

Previous articles providing historical information about machine tools have focused on a particular tool or a tool maker. That only provides a spotty record of overall machine tool development relative to time. This special article will try to put the time of these developments in perspective relative to other historical events. Society's natural progress from agrarian to mechanical industrial work marks the beginning of machine tool development to satisfy the needs and to support that change starting about the year 1800. For example, the textile industry with mechanical looms, steam engines, the evolving railroad industry, clocks and watches, sewing machines and guns, all required metal parts in quantity made more efficiently and more accurately. The three basic tools that evolved were the lathe, first to advance from rustic devices, the planer for making better lathe beds and later the milling machine for making irregular parts. The English were most prominent in early tool development but the Americans adopted and improved on their ideas if not the concepts. Early tools were made by individuals who were challenged to make parts for a product using ideas available but adapted to their specific project. Some soon saw the potential in making these tools as a new product line by itself to be sold to others, and started making tools for customer specific use or for general purpose use. Consider the need for screws and bolts which had to be made by hand initially. With the advent of the lathe with lead screw driven slide rest, screw thread making was made simpler and faster. An early objective for gun makers was that parts should be interchangeable in the field. Use of machines reduced the labor intensive cost of making guns in quantity. During the Civil War, great quantities of guns were needed by both armies and screws were an essential part. One development was the turret lathe which came about to eliminate changing tool settings for each screw and also allow utilizing less skilled labor. Later still the automatic screw machine evolved to make this process even more efficient for quantity production. Early lathes had wooden beds, then metal beds scraped smooth by hand were made until the planer was developed to make this process less labor intensive. Milling machines were developed to make intricate parts for textile machines for example and were initially quite specialized in nature until the general purpose machines came about.

It was in the eighteenth century when two English men and a French man combined their ideas and skills to make woodworking machinery used in the manufacture of wooden blocks. These were a major expense in building commercial and naval ships, and were used for the handling of the multitude of lines found on sailing ships of the time. It was said that using these machines, ten unskilled workers could do the work of one hundred and ten skilled workmen. The Englishman, Henry Maudslay, was the mechanic with the practical skills who brought the designs to working tools. It was he also who perfected the metal working lathe slide rest operated by a lead screw and change gears. He was also instrumental in the development of the planer along with others. Another Englishman, Richard Roberts, built one of the earliest planers in 1817 for which a picture shows recognizable features common today, although it was hand operated with a chain driven platen. It is preserved today and shows the chisel and file marks made when making the bed where a planer was not yet available for that purpose. Roberts was also credited with inventing the back-gear

lathe headstock with the cone pulley turning freely on the spindle. It should be pointed out that it was not until about 1830 that the current scientifically correct shape of gear teeth came to be known and put into practice. Earlier gear shapes were prone to considerable friction and wear.

