw machine of Frederick Howe, then he transformed the bed-type milling machines of the gun makers with a knee and column to produce the universal milling machine, making it a true tool-room machine. This was followed by a formed milling cutter for gear teeth which could be sharpened by simply grinding away the face of each cutter tooth. Finally came the universal grinding machine, completed in 1876 and, like the universal milling machine, the start of a long line of machine tools.

Joseph Rogers Brown biography as provided by the American Society of Mechanical Engineers:

(1810-1876), U.S. and mechanical engineer known for his precision tools and instrumentation, established his own shop in 1831 and began to make small tools, especially for lathes. He soon rejoined his father?s shop as partner in Providence to manufacture watches, clocks, and surveying and mechanical instruments. After his father retired in 1841, he carried on business alone and created many notable machines. In 1850 he built a linear dividing machine, the first automatic machine for graduating rules in the United States. A year later, he produced the varnier caliper, reading to thousandths of an inch, and in 1852 applied it to protractors. In 1853 he

became partners with Lucian Sharpe (J. R. Brown & Sharpe). In 1855, Brown invented a precision gear cutter that would produce accurate gears, frill index plates and do circular graduating. By 1861 he began devoting his time to developing machine tools. Among many inventions, he designed and built a turret screw machine for muskets (1861), a successful universal milling machine (patented 1865), and a micrometer caliper (1867). His greatest achievement was the universal grinding machines, which allowed manufacturers to first harden articles and then to grind them with accuracy (patented posthumously, 1877). He was born Jan. 26, 1810, Warren, Rhode Island, and died July 23, 1876, Shoals, New Hampshire.

Lucian Sharpe bio from the American Precision Museum in Windsor, VT:

Lucian Sharpe (1830-1899)

Born in Providence, Rhode Island, Sharpe signed on to a 5 year apprenticeship in 1848 under Joseph R. Brown, to learn to be a watchmaker. His father paid a fee of $50 a year plus $2.50 a week for board. Sharpe made his own set of watchmaker's tools and built his watchmaker's lathe. In addition to mechanical skills, he soon demonstrated administrative ability. He wrote business letters for Brown, some in French. When the apprenticeship was completed, he was made a partner in J. R. Brown & Sharpe. Disturbed by the confusion of gages for measuring the thickness of wire and sheet metal, Sharpe led the development of what became the standard American Wire Gage. He also developed the Brown & Sharpe apprentice program that became the model for such programs. Woodbury has written that "it was Brown who was the mechanical genius and Sharpe who was the outstanding businessman, but one who thoroughly understood, appreciated, and encouraged the work Brown was doing."

Regarding Mary Elizabeth Sharpe, according to a bio from the Brown University library:

“Mary Elizabeth Sharpe (1884-1985) was a successful businesswoman (owner of a successful tea shop and candy room in New York City) when she married her husband Henry Sharpe in 1920. Mrs. Sharpe was a philanthropist with many interests but was best known for her efforts to beautify Brown University and the city of Providence, RI. A

self-taught landscape architect, Sharpe established an annual tree fund and lead the fundraising efforts to create India Point Park, a Providence waterfront recreation area.”

The Brown University Library Portrait Collection has the following information:

SHARPE, MARY ELIZABETH (1885-1985)

Role:
Dates:
Portrait Location: Rochambeau 104
Artist: Mather, Eleanor George ()
Portrait Date: ca. 1967
Medium: pastel chalk on paper
Dimensions: 19
Framed Dimensions:
Brown Portrait Number: 245
Brown Historical Property Number: 1118

Mary Elizabeth Sharpe was born October 23, 1885 in Syracuse, New York to William E. G. Evans and Fanny Elizabeth (Riegel) Evans. Her father died when she was young, and to support the family her mother and three sisters began a candy-making business. Eventually the chocolate and candy store did well, and Mary Elizabeth moved to New York to manage her own company "Mary Elizabeth Ltd of New York." She opened tea rooms in Boston and Newport as well. At the onset of World War I she joined up with the U.S. Food Administration and later traveled to Paris with the Red Cross to oversee the U.S. Central Diet kitchen. During the war she also published two books, one divulging her candy and chocolate?making techniques and the other detailing a collection of wartime recipes. The recipe book was reprinted during World War II to help home-makers with domestic food rationing.

After WWI Mary Elizabeth returned to her life as a successful businesswoman. At this time she was courted by Henry Dexter Sharpe, whom she had met on a horseback-riding trip out west prior to the war. They were married in 1920 and moved to Providence, the site of Brown & Sharpe, Henry Sharpe's family manufacturing business. Moving from the confines of New York City to the relatively open environment of Providence allowed Mary Elizabeth to pursue her love of gardening. She closed her own business in the mid-30's and busied herself in the cultural goings-on of Providence. She was the first to bring the Community Concert Series to

Providence and was active on many arts councils and boards. Reflecting her interest in French culture, she and Henry built a French-style house at 84 Prospect Street which they named Rochambeau House. This building is now home to Brown University's Romance Language departments. Highly active in the Garden Club of America, Mary Elizabeth served in a volunteer capacity as the University landscaper during the 1940's at the request of President Henry Wriston. In 1950 Sharpe Refectory in Wriston Quad was named in honor of Mary Elizabeth and Chancellor Henry D. Sharpe.

