

*A Measure  
of Perfection*

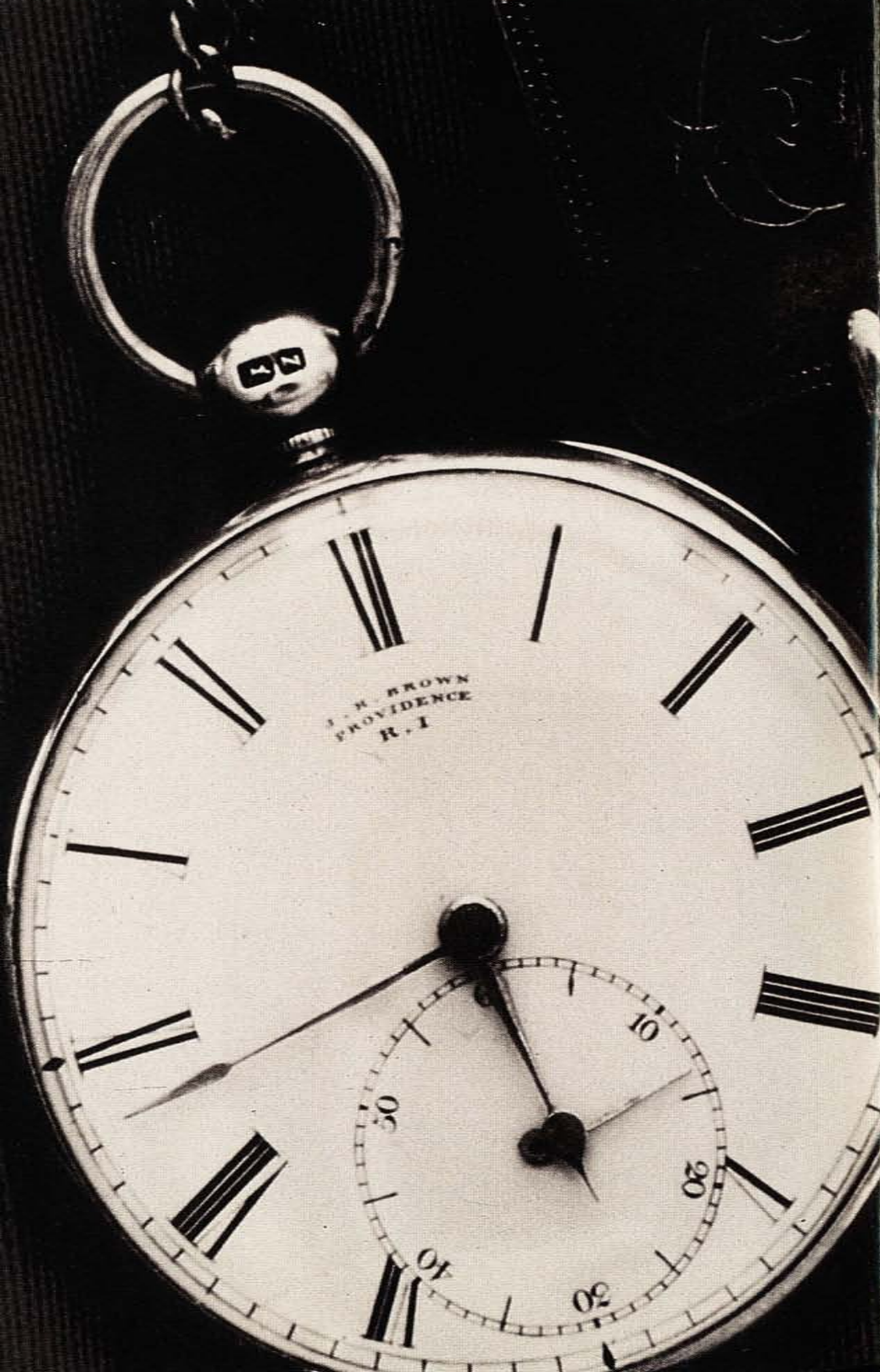
THE HISTORY OF  
BROWN & SHARPE

AS TOLD BY  
HENRY DEXTER SHARPE

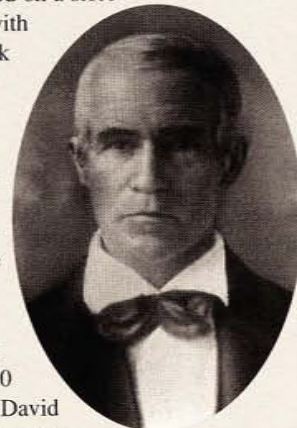
EXCERPTS FROM AN ADDRESS TO THE  
NEWCOMEN SOCIETY OF ENGLAND

RIVERSIDE, RHODE ISLAND

MAY 4, 1949



**D**avid 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.



David Brown

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.

**T**his 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

**D. BROWN & SON—WATCH, CLOCK MAKERS, &c.**, have taken the Stand No. 43 South Main street, Sign of the Turret Clock, where they offer their services in the above business.