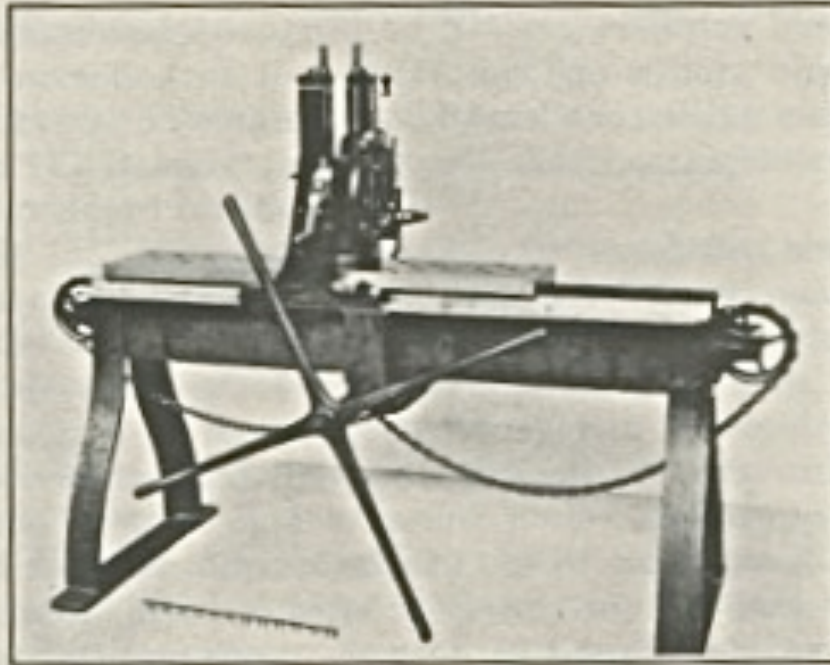


FIGURE 20. ROBERTS' PLANER, BUILT IN 1817

The men involved in the American machine tool industry were inventive entrepreneurs that became known for their machine developments and were often enticed away from one company to another for their expertise. Individuals often moved up through factory draftsman, engineer and superintendent positions to owner ranks, and companies were formed and reformed quite frequently. Documentation of the careers of many of these industry leaders is fairly complete probably because their companies used the information as selling points for their products. At the end of this article is a "Genealogy" chart showing the progression of companies and industry leaders that spent all of part of their careers in the Worcester, MA, area, one of several major tool building centers in New England during the nineteenth century. Information about early machines is less available. Printed advertisements and catalogs provide a major source of such information. The machines were often quite rough and of limited purpose. Thus they disappeared as soon as an improved version was developed. The first foundry in Worcester was established in 1823 by William Wheeler and by 1836 was turning out 700,000 pounds of castings annually. That is a lot of iron and there were a lot of foundries needing iron for raw material. That probably led to scrapping of worn or outdated machines, reducing availability of examples today. In the latter half of the nineteenth century the machines had become much more smooth and accurate in

operation, and in some cases more ornate than needed. Looking at our oldest machine, a Shepard, Lathe & Co engine lathe made about 1860, the detail of the turned parts indicates that this was part of the selling process more than for practical reasons. In 1853, Joseph Whitworth, the Englishman who had proposed the thread standard known by that name in 1841, visited the United States to observe industry in general. His report influenced changes in English practice, perhaps most notably in the gun making industry. His principal observation though was that Americans were most inclined toward developing and utilizing machine tools rather than the labor intensive practices found in England. It thus appears that America was advancing more quickly in the direction of accuracy and efficiency.

Following is a listing of individuals, companies and products prominent during the 1800's, showing the widespread industry of the times and showing the time line for the development of the three basic types of machines. Some clarification of terminology used to describe some machines is in order. An engine lathe is one in which the tool-holding slide rest is geared together with the spindle to make the turning of screw threads consistently accurate. A hand lathe is one that does not have a tool holder, the skilled operator holding the tool himself. Screw machine was the term first used to describe what we now call a turret lathe. A hand planer or shaper was powered by the operator turning a crank. Planers and shapers make straight cuts using cutting tools similar to those used on a lathe, the planer by moving the piece being cut and the shaper by moving the cutting tool. Planers can make much longer cuts and handle much larger pieces. A hand milling machine requires the operator to move the bed longitudinally or vertically relative to the rotating cutter by use of a hand lever. A Lincoln miller is named after the inventing company owner and simply means the work table is mounted to the bed of the machine rather than a vertically adjustable knee. They are intended for high production rates of identical parts. Other related terms generally are self explanatory and describe some design feature of the machine. Sources of information used are a series of books by Kenneth L. Cope that use illustrations from ads and catalogs and give brief company histories. Another source is a book by Joseph W. Wickham, English and American Tool Builders, first published in 1916, that focuses on the whole of industry by geographical areas and prominent individuals responsible for the developments described. Beginning about 1800, the following are notable events:

1798 - David Wilkinson, Pawtucket, RI; developed a screw cutting lathe with a slide rest which he patented in 1798. Early associates Edward Bancroft and James S. Brown later made contributions to lathe design. It was at this time that the cotton textile mill industry was started in Pawtucket, RI. England had imposed an embargo on the export of machinery to America following the Revolution. An English immigrant, Samuel Slater, working with Wilkinson in Pawtucket helped develop the machinery from his knowledge of that then in use in England.