In addition to beautifying the campus with elms, evergreens, and flowering trees, she was influential in many parks projects around the city. In 1970 she pledged $153,000 to reclaim the dilapidated waterfront area at India Point in Providence and convinced the mayor to match her funds for the project. India Point Park was dedicated in 1974. Along with her cultural good works she was also active politically. She was a delegate to the Republican National Convention in 1928 and 1936 and was a Republican Elector in 1932. She received an honorary degree from Bryant College in 1966 and an honorary AM from Brown University in 1950. She had one son, Henry Dexter Sharpe, Jr., who still resides in Providence and oversees his family's company, Brown & Sharpe. Mary Elizabeth Sharpe died April 4, 1985 at the age of 100.

Artist Eleanor George Mather lives in London and was the daughter of Robert H. George, Professor Emeritus of Art History at Brown. In 1967 Mary Elizabeth Sharpe commissioned Mather to paint the portrait of Pembroke Dean Rosemary Pierrel to commemorate the 75th anniversary of the founding of Pembroke College. It is thought that Mather made this portrait of Mrs. Sharpe at about the same time.

Regarding Henry D. Sharpe (the former owner of the clocks), according to a bio from the American Precision Museum in Windsor, VT:

Henry D. Sharpe (1872-1954)

A son of Lucian Sharpe, (who, though a trained machinist, was the commercial half of the partnership with Brown) took on the same role in Brown & Sharpe after his father's death in 1899. He expanded the famed apprentice program, tolerated neither alcohol nor tobacco, constantly policed the product quality, wasted no money on fancy offices but maintained a factory that was considered to be one of the finest in America.

Regarding Henry D. Sharpe Jr., according to Wikipedia

“Shortly after the Second World War, Henry D. Sharpe, Jr. succeeded his father as president of Brown & Sharpe Manufacturing Company, at which point it evolved into a new and modern company built, or at least designed, to last. The firm stopped producing its old stalwarts: sewing machines, hair clippers, and outmoded machine tools. Instead the company refocused on the mass production of automatic screw machines as it completed a three-year, $4 million refitting program for its Providence plant in 1957. In keeping with the latest management theories, Sharpe also reorganized the company into separate divisions, with each one responsible for its own profit and loss. During this era, Brown & Sharpe began to experiment with international expansion and the company established its first overseas subsidiary in Plymouth, England, in 1955. Between 1957 and 1961 the company further expanded through the acquisition of related manufacturers, most notably the machine-producing Double A Products Company.”

An interesting company history as provided by Rose Antique Tools on their website. It is essentially the text from "Joseph R. Brown, Mechanic, and the Beginnings of Brown & Sharpe", Henry Dexter Sharpe, Newcomen Publications, Princeton University Press, 1949. This text was apparently available on the B&S website at one time, but was not found there as of 2012. References to clocks are highlighted. The text indicates the company was making Watch Clocks as early as the late 1850's.

A Measure of Perfection

David Brown, born in Warren, Rhode Island, carried on a store for the disposal of clocks and watches, together with silverware, and as times became very poor he took "to the road" as a peddler to dispose of his stock through New England villages. As time went on, he established himself in Pawtucket, in the making of clocks of various sorts, in which occupation, for a time, his son joined him. **Joseph R. Brown**, the son, learned his machinery trade in the shops of Walcott & Harris in Pawtucket. On attaining his majority in 1831, we find Joseph setting up a little shop of his own for the manufacture of small tools for machinists and for the building of lathes. Mutual interest proved such, however, that father and son soon combined their activities, starting a partnership in 1833, located at 60 South Main Street in Providence, under the firm name of David Brown & Son, for the making and repairing of clocks and watches and doing other light mechanical work of precision.

This work was carried forward upon a modest scale, as indicated by the fact that their shop was without power or a forge. David Brown had such a high reputation in the city for making and repairing clocks that without doubt he had ample patronage. As was his son, David was a pronounced character. He was known as a skeptic, which presumably means he was not affiliated with any religious body. As an explanation of his willingness to repair the clock of the Old Baptist Meeting House he is reported to have replied: "One has always to give the devil his due." Many church clocks in New England were made by him and his son. A number have endured to the present. Among his clocks, is a treasured one in the Brown & Sharpe Works, having a compensating mercury-filled pendulum. It still is an excellent timepiece, after a hundred years of continuous service.

This embryo industry was the nucleus from which has evolved the business of the Brown & Sharpe Mfg. Co., making the Year 1833 notable. The mechanical business of the New England territory, in 1833, principally was concerned with making cotton machinery. The evolution growing out of the manufacture of clocks and instruments of one kind or another was in itself of importance.

Though both of the Browns had shared in the impress of the cotton machinery industry, their interest in mechanical things largely was centered in articles calling for greater precision.

It would seem that from the beginning of his business life Joseph R. Brown was a forward-looking, self-respecting man. Like many a new enterprise, the young firm suffered a serious loss through a fire which occurred in 1837; and, as frequently happens, the loss was but slightly covered by insurance. Nevertheless, the partners were not discouraged, and they went into temporary quarters while the building was being re-erected. Two years later, additional space was secured in a neighboring building. The partnership, however, was terminated a few years later, following the advent of the "Dorr War." David went West in disgust, and settled in Illinois; while the son continued his retail and jobbing business.