They will give ocular demonstration that they are prepared, and by assiduity will show themselves qualified, to supply many of the wants of others to their satisfaction.

They will pay particular attention to repairing Watches and all other Time Pieces that may be offered, and make such as are called for. They have 1 Turret Clock, and 1 large Cutting Engine, on an improved plan.

They have a Dividing Engine for making the most accurate graduations for Mathematical and Nautical Instruments, and will attend to making and repairing such as are ordered. They intend to exhibit specimens of their own production, for sale.

Dividing Plates for all sized Engines graduated in the most perfect manner.

Spiral, Spiral and Bevel Gear, and Screws for Worm Gear, Tops, &c. for repairs of Spinning Machinery, turned and cut as directed.

Various Jobs will be punctually attended to.

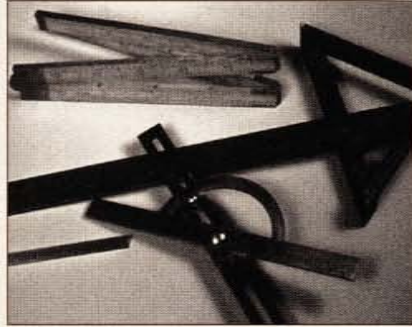
After having been to great research and expense, and agreed to do the above work with despatch by manual labor only and individually, they think they need only to be known to have steady business.

**DAVID BROWN,  
JOSEPH R. BROWN.**

**N. B. A Testament wanted, suitable for six in a family!**

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.



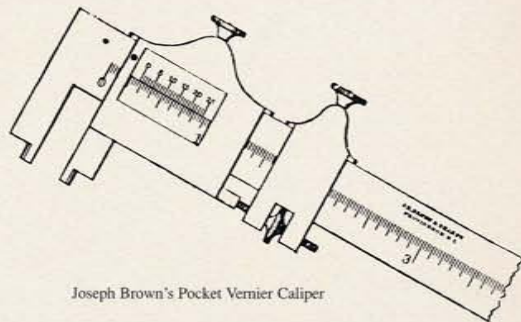
Early Brown & Sharpe Graduated Rules

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."

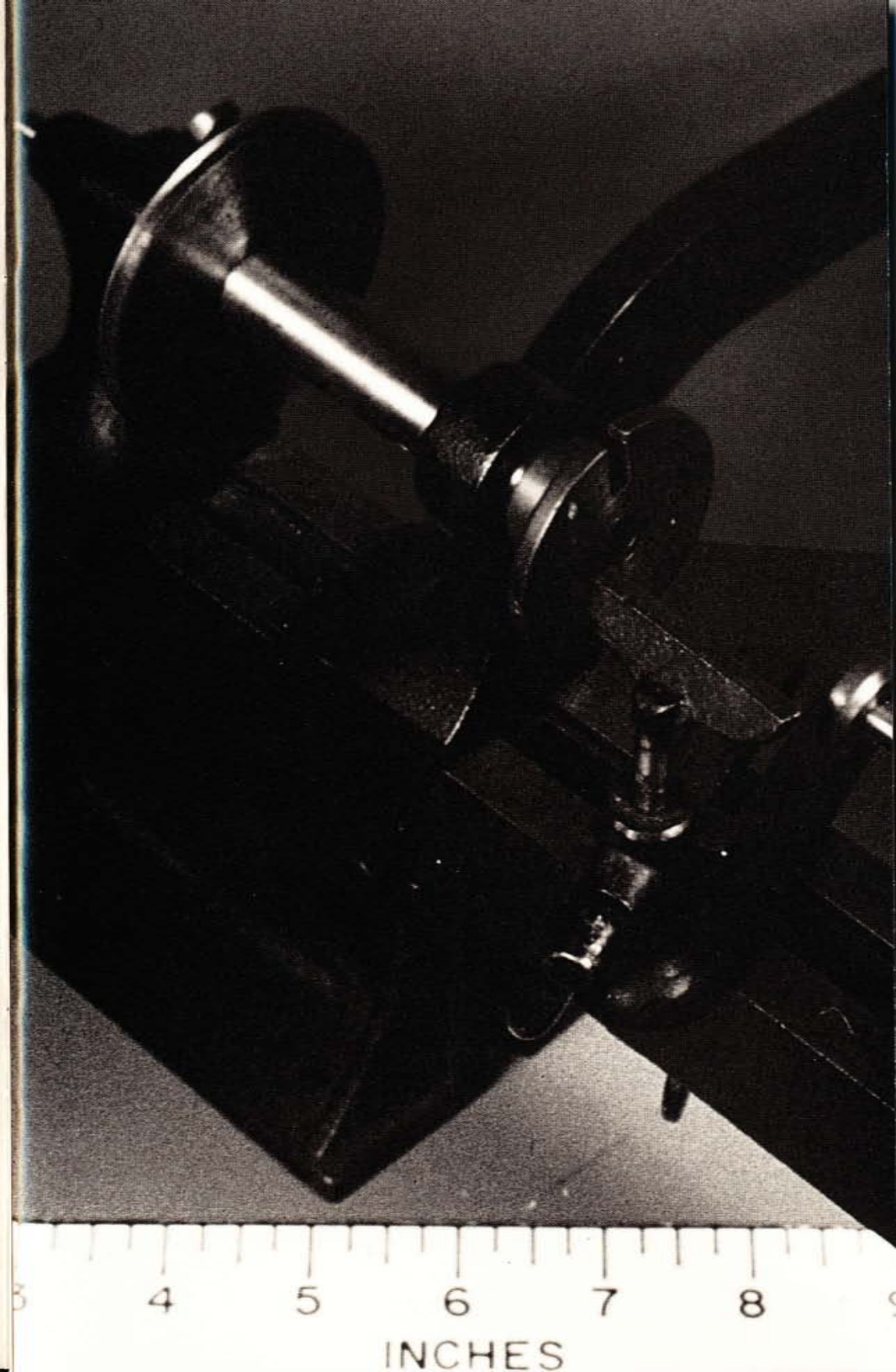
Mr. Brown says, regarding the graduating machine: "having been convinced by long experience that it is impractical to make a screw sufficiently accurate to be used in a dividing engine, I have constructed a machine on an entirely new principle which I am happy to say produces the most satisfactory results."



