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Nineteenth Century Technology

Technology of the 1800s

by Brent D. Glass

In his classic study, *Democracy in America* (1835–1840), Alexis de Tocqueville titled one of his chapters "Why the Americans are more Addicted to Practical rather than Theoretical Science." He observed that the political and social conditions that fostered a spirit of individualism and freedom of thought also resulted in a pragmatic application of scientific knowledge. "The Americans," he wrote, "always display a clear, free, original, and inventive power of mind."

Patent for a combination steam whistle and boiler signed by James Buchanan as secretary of state, May 28, 1846. (Gilder Lehrman Collection)

Any discussion of what de Tocqueville called "the inventive power of mind" in nineteenth-century America needs to pay attention to the connection between technological innovations and the political, social, cultural, and economic circumstances of an emerging democracy. At the beginning of the century, the United States had barely secured its independence from Great Britain and had embarked on an ambitious strategy to expand its boundaries westward to the Pacific Ocean. During the middle years of the 1800s, a series of major military conflicts including the Mexican-American War, the Civil War, and the Indian Wars resulted in the abolition of slavery and the development of an industrial economy. By the end of the century, the United States had become a world power recognized for its extraordinary technological achievements.

One of the driving forces behind the American system of technological innovation was the United States Patent Office. The Constitution of the United States authorized Congress "to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and inventions." In the early 1790s, the Congress established new procedures to secure patents, and this process remained in place until 1836. Under this system, some of the most famous inventors in American history secured patents including Eli Whitney for the cotton gin in 1794, Eleuthere du Pont for the improved manufacture of gunpowder in 1804, and Robert Fulton for the steamboat in 1809.

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In 1836, about the same time that de Toqueville's essays first appeared in print, the US Congress radically changed the patent process and also provided funding for a new Patent Office building. This magnificent structure became the symbol of American commitment to technological innovation. Among the provisions of the 1836 law was a requirement for patent models to be submitted with each application. The models became highly effective tools to communicate the originality and special features of various inventions. The number of patents issued by the office rose in dramatic and spectacular fashion. From 1790 to 1840 the office issued a total of 11,500 patents; in the years between 1840 and 1900, the number of approved patents swelled to more than 682,000! "The patent system added the fuel of interest to the fire of genius," noted Abraham Lincoln, himself a recipient of a patent for a device to raise steamboats over sandbars.

The other major influence that drove America's technological development was the spectacular expansion of the nation's boundaries, population, and economy. The territorial size of the United States quadrupled from 1800 to 1900, a nation spanning the continent from Atlantic to Pacific. The census of 1800 recorded a total population of 5.3 million people; by 1900, the United States was home to more than 75 million. The need to connect and supply this expansive nation encouraged the development of innovations in transportation, communication, and manufacturing.

The shaping technology of the nineteenth century was steam power. The steam engine, developed first in England and later refined in the United States and other industrializing nations, provided a more reliable and powerful source of power than water or wind. The impact of steam power is evident in the growth of iron industry to build engines and steam-driven machinery and in the expansion of coal mining to provide fuel. American cities became centers of steam-powered manufacturing and by 1900 nearly 40 percent of the population lived in urban areas, a seven-fold increase from 1800.

The most significant innovation in the Age of Steam was the development of railroads. The first American railroad was the Baltimore and Ohio that began service in 1828. By 1840 there were 2,818 miles of track in the United States. The number of track mileage grew to more than 30,000 miles by the Civil War and almost 200,000 miles by 1900—40 percent of the world's total. The railroads symbolized America's technological ambitions, and the completion of the first transcontinental rail link in 1869 was one of the defining moments in the history of the nation, a prodigious feat of engineering, finance, and labor.

Technological advances changed nearly every aspect of life in the nineteenth century. A farmer using a wooden cradle in 1830 could cut four times more wheat than his counterpart in 1800 using a sickle. After the introduction of Cyrus McCormick's reaper in the 1840s, the same farmer tripled his wheat harvest. Steel manufacturing was a new industry made possible by technological developments in England and the United States. The Bessemer process, developed in the 1850s, increased both the quantity and quality of steel and transformed the manufacturing and construction industries.