In 1848, the business was removed to 115 South Main Street in Providence; and two years later, in 1850, we find Mr. Brown starting out along new lines. His pioneer work was directed towards raising the standard of accuracy in machine shop operations, because in that year,

he built an **Automatic Linear Dividing Engine**, so fundamentally correct in its design and of such careful workmanship that today, after 100 years of continuous service, it, and other machines of like design built during the following years, have not been superseded for their particular class of work.

To build these machines for *graduating* rules of steel led not only to the manufacture of high-grade steel, ivory, and boxwood rules in great varieties with standard and special graduations, but also to the development and marketing of the **Pocket Vernier Caliper**, of which it has been said: "It was the first practical tool for exact measurement which could be sold in any country at a price within the reach of the ordinary machinist, and its importance in the attainment of accuracy for fine work can hardly be overestimated."

Mr. Brown says, regarding the graduating machine: "having been convinced by long experience that it is impractical to make a screw sufficiently accurate to be used in a dividing engine, I have constructed a machine on an entirely new principle which I am happy to say produces the most satisfactory results."

We see, in imagination, the picture of a little shop with its show-window filled with watches, clocks, scientific instruments, and mechanics' tools, carefully and neatly arranged by **Lucian Sharpe**, the apprentice, who had commenced work for Mr. Brown on September 12, 1848. Mr. Brown's old job book, of the period, entering jobs for oiling and repairing clocks and watches, has sandwiched in between such items the momentous entry: "Lucian Sharpe came to work for me this day as apprentice."

Lucian's apprenticeship was of the old type of indenture, payments for services of $50.00 per year being made by his father, Wilkes Sharpe; there being in addition an allowance of $2.50 per week for board, except for such times as he boarded in Mr. Brown's home.

As a youth at school he acquired habits of promptness, industry, and integrity; and he had a fondness for reading, a retentive memory, and unusual bodily vigor. From his beginning with Mr. Brown, he showed a commercial talent and administrative ability of high order and real promise.

As he completed a grammar school course and attended two years at Providence High School, he went to work for the Providence Machine Company, where a few months experience failed to enlist his enthusiasm. Through the counsel of his friend and mentor, Owen Mason, who was highly regarded in the city during those years, he applied for opportunity of apprenticeship with Mr. Brown. It is said that Mr. Mason said of Mr. Brown's shop that he had noticed "though the shop was small, it was always busy." From testimony of associates of these years the apprentice showed certain qualities which made him stand out from the other employees; he was the first at the shop in the morning, and when the workmen arrived he had opened the safe and arranged the show-window; swept out the shop, and had everything in readiness.

Early in his apprenticeship we find him writing letters for Mr. Brown, even writing the letters, when required, in good French, in corresponding with French agents in New York City through whom watch parts and books were imported. He is reported to have translated one or more French books into English for his own use and that of his shop mates.

As a part of the agreement of apprenticeship, Lucian Sharpe was privileged to provide himself with a set of tools such as were then used by watchmakers. A watchmaker's lathe made by him during these years of apprenticeship still exists. On March 1st, 1853, before the expiration of his contract with Mr. Brown, he was made a full partner in the enterprise newly created under the name of **J. R. Brown & Sharpe**. With no funds to undertake a financial participation, this was furnished, it is understood, by his old friend, Mr. Owen Mason, his mentor of years previous, notably in his coming as an apprentice with Mr. Brown himself.

This partnership proved an effective combination: Mr. Brown, with his mechanical ability, and Mr. Sharpe, as a business executive. Mr. Brown thoroughly disliked office and business duties, preferring to spend his whole day in mechanical problems which came to his notice; whereas Mr. Sharpe thoroughly enjoyed the business activities so important to a young enterprise. In spite of their varying abilities, perhaps because of them, these men had throughout life a warm personal regard and sincere respect each for the other. They were more than congenial in many ways, and each helped and influenced the other, through their mutual confidence. From the date of this partnership, the business prospered and expanded.

Under the name of J. R. Brown & Sharpe they first occupied a space of 60 x 30 feet, and employed 14 workmen.

We learn that at this time a cask of Stubs' wire, tools, etc. was imported by the firm from England, the customs charges of $600 straining its modest financial resources.

While in the early days Mr. Brown did a regular business in the repairing of watches, he made only two complete watches - one for his wife and one for himself. He did, however, make a regular line of watchman's clocks, the manufacture of which was continued long after the jobbing and repair business in timepieces was abandoned.

Meanwhile, they continued to make certain textile manufacturing appliances, the manufacture of some of which endured for many years, and one even to this day - the well known yarn reel.