Joseph Brown



Joseph Brown's Pocket Vernier Caliper



# THE STANDARD WIRE GAUGE

Manufactured by

J. R. BROWN & SHARPE,

115 South Main St. Providence R.I.

Adopted by the Brass Manufacturers

This gauge was made from the best steel and all measurements accurate. Some specimens were stamped as in the accompanying mill run trials marks.

## RESOLUTION OF THE BRASS MANUFACTURERS.

Resolved, that some measure be taken to secure a more complete uniformity in wire gauge used by the brass makers, and

Resolved, that J. R. Brown & Sharpe of Providence, R.I. have, at their own expense prepared a gauge with a new grade of steel, a plan which is by us approved, therefore

Resolved, that we will adopt said gauge and be governed by it in rolling our metals and will use our exertions to have it come into general use as the Standard U.S. Gauge.

Signed

Benedict & Burnham Mfg. Co.  
Chas. Benedict Secy.

Waterbury Brass Co.  
J. S. Coe Secy.

Brown & Brothers  
Phil. Brown Pres.

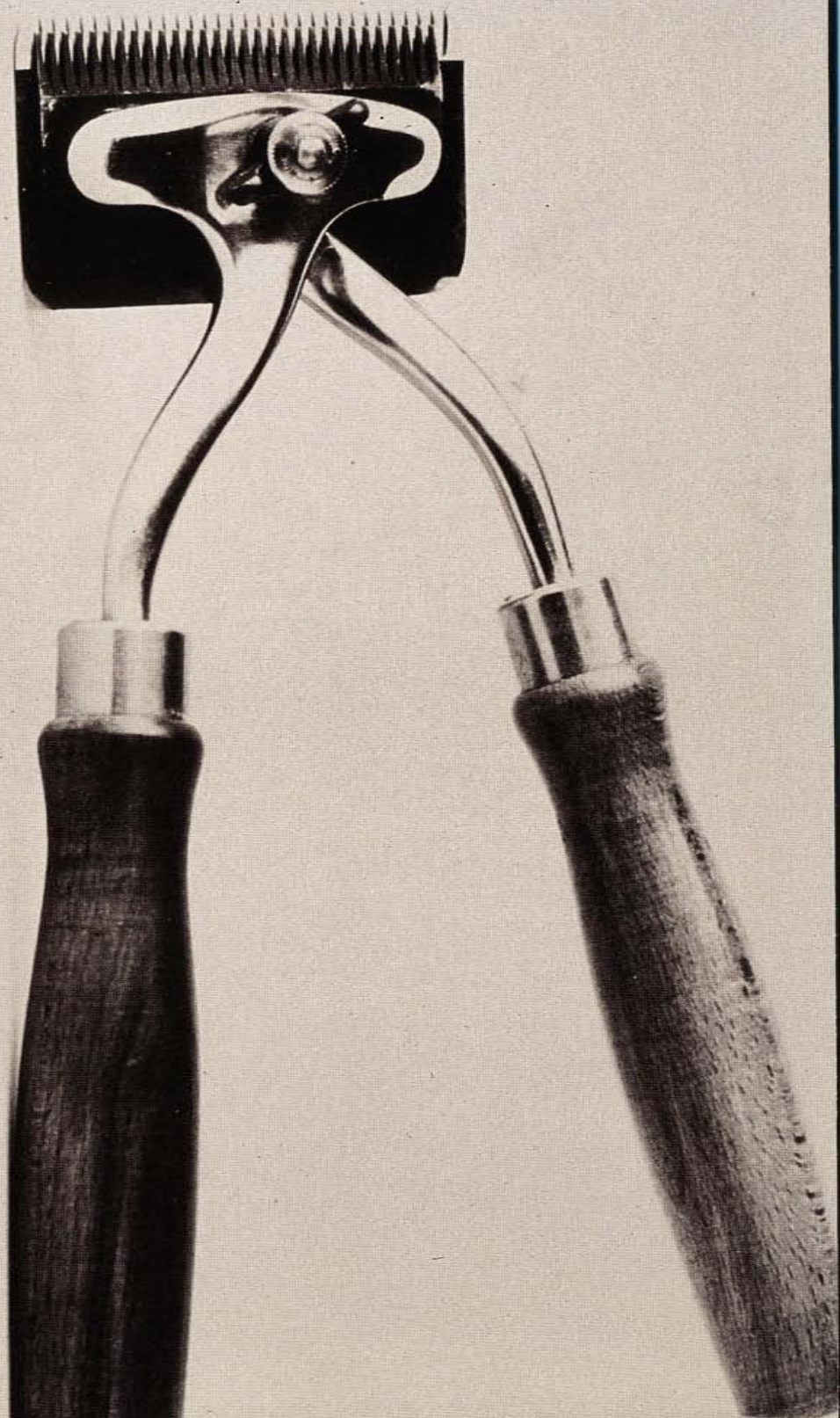
Holmes, Booth & Haydon  
J. C. Booth Secy.