One immediate impact of the improvement in the quality of steel occurred in bridge-building technology. The best-known and most successful bridge designer during this time was John A. Roebling, a German immigrant who first settled in western Pennsylvania and later established a steel wire rope factory in Trenton, New Jersey. Roebling's creative use of wire rope technology resulted in spectacular suspension bridges that offered unobstructed passage for ships and moved rail traffic over challenging barriers. From the Pittsburgh's canal aqueduct (1840s) to the rail and road bridge over the Niagara gorge (1855) to the Cincinnati suspension bridge over the Ohio River (1867) to his masterpiece, the Brooklyn Bridge, completed in 1883 (fourteen years after his death) Roebling's daring structures were both functional and beautiful.

The full implications of some technological advances were not evident for many years or even decades. In August 1859, for example, Edwin Drake created the world's first oil well near Titusville, Pennsylvania, using drilling technology he observed in local salt mines. By 1900, Pennsylvania produced half of the world's oil supply and there was drilling activity in thirteen other states. However, the uses of oil were limited in the nineteenth century mostly to illumination and medical products such as Vaseline jelly. Refining oil as a fuel and lubricant for cars, ships, and locomotives and using oil as a base for plastic and synthetic products would take place in the twentieth century.

The nineteenth century was also a time when inventors became celebrated as central figures in the spectacular growth of technology. Through newspapers, scientific journals, and magazines, Americans learned of the accomplishments of Cyrus McCormick (reaper) and John Deere (steel plow), who revolutionized agricultural production in the 1830s.

Samuel Morse's invention of the telegraph (1835) and Alexander Graham Bell's telephone (1876) made long-distance communication possible in a rapidly expanding nation. In 1846, Elias Howe patented the sewing machine, followed by Isaac Singer's improved version in 1851. The names of other inventors and innovators such as Charles Goodyear (vulcanized rubber in 1844); George Pullman (sleeping car in 1859); Oliver Winchester (repeating rifle in 1860); and Richard Gatling (machine gun in 1862) were inextricably linked with their products.

Thomas A. Edison was without question the dominant figure among this extraordinary roster of American inventors. In his lifetime, he amassed more than 1,300 patents including the electric voting machine (1869); the phonograph (1878); the incandescent lamp (1879); movie film and the motion picture camera (1889 and 1891);and the radio (1891). In New York, he constructed the world's first central electrical power plant and in Menlo Park, New Jersey, he assembled the world's first industrial research laboratory. In many respects, Edison symbolized the uniquely American approach to technology that de Tocqueville observed earlier in the century.

Edison and his fellow inventors worked in an international environment that fostered both competition and mutual support. Europe was a particularly fertile ground for new technology. A series of expositions and fairs showcased the latest achievements. Beginning with the Crystal Palace fair in London in 1851, there were at least ten major fairs that showcased the technological developments from nations throughout the world. The United States hosted three of these fairs including a Crystal Palace exhibition in New York in 1853; the Centennial exhibition in Philadelphia in 1876 (attended by ten million visitors over six months); and the World's Columbian Exposition in Chicago in 1893 (attended by twelve million people). The Chicago fair, attended by twelve million people, featured a spectacular Manufactures building, the largest such structure in the world, a dazzling display of electric lighting, and the newly invented Ferris Wheel.

The great fair in Chicago represented the convergence of invention, industry, and business. The application of technology achievements drew upon the entrepreneurial skills of a rising business class. Andrew Carnegie, for example, was able to translate the innovations in steel production into a formidable manufacturing corporation that eventually became United States Steel. John D. Rockefeller secured control of the production, refining, transportation, and distribution of oil through the Standard Oil Trust. At the end of the century, Henry Ford, improving on the inventions of European and American car makers, established a company to manufacture automobiles at an unprecedented scale.

The enormous scale of these corporate operations resulted in extraordinary wealth for America's leaders of industry, finance, and business. The marriage of technology and business also offered great opportunities for millions of American workers; however, the struggle for wages and a safe workplace led to a series of epic conflicts between labor and management that erupted in nearly every major industry. At the same time, government regulation over industry and business became necessary to ensure fair competition and to protect consumers. The impact of technology must be understood in this broad context. Just as the technology of the nineteenth century responded to the social and economic needs of a new and expanding nation, so too did the uses and consequences of technology extend into every aspect of life as America entered the modern age of the twentieth century.

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