An important step in developing the business after the formation of the partnership was the building of a **Precision Gear Cutting and Dividing Engine** by Mr. Brown, in 1855. An accurate method for making gears was being sought by him based upon the studies of Professor Willis, then in commanding attention. A machine for this purpose required accuracy in a dividing wheel, from which teeth could be produced on the wheel itself. On this dividing wheel provision was made for graduating on a copper ring set in the wheel, this being centered by original methods devised by Mr. Brown. The graduating itself was done in the City of Washington under his personal direction, at the Coast and Geodetic Survey, upon a machine whose master wheel came from the famous Troughton & Simms concern in London, then apparently the last word in such work. The machine was a notable achievement leading to the building of other similar machines and to an expanding business in gear cutting, circular graduating, and index drilling, thus giving an increasingly wider reputation for high grade work.

Another activity begun in the 'fifties was the production of accurate gages. The brass business of Connecticut, centered in the Naugatuck Valley, required sheet metal and wire gages for measuring their products. Mr. Sharpe, with his methodical mind, conceived the idea of producing sizes of wire in a regular progression, choosing a geometric series as best adapted to these needs. Such gages as were in use prior to this time were the product of English manufacture and were very irregular in their sizes.

Fifty of the new gages were made and taken by Mr. Sharpe to a meeting of the brass manufacturers, to show the uniformity possible to attain in a comparatively low-priced gage suited to such work. This led to its adoption as the American **Standard Wire Gage**, which has had such extensive use since that time.

The facilities afforded by the shop in these early days were very limited. One party, first employed by the company for a short time in 1856 and 1857, records that mechanical equipment consisted of three small engine lathes, two hand lathes, one small upright drill, one hand level planer (designed by Mr. Brown), and one donkey planer; the personnel being 4 men on watches and clocks, 3 machinists, 2 men on scales, squares and bevel protractors, 2 men on watch clocks, one graduating, and one boy, doubtless to run errands.

The castings used in the business were made at the New England Butt Company, a mile away, and were brought to the shop in a "green wheelbarrow" trundled by the boy. Among the novel productions at this time were gyroscopes and ring puzzles.

Their co-partnership, announced as of March 1, 1853, gives an adequate idea of the activities of the firm at that time:

"*The undersigned*, having entered into co-partnership, will continue the clock, watch and machine business at 115 South Main Street under the name of J. R. BROWN & SHARPE. An assortment of Clocks, Watches, Jewellers' Tools, Stubs Files, U.S. Standard Rules, Drawing instruments and materials, etc., etc., may always be found on hand.

The strictest attention will be paid to the manufacture of articles in their lines, and especially to the repairing of Clocks and Watches.

Joseph R. Brown Lucian Sharpe."

Mr. Brown, by taking a partner, was left free to do what he liked, to busy himself with mechanical concerns whether at the labor of designing or at the bench, or in experimenting with some novelty which had caught his fancy. Much testimony has accumulated as to his imaginative capacity, and his quick appreciation of new ideas which had been brought to him. In my earlier days I occasionally encountered men who remarked how they used to know Mr. Brown - who invariably related an incident how he had impressed them. Most apparently he was a real personality. Certainly he deeply impressed his shop associates.

From the first, Mr. Sharpe directed all so-called business matters. He ran the office, wrote and copied the letters, rendered the bills, and collected the accounts. He liked all such things.

The business from its start was deeply marked by the personalities of its two partners, which endured to the end of their lives. Incidents of early days are related showing the characteristics and impressions of the two partners, some of which can be related here. Activity on the part of both of them, however, did not of itself make money. New products were necessary.

In those early days - in 1851 to be precise - Mr. Brown writes to his father, absent in the West: "I have plenty of work but the profits are small, as my expenses are large. Life has not changed nor is there a prospect of it at present." Later he states: "Our rule finisher was taken sick day before yesterday" and, after explaining what and when deliveries can be made in the circumstances, says: "We are short of money at the present time. If you can send us some so we can use it next Saturday, it will accommodate us very much. We shall have to curtail our jobbing department in order to be in better condition to fill such orders."

Making purchases of clocks, watches, supplies, etc., in Boston and New York by correspondence, Mr. Sharpe suggested that their furnishers in turn become *agents* for their own tools. Always the repairing of clocks and watches, not to speak of the manufacture of clocks themselves, seems to be prominent in their activities.

Work in building ***tower clocks***, which first had been undertaken by his father, had been pushed by Joseph R. Brown, the oldest one of his make known to be in existence being in the Methodist Church at Warren, Rhode Island, installed in 1849, and since then known as The Town Clock.

This clock, after running 75 years, required some repairing which, because of its historic interest, the **Brown & Sharpe Mfg. Co.** offered to do without charge. When the works were brought to the factory for these repairs, much admiration was expressed as to the excellent

design and fine workmanship displayed. Even the weathering of three-quarters of a century had not obliterated the indications of this high-grade workmanship.

In 1853, a clock was built and installed by Mr. Brown in what is now the old abandoned State House at Newport. Much interesting correspondence has been preserved showing the care as to every detail which was taken in an installation of this kind. A contemporary article in the Old *Scientific American* (p. 176, volume 10, issue 22, February 10, 1855) described the mechanism of this clock under the title *Brown's Pendulum Detachment,* this invention having proved its value in intervening years:

"The clock has a two seconds pendulum with a length of 13 feet 5 inches. Concerning its performance a leading watchmaker of the time at Newport writes: 'its operation is most admirable; it having been running on meantime notwithstanding the changes of temperature'; and he concludes: 'I think it is the most perfect timepiece in New England.' Interesting as it may be, this State House clock at recurring periods has had the supervision of the company's best clock mechanics."