Scoville Mfg. Co.  
C. W. Kingham

Bristol Brass & Casing Co.  
Cut. Metal Co.

Thomas & Mfg. Co.  
W. Thomas & Son

Wellcase & Sons  
The Millers



Providence R.I. April 30<sup>th</sup> 1848

Mr. Jos R. Brown  
Sir:

At your request I write down the agreement between us, which I understand to be as follows

- 1<sup>st</sup> That I am to work for you from the time I commenced (Sept. 12<sup>th</sup> 1848) to March 20<sup>th</sup> 1853 making 4 years 6 months & 8 days.
- 2<sup>nd</sup> That for the first two years 6 months & 8 days I am to work for you as an apprentice and for the last two years as a journey man.
- 3<sup>rd</sup> That during my apprenticeship you are to learn me the clock and watchmaking business and such other branches as you may pursue.
- 4<sup>th</sup> That I am to receive for <sup>work in</sup> said term of apprenticeship \$50.00 per. yr. and \$2.50 per. week for board. Also a full set of watch tools as far as you are in the habit of manufacturing them. These I am to make during the said term of apprenticeship.
- 5<sup>th</sup> That I am to have two weeks <sup>each year</sup> for recreation, all other time that I may be absent to be made up after my apprenticeship

Lucian Sharpe's Terms of Apprenticeship 1848 - 1853  
(memorandum to Joseph Brown in his own handwriting)

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

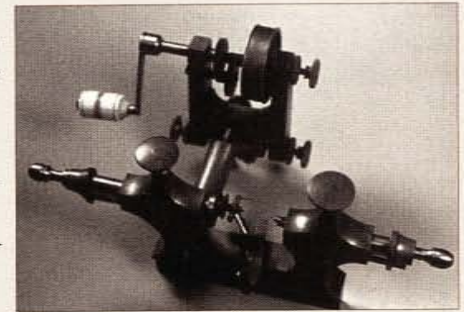


Watchmaking instrument made by Lucian Sharpe as part of his apprenticeship agreement.



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.

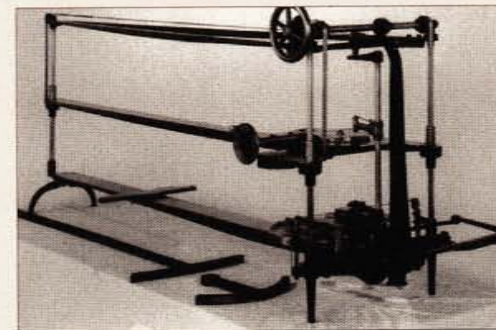


Hand-operated watchmaking instrument.

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.



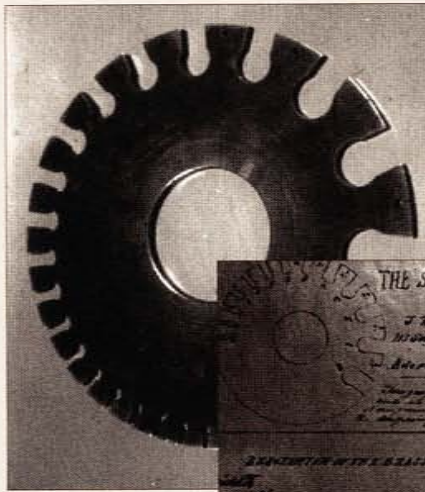
Meanwhile, they continued to make certain textile manufacturing appliances, the manufacture of some of which endured for many years, and one even to this day — the well known yarn reel.

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 casting 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:

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.