1813 - Eleasor Jenks built a machine shop in Pawtucket for making heavy forgings and textile machinery. Larned Pitcher also started a machine shop there at that time and in 1819 Ira Gay joined to form Pitcher & Gay. Gay relocated to Manchester, NH in 1824 to work with Amoskeag Manufacturing Co and a new company, Nashua Manufacturing Co.

1814 - Leach, Shepard, of Easton, MA; primarily a foundry operator, they also made lathes.

1818 - Eli Whitney, of New Haven, CT; a contractor making US military arms beginning in 1789 is credited with one of the first milling machines made in 1818. He is noted for having earlier initiated the concept of interchangeable parts using machines in the manufacture of muskets. In the same time frame, Simeon North, of Berlin, CT, was contracting with the government for making horse pistols using similar production methods.

1818 - Robert Johnson, of Middletown, CT; an English immigrant gunmaker made one of the early milling machines comparable to a rotary file.

1818 - Thomas Blanchard, Springfield Armory; in Worcester invented an apple peeler, a tack forming machine and at the Armory a wood lathe for turning irregular wood shapes such as the gunstock.

1819 - James S. Brown, of Pawtucket, RI; working for Pitcher and Gay, Brown developed a slide rest with tool height adjustable while the lathe was running. He later replaced Ira Gay in the partnership and in 1842 bought out Pitcher, making lathes, boring machines and gear cutting machines.

1822 - Samuel Slater with others founded Amoskeag Manufacturing Co. in the Manchester, NH area which became one of the largest cotton textile mills in the world. But they also operated machine shops for the manufacture of locomotives, engines, boilers, textile machinery, machine tools and mill machinery.

1824 - Nashua Mfg Co, of Nashua, NH; was established to make lathes and planers with Ira Gay as superintendent.

1830 - Edward Bancroft, of Providence, RI; is credited with building the first iron planer.

1830 - Fales & Jenks, of Providence, RI; formed to make textile machinery and pumps, made a planer before 1840 and milling machines later during the Civil War.

1830 - Ira and Ziba Gay, of North Chelmsford, MA; formed a partnership to make textile machinery, lathes and other machine tools. One product built was a granite bed 42" planer with chain drive made in 1836, one of the first American built planers. Frederick Howe learned the machinist trade here before joining Robbins & Lawrence in 1853. Possibly the first American shapers were made here in the 1850's.

1830 - Nathaniel Wiley, of Watertown, NY; made a 22 inch swing wooden bed rack drive lathe that was in use until 1889.

1833 - Baxter D Whitney, of Winchendon, MA; designed and built an 18 inch swing lathe with advanced features such as a worm driven feed system.

1835 - Ames Mfg Co, of Chicopee, MA; was founded by James and Nathan Ames to make cotton machinery and machine tools. One of the first tool builders to make a standard line of machine tools. Beginning in 1850, they were important suppliers to the Springfield Armory.

1835 - C M Marvel & Co, of Lowell, MA; was formed to make textile machinery and machine tools of every description.

1836 - Patent Fire Arms Co, of Paterson, NJ; Samuel Colt founded this company to make a new revolving pistol. Employee William Ball designed and built index milling machines, screw machines and drill presses. The company failed in 1842.

1836 - J & S W Putnam, of Ashburnham and Fitchburg, MA; was formed and were offering lathes by 1838.

1837 - John H Gage, of Nashua, NH; began making lathes and other machine tools.

1839 - Samuel Flagg, Of Worcester, MA; began making machine tools, the first to do so in Worcester.

1841 - Whitney Armory, New Haven, CT; founded by Eli Whitney, Jr, they made a variety of firearms and appear to have made a William H Robertson patented milling machine in 1852, the first American milling machine patented.

1845 - S C Coombs & Co, of Worcester, MA; a partnership of Coombs, R R Shepard and M Lathe, they made a variety of machine tools including lathes. Coombs left in 1853 and they reorganized as Shepard, Lathe & Co.