SEWING MACHINE MANUFACTURE

Important as these days may be as to activities of the new partnership, the advent of the sewing machine manufacture, that of **Willcox & Gibbs**, was probably the most important event in the history of the concern. It would seem that new sewing machine enterprises in the middle of the last Century were as frequent as were typewriters, bicycles, and automobiles in later decades. The manufacture of a sewing machine gave importance to any concern who had a contract. **Mr. James E. A. Gibbs**, the inventor of this new sewing machine, came from the back counties of the Commonwealth of Virginia. A descendant of old New England stock and possessed of a native mechanical curiosity, he had brought to his attention a printed illustration of the Howe Sewing Machine, lately invented. With his curiosity and ingenuity aroused, he proceeded to make a crude model of wood and wire, filing a piece of steel into a hook, until he succeeded in making it pick up the thread and *take* stitches. When he showed this as his solution of the way the Howe sewing machine worked, he was told that his was not like the Howe machine because that required two threads while his machine operated with *one* thread only. Thus was invented the single thread sewing machine.

Soon a connection was made with **Mr. James Willcox**, a hardware merchant of Philadelphia, when possibilities of the machine were appreciated. Through him, the young concern of J. R. Brown & Sharpe, which had already achieved a reputation for accuracy and high-grade workmanship, made arrangements for manufacture. This connection, as already stated, was a great event in the history of the enterprise. The association has been continuously maintained since 1858. The contract originally concerning the making of household machines has been followed by a long line of manufacturing machines going to all parts of the World.

It was most important indeed, in that it led to the originating and introduction of manufacturing methods, the use of jigs and fixtures, for producing interchangeable work, and the designing of machine tools primarily in order that the sewing machines could be better and more economically manufactured.

Floor after floor of the original building was occupied with the increasing work. Outgrowing the quarters of this building, additional space in adjoining buildings and in other parts of the city had to be secured. During the intervening years, thousands of sewing machines, not only household machines but many intricate sewing machines for special purposes, were built by B. & S. for the Willcox & Gibbs Sewing Machine Company.

Machine Tools

The manufacture of sewing machines in large quantities, begun in 1858, introduced many new problems, and resulted in the invention and perfection of important lines of machinery to be used in connection with this work. Once invented and offered for sale, the new products in a short period overshadowed those of the sewing machines and small tools.

The first *machine tool* built by B. & S. was a **Turret Screw Machine**, the need for which was stimulated by the manufacture of sewing machines, which require screw machine products, and stimulated also by the needs of the Civil War, then well under way.

Frederick W. Howe, Superintendent of the Providence Tool Company, then engaged in the manufacture of fire arms for the Northern Armies, had been closely associated with the making of Turret Screw Machines at the Robbins & Lawrence Company of Windsor, Vermont, in the mechanical development of whose products he had been an important factor.

Mr. Howe became closely acquainted with Joseph R. Brown because of their mutual mechanical interests, and it is evident that they often compared notes as to mechanical matters. It was through the influence of Mr. Howe that the manufacture of this screw machine was undertaken, the castings being obtained from the patterns then in the possession of the Robbins & Lawrence company itself.

Mr. Brown added-important features to the then-established design by providing ingenious revolving means for the turret, automatic feeding devices for the stock and reversible tap and die holders, patents for which two latter features were taken out by him.

In the Autumn of 1861, the Providence Tool Company had a contract for manufacturing large quantities of muskets, requiring many drilling operations. Twist Drills in those days were made by the slow and tedious process of filing the grooves; and Mr. Howe, with his active mechanical mind, studied for a quicker and better method of producing these drills. We find him consulting Joseph R. Brown, informing him, no doubt, of types of milling machines with the design of which Howe had previously been identified, and which had been designed for Robbins & Lawrence and for the Newark Machine Company, such machines having many universal features. Mr. Brown, realizing the need of a machine for cutting spirals in his own work and from his experience in the use of gearing and other products having this need, conceived the idea of building a machine suited not only to the particular work of grooving twist drills, but general utility in machine shops. The result of his study was the invention of the modern **Universal Milling Machine**, shown in his drawing of October 1861, a drawing with his autograph signature upon it. This machine has the vital features of the modern Universal Milling Machine, and is the prototype from which knee and column milling machines, both plain and universal, have since been evolved.

The Patent Office record of this machine is handwritten on vellum and the drawings are hand made tracings, illustrating the old time methods. The patent is fundamental in the character of its claims, being so basic that as far as known it was respected by other manufacturers and no attempt was made to evade or infringe it, during the time it remained in force.

Each of the three claims relates to a separate feature of invention: *The first* to a machine with a revolving cutter spindle, having a knee and cross slide, and with a swiveling plate carrying a sliding table; *the second,* to the connection between the sliding table and a spindle for cutting spirals; and *the third,* to a swinging block as a part of the spiral head, allowing for the indexing of work when held at an angle. The specifications are clear and detailed as to the uses and possibilities of the machine.