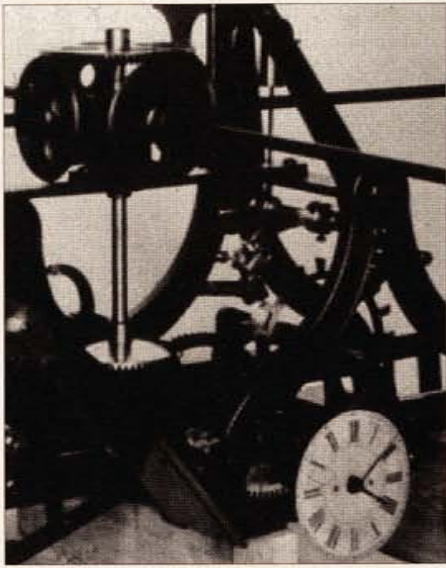
From the first, Mr. Sharpe directed all so-called business matters. He ran the office, wrote and copied the letters, rendered the bills, and collected the accounts. He liked all such things.

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."



Lucian Sharpe with his young son, Henry Dexter Sharpe.



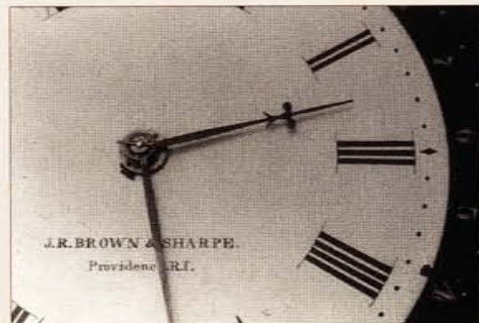
Making purchases of clocks, watches, supplies, etc., in Boston and New York by correspondence, Mr. Sharpe suggested that their furnishers in turn become *agents* for their own tools. Always the repairing of clocks and watches, not to speak of the manufacture of clocks themselves, seems to be prominent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

**W**ork 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* 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."



Detail of a Brown & Sharpe watchman's clock.

# WILCOX & GIBBS' SEWING MACHINE.

Patented June 2, 1857. Re-issued July 13, '58, Pat. Aug. 10, '58, and Licensed under Six Patents, owned severally

by Elias Howe, Jr., Wheeler & Wilson Manuf'g Co., I. M. Singer & Co. and Grover & Baker Sewing Machine Co.



**PURCHASERS MAY THEREFORE FEEL ASSURED THAT THEY ARE NOT BUYING A PIRATED MACHINE.**

The undersigned desire to place this Machine before the public *solely upon its merits*, convinced that it will establish itself as a general favorite with all classes, and particularly among families.

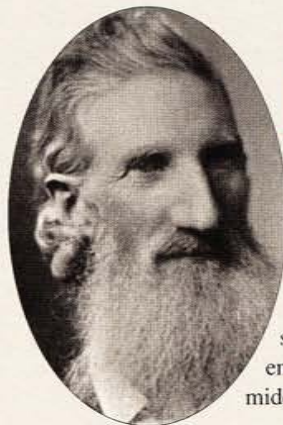
The beauty and accuracy of the mechanism of this Machine is strikingly exhibited in the fact that it is capable of making *unerringly*

**4000 STITCHES A MINUTE,**

And in the opinion of the Judges of the LATE FAIR OF THE FRANKLIN INSTITUTE, "fills nearer the requirements of a **FAMILY MACHINE**, than any other," and their judgment is fully



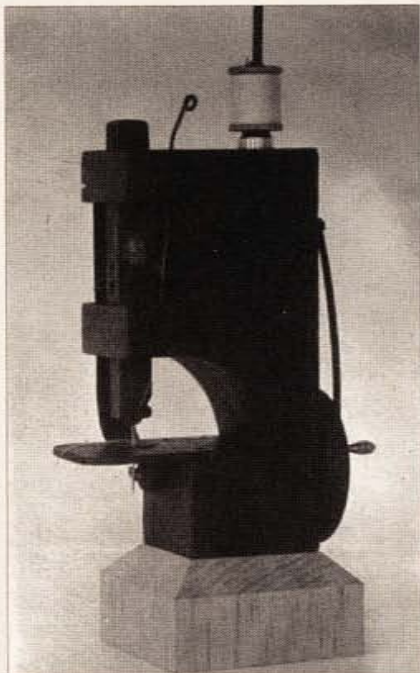
## SEWING MACHINE MANUFACTURE



James E.A. Gibbs

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.



James Gibbs wooden model of a single thread sewing machine

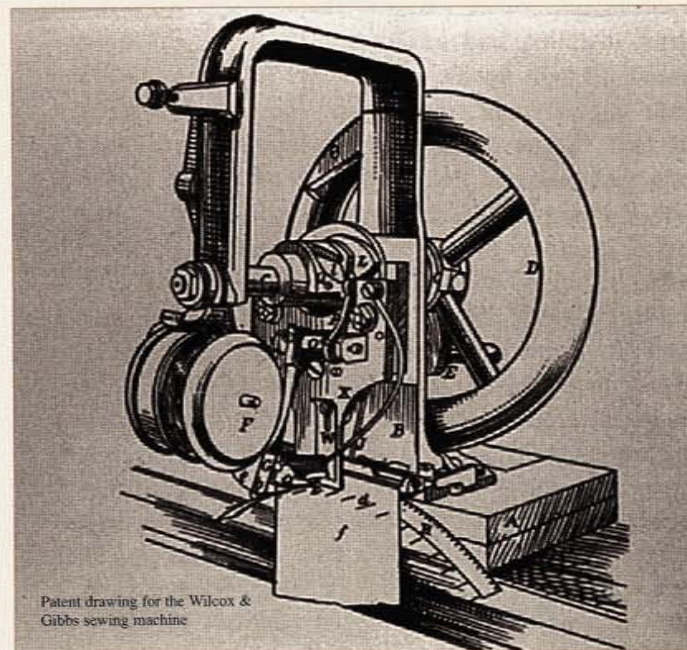


James Willcox

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**.