1845 - Lowell Machine Shop, of Lowell, MA; primarily makers of textile machinery, they also made a variety of machine tools, most of which were designed by William B Bement who later became a principal in other companies in the Philadelphia area.

1846 - Phoenix Iron Works, of Hartford, CT; a partnership of George and Charles Lincoln, they made large machine tools such as a lathe with a 40 inch swing and in 1856 one with an 86 inch swing. Amos Whitney worked here 1853 to 1860 and developed the Lincoln miller, an improvement over the Howe miller using a screw feed for the table.

1846 - Woodburn, Light & Co, of Worcester, MA; was formed to build engine and hand lathes, and planers.

1848 - Union Works, of South Boston, MA; designed and made large lathes and planers, one such planer made for the Charlestown Navy Yard in 1863 could plane 18 feet wide, 14 feet high and 20 feet long.

1848 - Colt Patent Firearms, of Hartford, CT; made a milling machine designed by superintendent Elisha K Root which was the first with a cylindrical overarm and had a worm driven table. Root had been hired away from his position as foreman at the Collins Company, a foundry in Collinsville, CT, and was responsible for designing and building the Colt Armory in Hartford.

1848 - Bancroft & Sellers, of Philadelphia, PA; products included engine lathes with a feed gear change designed and patented by Bancroft and William Sellers. After Bancroft died in 1855 the firm was reorganized as William Sellers & Co. Sellers patented a spiral geared planer in 1862. He also developed the National screw thread standard now in use and presented it to the Franklin Institute where it was adopted and promoted in 1865.

1850 - Robbins & Lawrence, of Windsor, VT; was a reorganization of Robbins, Kendall & Lawrence. The primary products were a variety of firearms made under contract to the American and English governments. Machine tools of their own design became a secondary product line. Machines produced included chain fed engine lathes patented by Frederick Howe and also small turret lathes designed by Howe. These were later improved by Pratt & Whitney and Brown & Sharpe. Howe is also credited with designing the first universal milling machine. The company failed in 1856 but Ebenezer Lamson bought the plant in 1859 and formed Lamson, Goodnow & Yale. The factory in Windsor is now the home of the American Precision Museum and many of the machine tools used for gun making are on display there.

1852 - Wood, Light & Co, of Worcester, MA; a reorganization of Woodburn, Light & Co, they began making indexing milling machines.

1853 - Brown & Sharpe, of Providence, RI; was formed to produce measuring tools, clocks and sewing machines. Manufacture of clocks, watches and sewing machines

were the first industries to capitalize on the interchangeability principles introduced by gun makers Whitney and North. Machine tool production began in 1861 with a screw machine designed by Brown. Milling machine production began in 1862 with design help from Frederick Howe, then working at Providence Tool Co.