A most important invention of Mr. Brown's, of about the same time as the Universal Milling Machine, was that of the **Formed Cutter**, which can be sharpened on its face without

changing its cutting form. This materially widened the field of milling and stimulated the sales of the Universal Milling Machine.

The first Universal Milling Machine built was purchased by Mr. Howe for the Providence Tool Company, and was placed in use in that shop on March 14, 1862. During the years, it had a varying ownership; returning at length to the possession of the Brown & Sharpe Company, where it holds a place of honor among our historical exhibits. In 1862, there were delivered ten of this new machine, and, in the remaining years of the Civil War, seventeen were turned out. Through 1870, twenty were sold to twelve foreign nations, this following a showing at the **Paris Exposition of 1867**.

While it is probable that there has been no *machine tool* originated in the past Century which has done more than the column and knee type Milling Machine, to make possible the tremendous advance in modern lines of manufacture of which the automobile and airplane are examples, yet a close second to this is the Grinding Machine, suited to fabricate accurate cylindrical work. In this, Mr. Brown was distinctly a pioneer designer - first, in developing grinding attachments to lathes suited to grinding the needle bars of sewing machines, and similar work, - then in improving and standardizing this design to a point where such machines were ready to be utilized by a growing clientele. This development occurred between 1865 and 1875.

During the latter part of the period mentioned, study was given to and drawings made for a completely organized **Universal Grinding Machine**, taking tangible form in metal in 1875; it was one of the new tools exhibited at the Centennial Exposition in 1876.

Mr. Henry M. Leland, then in the employ of the company and later at the forefront of the development in automobile manufacture at Detroit, says of the grinding machine:

"What I consider Mr. Brown's greatest achievement was the Universal Grinding Machine. In developing and designing this machine he stepped out on entirely new ground and developed a machine which has enabled us to harden our work first and then grind it with the utmost accuracy, at the same time protecting the ways, - the surface on which the platen travels, - from emery and grit; also the improvement of revolving the work from dead centers thus eliminating the error of live spindles and live centers. If all these machines should suddenly be taken away it is hard to imagine which the results would be. It would be impossible to make any more hardened work for the best parts of our machinery and tools, that would be round, true and accurate in every detail to the closest possible limits. This in my judgment is one of the most remarkable inventions and too much cannot be said in its praise, or in acknowledgment of Mr. Brown's perseverance, wonderful initiative and genius.

"The mechanical engineers are now searching the records for men who have made themselves prominent in the industrial world as inventors and manufacturers, for a list of men to have honorable mention and to have their achievements and ability so recorded that the modern world may bestow upon them the credit and gratitude which they so richly deserve. Among these names I know of none who deserves a higher place or who has done so much for the modern high standards of American manufacture of interchangeable parts for such machines as have been mentioned above and the long list of others which might be mentioned, as Joseph R. Brown."

During these years of development of Milling and Grinding Machines, Mr. Brown was extremely active in the study and development of means of cutting gears, using both the Involute and Epicycloidal gears as developed by Professor Willis. This activity, aided by the invention of the patented Formed Cutter, greatly added to the reputation of the company, later being expanded by the manufacture of the **Automatic Gear Cutting machine.**

The period of expansion here related, due to the taking up of sewing machine manufacture and the building of machine tools, also stimulated activity in connection with measuring

tools and other tools for machinists' use, in some lines of which we already have seen Brown & Sharpe were pioneers.

Competition along such lines became keen through the setting up of a rival manufacture at Bangor, Maine, with **Samuel Darling** as its presiding genius. Mr. Darling, a farmer with a natural bent for mechanics, had this interest stimulated no doubt by growing up in a region of sawmills. Leaving the farm in 1846, we find him at work in a machine shop giving his whole attention to tools used by machinists, he having built a graduating machine somewhat later than Mr. Brown's. This machine, built along radically different lines from Mr. Brown's, was capable of producing scales of a high degree of accuracy.

As an illustration of the influence of environment, it is to be remembered that Mr. Darling not only used saw stock, such as he was familiar with at his saw mill, in making his scale and squares, but also used it quite freely for parts of his graduating machine.

As the years went on, competition between these two firms became very keen. Mr. Darling, with the firm of *Darling & Swartz,* developed his machines along the lines of high accuracy and his product as well. Competition became so keen that, in 1866, a truce was called, resulting in a joining of interests by the formation, in that year, of a partnership under the name **Darling, Brown & Sharpe**. Mr. Darling had kept his machines and processes very secret, a characteristic he exhibited throughout his life.

An incident is related as to Mr. Darling's habits of exactitude, when Mr. Brown was being shown some of the former's refinement of workmanship. Two straight edges held together against the light revealed a ray of light was to be seen, indicating that at least one of the straight edges was not correct. Mr. Darling however pointed out to Mr. Brown that he had handled the straight edges with bare hands, and that the warmth of them had affected their straightness. He produced a pair of woolen gloves, explaining that he always wore these in handling precision instruments so as not to affect their accuracy by a change of temperature caused by the warmth of the hands.

Mr. Darling, donning his gloves, then put a fine hair under one end and showed a tapering bar of light which did not disappear until within about 1/16 of an inch of the ends which were touching, thus illustrating the reason of the seeming inaccuracy.