Patent drawing for the Willcox & Gibbs sewing machine

## 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.

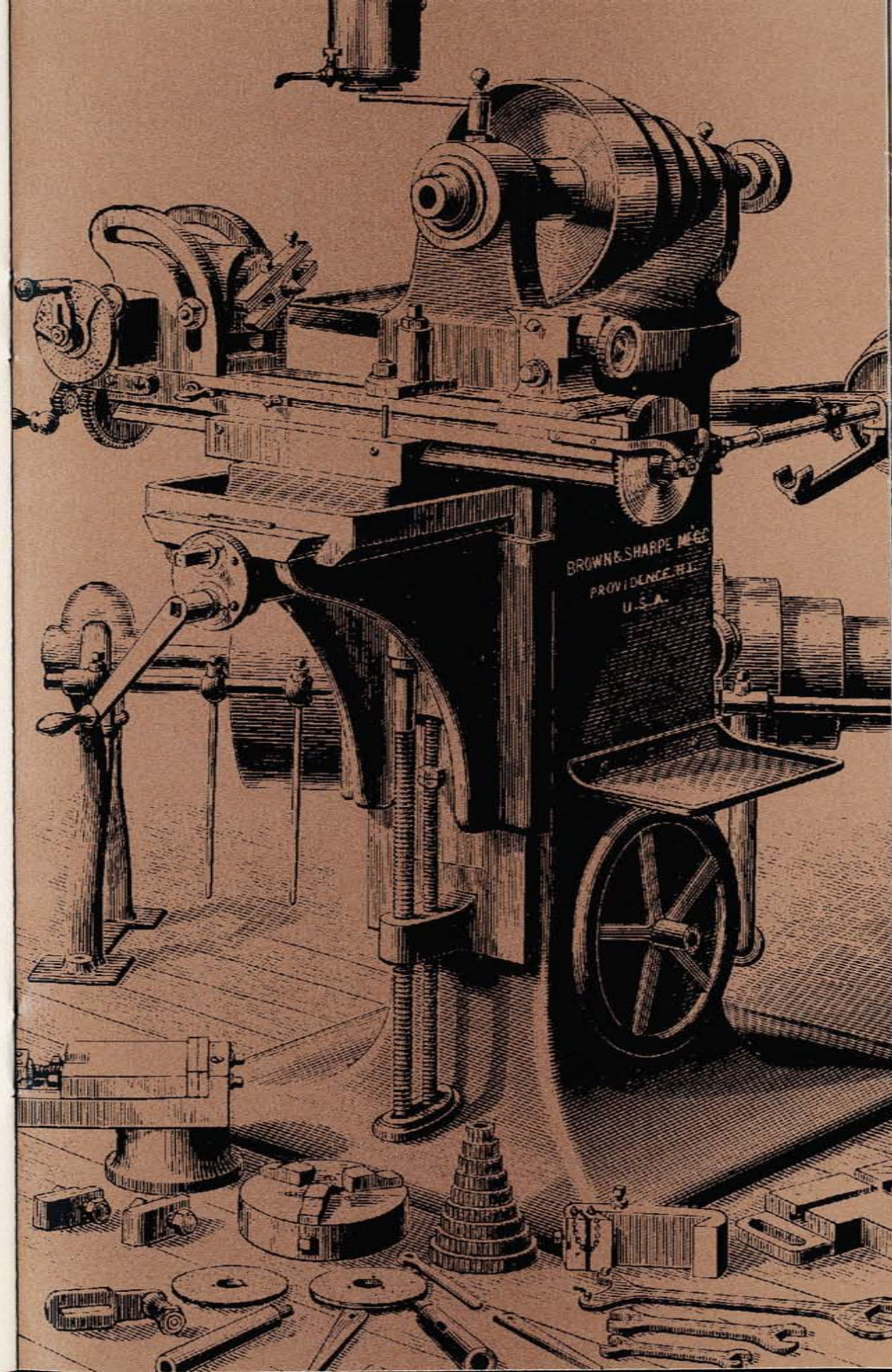
The first *machine tool* built by B. & S. was a **Turret Screw Machine**, the need for which was stimulated by the manufacture of sewing machines, which require screw machine products, and stimulated also by the needs of the Civil War, then well under way.