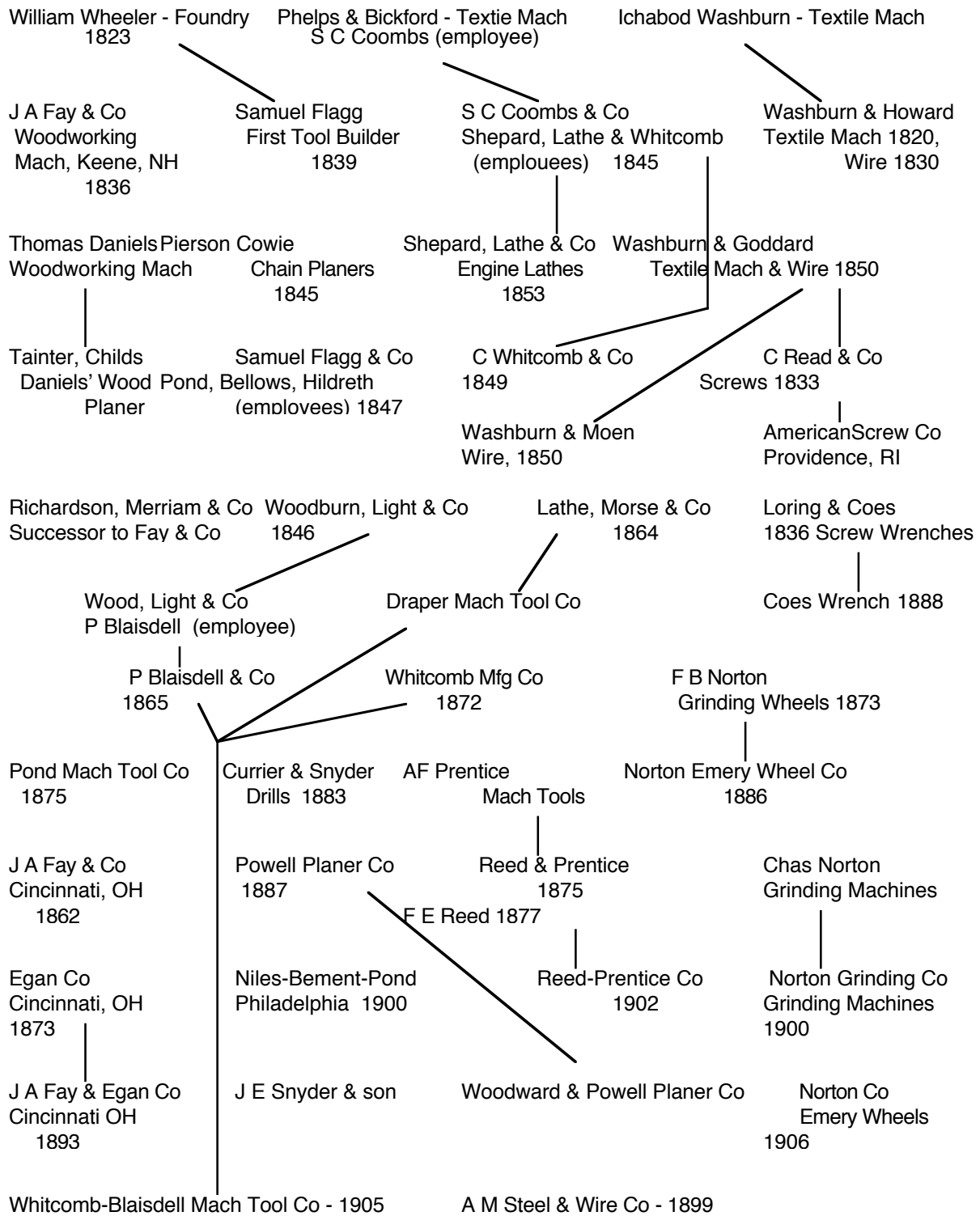
1860 - Pratt & Whitney & Co, of Hartford, CT; was formed to make silk machinery, lathes and planers. Both Pratt and Whitney had worked previously at Phoenix Iron Works in Hartford and at the George S Lincoln Company and had done contract work at Colt.

1869 - Billings and Spencer Company, of Hartford; formed by Charles Billings and Christopher Spencer, who like Pratt and Whitney had worked for Colt, they specialized in the forging process and developed drop hammer technology.

1870 - Hende Machine Co, of Torrington, CT; was formed by brothers Henry and Arthur, their primary products initially were shapers and planers. William P Norton joined the company in 1886 and was instrumental in lathe design and lathes became a major product line. Norton received a patent for probably the first successful geared feed design with lever shifting which became known as the Hende-Norton lathe.

The above listing describes only a fraction of the enterprising individuals who were instrumental in the early development of machine tools. Many early efforts failed of course but it also has to be recognized that each successful machine was soon improved upon if not by that company, by others. It is intended primarily to show the time frame and geographic diversity in the New England area. The midwest, particularly in Cincinnati, had a similar developing machine tool industry somewhat later.

WORCESTER, MA, MANUFACTURING AND TOOL MAKING COMPANY AND PERSONEL PROGRESSION



(All located in Worcester unless otherwise noted)