In the Spring of 1866, Mr. Darling moved to Providence; bringing with him his entire equipment, together with a number of his experienced workmen. Their transportation was in a Maine schooner which was moored near to the proposed location of the newly received equipment, which was to be on Elm Street in Providence, adjoining the river, near to the present Narragansett Electric Company's plant. A later location was made for this manufacture, as the company moved to its new plant on Promenade Street, in 1872. It was always apart from other activities and was surrounded with considerable secrecy - characteristic of Mr. Darling.

Mr. Darling, like Messrs. Brown & Sharpe, was a stickler for the very highest attainable accuracy, never satisfied even with the degree of perfection which he obtained.

It previously has been pointed out that Mr. Brown did not make use of a lead screw for indexing his linear graduating machines, because of the difficulty in securing and maintaining a sufficiently perfect screw. Mr. Darling devised and patented a correcting device for making a screw which made it possible to continue to improve screw after screw by using each, in turn, as a master; finally to obtain practically accurate results. This method again could be applied to correct the inaccuracy of a screw, after long use.

Mr. Darling's conservative and secretive methods, so peculiar to him, made it possible for him to discourage an expansion of his end of the enterprise. So, in due time, other means were taken to by-pass his conservative influence. To accomplish a better development in

improved graduating machines, the talents of Mr. Oscar J. Beale were enlisted. This brought brilliant results to the company, because he was something of a genius in his work. The successful completion of Mr. Beale's work finally led to the buying out-of Mr. Darling's interest, in 1892; and, following Mr. Darling's death in 1896, the name, Darling, Brown & Sharpe was discontinued on January l, 1897, the entire business being thereafter conducted under the name of ***Brown & Sharpe Mfg. Co.***

The introduction of the micrometer caliper to the mechanical world came about by the visit of the two partners to the Paris Exposition in 1867. Attention there was called to the invention of a **Mr. Jean Laurent Palmer** who had patented a measuring tool in France, in 1848. This greatly interested both Mr. Brown and Mr. Sharpe. A combination of the Palmer design with an idea for a measuring tool submitted by a Bridgeport brass manufacturer only a few months before, quickly suggested the modern tool so familiar to all mechanics and so permeating all modern manufacture. Its development in succeeding years brought notable credit to the company.

The requirements of accurate workmanship were of great importance in the business: especially in sewing machine manufacture, for which, among else, Whitworth gages, plugs, and rings were relied upon. At that time, these Whitworth gages were considered the "last word" in accurate shop practice. A discriminating use of them, however, revealed they had certain deficiencies, so it was decided to create original standards, a standard yard and meter, with a system of measuring products based upon these new bases, which came to be know as the ***B. & S. standards***. Growing out of Mr. Brown's studies, this whole system of original standards took years to perfect and was not completed until long after Mr. Brown's death in 1876. This long effort was directed by the patience and zeal of **Mr. Oscar J. Beale** who, beyond anyone, inherited Mr. Brown's ideals in the field of mechanical design.

The measuring machine as designed by Mr. Beale was never made an article of sale. It always has remained as a tool with which B. & S. gages were made and sold with a guaranty of accuracy to within *one ten-thousandth of an inch*. In such a way, there has been maintained and assured the company's standards as to measurement. Each machine contains an original scale of such fineness and smoothness as will be easily readable and will give most exact results.

Mr. Beale, to whom this development was due, was a somewhat remarkable man. From early life he showed a bent for mechanical work. After an apprenticeship at the Portsmouth Navy Yard in New Hampshire, he became an employee of the company, as a bench-hand. "Showing some knowledge of gear teeth led to his employment," according to his own relation "after first being told that no more help is needed." His close association with Mr. Brown led him to absorb many of Mr. Brown's ideas and, as well, to become acquainted with his plans for improvements along mechanical lines, including those for the further attainment of accuracy.

In 1885, Mr. Beale was assigned the task of producing a lathe which would itself produce a standard screw. In speaking about the difficulties encountered, he quotes Mr. Brown as saying: "The true story of the originating of the screw is probably lost in the long and shadowy past. It would be interesting reading but in our time it is better to take as good a screw as we can readily find and begin where someone else left off."

This was the plan adopted under Mr. Beale's direction, but even then it was a long and uphill task. The goal set was to produce a lathe in which a screw could be commercially cut within 0.0004" in one foot, or within 0.001 " in four feet; the lathe to cut screws up to about five feet long without fleeting, and having provision for fleeting the screw being cut, so that a much longer screw, even to over 30 feet in length, could be made.

Mr. Beale's originality in design is shown in breaking away entirely from the conventional lines of the general purpose lathe and making one, every detail of which is directed to

producing an accurate screw. This work of producing such a master screw and lead nut for this lathe is a long story in itself, but it will suffice here to say that Mr. Beale, as he said, "lived with the job." So he brought all his skill and experience, together with an infinite patience, to the task; until it was successfully accomplished.