**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.

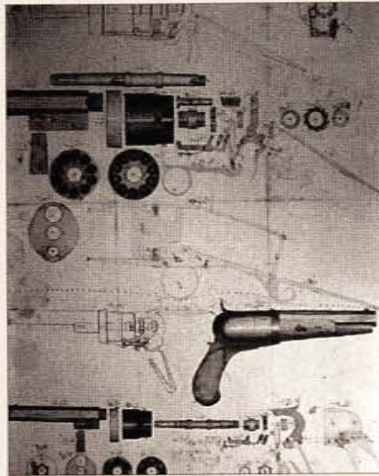
Mr. Howe became closely acquainted with Joseph R. Brown because of their mutual mechanical interests, and it is evident that they often compared notes as to mechanical matters. It was through the influence of Mr. Howe that the manufacture of this screw machine was undertaken, the castings being obtained 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 Civil War stimulated business in artillery parts

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**.

**W**hile 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.

The 1876 Centennial Exposition in Philadelphia

**M**r. 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:

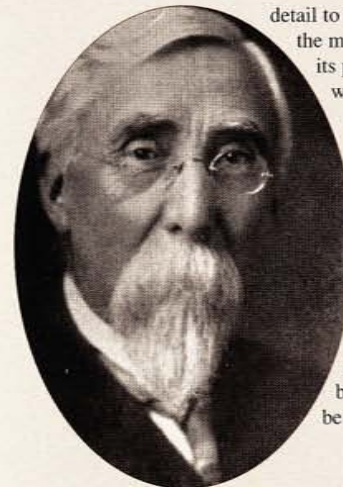
“What I consider Mr. Brown's greatest achievement was the Universal Grinding Machine. In developing and designing this machine he stepped out on entirely new ground and developed a machine which has enabled us to harden our work first and then grind it with the utmost accuracy, at the same time protecting 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



Brown & Sharpe's display of Universal Grinding Machines at the 1876 Philadelphia Exposition

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.



Henry M. Leland

“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.”

*Henry M. Leland*

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.

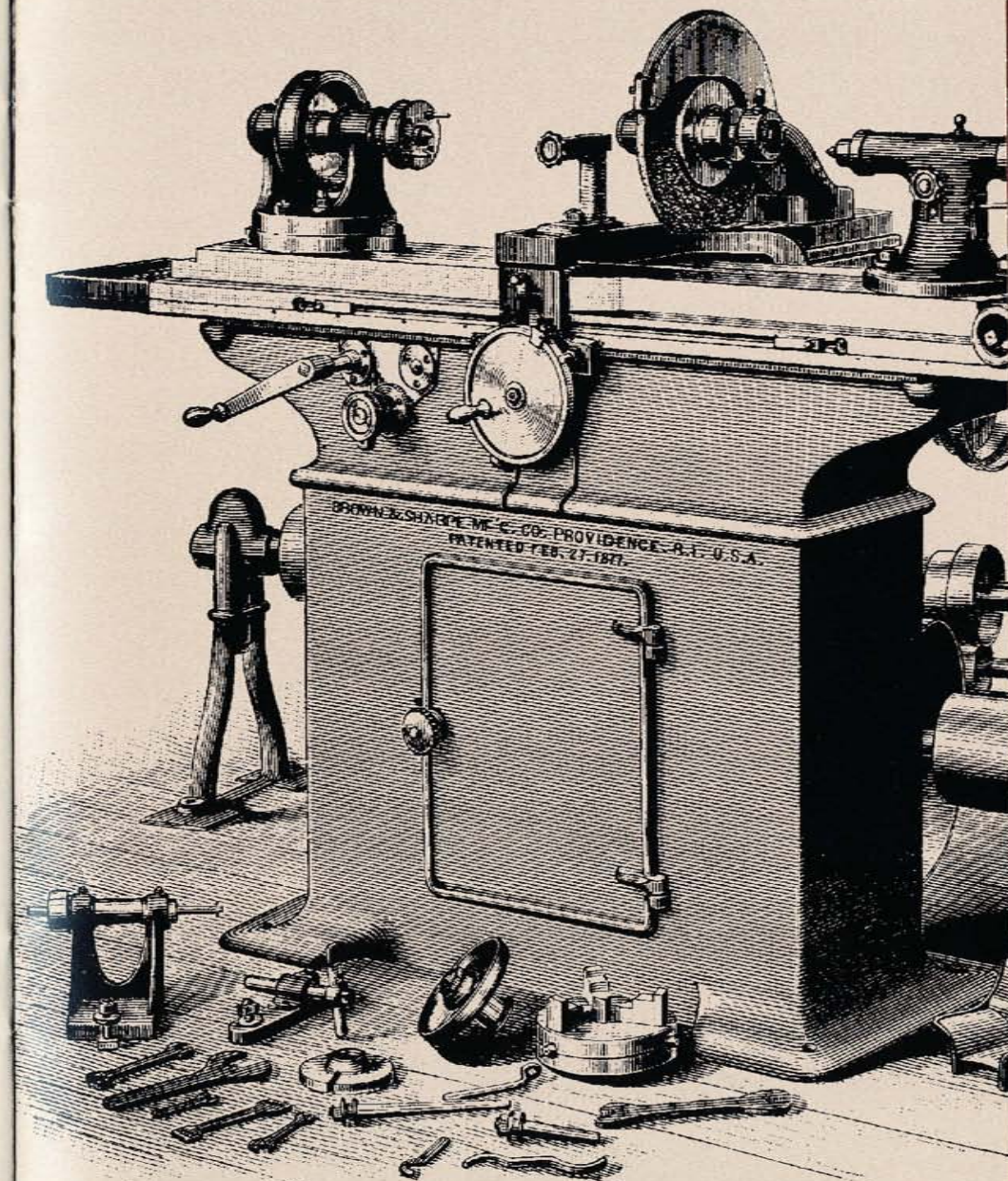
Competition along such lines became keen through the setting up of a rival manufacture at Bangor, Maine, with **Samuel Darling** as its presiding genius. Mr. Darling, a farmer with a natural bent for mechanics, had this interest stimulated no doubt by growing up in a region of sawmills. Leaving the farm 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  $\frac{1}{16}$  of an inch of the ends which were touching, thus illustrating the reason of the seeming inaccuracy.



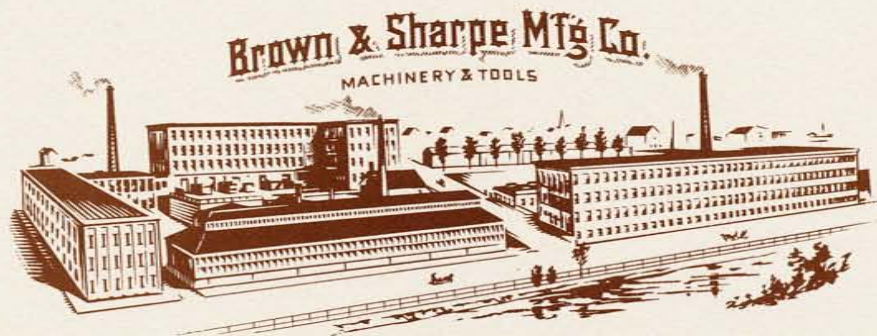
Opposite Page:  
The Universal Grinding Machine

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 1, 1897, the entire business being thereafter conducted under the name of *Brown & Sharpe Mfg. Co.*

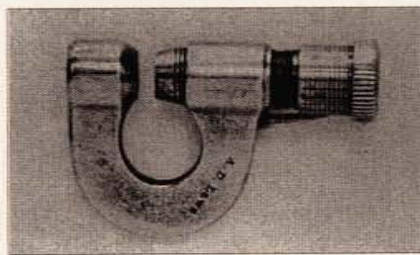


The Brown & Sharpe Micrometer Caliper adopted by the Master Mechanics Association as the U.S. Standard Measuring Instrument

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 "Système Palmer" Micrometer of 1848



Early micrometers such as this were difficult to read and subject to error

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 known 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.



Brown & Sharpe exhibited in international trade shows winning gold, silver and bronze awards which would establish them as the "World's Standard of Accuracy"



The Old Shop of J.R. Brown & Sharpe in 1872

**M**r. 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 benchhand. "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.



The Universal Grinding Machines In Operation

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.

**I**n 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.**

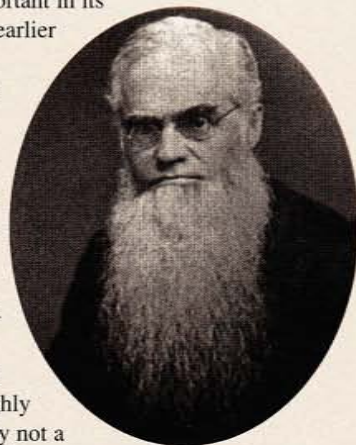
Mr. McFarlane, for several years before and after incorporation, was superintendent of production. Mr. Howe, aside from being a machine tool designer of experience and accomplishment, was well equipped for designing the new plant to be located on Promenade Street in Providence, to which he soon devoted 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.

**W**ith 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.



Joseph R. Brown

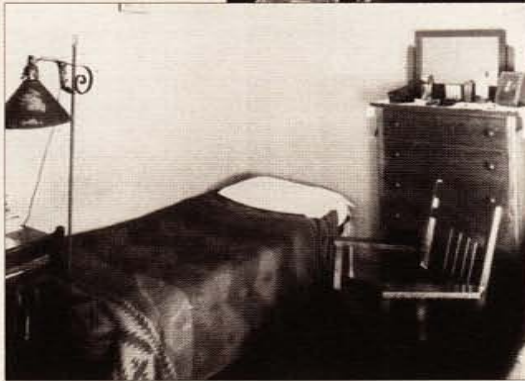
He was especially influential in his education of apprentices. Apprenticeship, which was indigenous to New England industry, had steadily deteriorated, as the decades went on. David and Joseph Brown had benefited by apprenticeship in their own time; and so had Mr. Sharpe, following his employment by 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.



The Brown & Sharpe apprentice school and living quarters.  
Photo on opposite page is of the apprentices in the style of the day — and their derby hats.