Aside from tasks of this sort, Mr. Beale devoted a great deal of time to producing machines for accurately cutting the teeth of gears and worm wheels, also for precision index drilling, hobbing, and circular graduating. The work in the solution of gearing problems was outstanding, and it brought great credit to the company. Much of his labor has been embodied in the Treatises on Gearing, which have educated generations in the art of designing and cutting gears.

In recounting the progress of the company during the 'sixties,' an important item is the association with it of Mr. Frederick W. Howe, of whom mention has been made as being associated with the Providence Tool Company. When Howe came to that company, before the opening of the Civil War, he had had active association with the well-known firm of Robbins & Lawrence, at Windsor, Vermont, out of whose plant had evolved a host of able mechanics who were making their mark in mechanical design and manufacture. It was no doubt due to his influence that Mr. Brown took up the designing and building of both the Hand Screw machine and the Universal Milling machine. Plain Manufacturing Milling Machines of Mr. Howe's design had already been taken over by *B. & S.* and were being manufactured. The hardening and annealing furnaces developed by Mr. Howe for the use of the Tool company were improved and built for use in the Brown & Sharpe Works in connection with their sewing machine and other work; and, with improvements made, soon became part of the regular line of manufacture. It is because of this close connection between the two companies that the close of the Civil War led Mr. Howe to cast his interests with the Brown & Sharpe business.

In 1868, the business was incorporated under the name of **Brown & Sharpe Mfg. Co.**; the original stockholders being **Messrs. Brown and Sharpe, Frederick W. Howe, and Thomas McFarlane**.

Mr. McFarlane, for several years before and after incorporation, was superintendent of production. Mr. Howe, aside from being a machine tool designer of experience and accomplishment, was well equipped for designing the new plant to be located on Promenade Street in Providence, to which he soon devoted a great deal of time and thought. He had real ability for painstaking designing and for careful planning of every detail of the new plant. Much of the work which he did at that time was so well done that it stood the test of time, and newer buildings, as they have evolved, have been provided with much of the same equipment, such as hangers, countershafts, shop benches, lock drawers, etc. He certainly was ahead of his time in the erection of a manufacturing building. The need for a new building had become very pressing, the original location on South Main Street having expanded to the limit and was overflowing to annexes in various parts of the city, wherever space could be secured. A floor of the New England Butt Company's new plant on Pearl Street was occupied for building Milling Machines. The Darling, Brown & Sharpe work of making machinists' tools was being done in another building on the corner of Elm and South Streets, etc.

The original building, consisting of one fire-proof brick structure, was built with such margin of safety that when requirements due to later expansion had to be considered, its more than adequate foundations, adjoining the bed of a river, served perfectly. The time of removal of the business to the new plant was in the Autumn of 1872, at which time less than 20 people were employed. Not long after this removal was made, came the business Depression of 1873, which ushered in a period of great strain to the enterprise, as well as to all business of the time.

Not only was the course of business itself one of real depression, but Mr. Brown was fast aging, requiring his partial withdrawal from activity and there was a rift between partners eventually resulting in the dissatisfaction and withdrawal of Mr. Howe, later followed by the retirement of Mr. McFarlane, as a stockholder and superintendent. In the meantime, Mr. Brown had passed on, in the beginning of the Summer of 1876. However, Mr. Sharpe, with many discouragements, kept on; with Mrs. Brown and Mr. Brown's daughter as partners.

With the death of Mr. Brown there has been finished the relation of the early shaping of the enterprise which determined the later success and steady growth of the concern. Principles and practices of early years successfully laid the foundation for results of later years, which have been so important in its history. While my relation as to personalities of these earlier years has been principally with the activity of the founders, there were, of course, a host of other people who contributed their important part.

Following the death of Mr. Brown, there were a great number of important individuals who were more than worthy of mention. To recount them, however, would detract from our informal story concerned with the main thesis of this *Newcomen* address. However, an exception will be pardoned in the distinguished contribution to the company made by Mr. Richmond Viall who, after being made superintendent in 1878, made a deep impress. Mr. Viall continued in his position, roughly speaking, for a quarter of a century. Though technically not a mechanic and never pretending to be, he used to describe himself as having learned the trade of "a soft solder jeweler." He had a real appreciation, however, of mechanical practice and an extraordinary ability as a leader of men, and as a teacher of many mechanics who had employment with the company and later spread over the land to a great many industries. Viall was a great teacher for those in his employ. When these people left Providence so many of them carried with them Mr. Viall's ways of leadership.

He was especially influential in his education of apprentices. Apprenticeship, which was indigenous to New England industry, had steadily deteriorated, as the decades went on. David and Joseph Brown had benefited by apprenticeship in their own time; and so had Mr. Sharpe, following his employment by Mr. Brown. The practice was not lessened as the company became larger. Mr. Viall, in his time, gave apprenticeship great encouragement. He liked to be with young men, and he gave the apprentice much more of his time and attention than would the ordinary superintendent. The practice of a sound apprenticeship has been enlarged and amplified with the ensuing years, and it can be said to be one of the foundation stones in the present organization. Most of the foremanship of the Works has evolved from former apprentices.

In closing this account of Mr. Brown and the beginning of the concern, it is well to observe that the practices and principles of those early days have entered into the very fabric of whatever success has come to the enterprise in the days that followed.

- Henry Dexter Sharpe
1949