

25.3 Improved Technology

By the 1860s, many of the factors necessary for the rapid industrialization of the United States were already in place. Machines had taken over much of the work once done by hand. Work had moved from homes to factories. Railroads had begun to connect customers and manufacturers with an efficient transportation system.

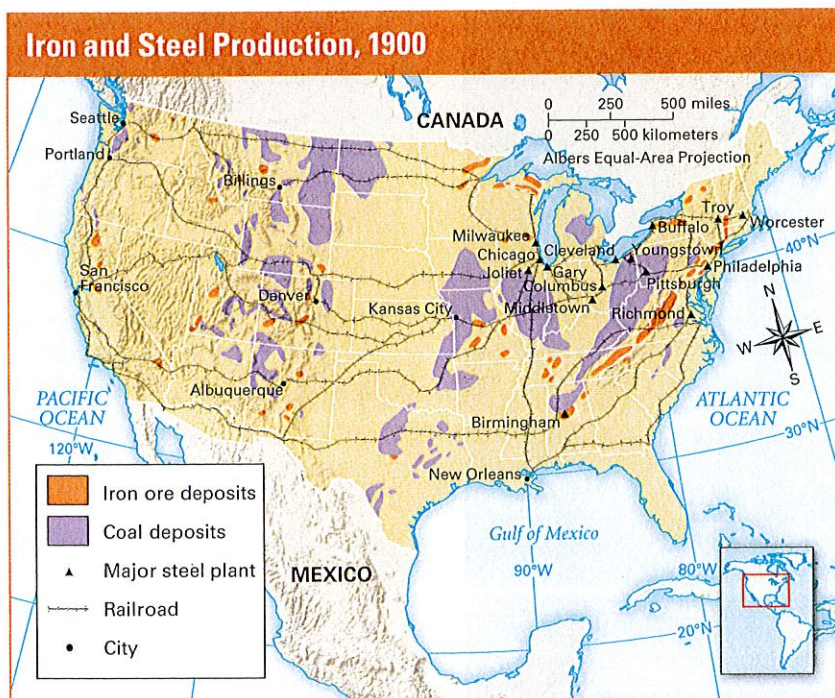
After the Civil War, new inventions and improved technology prompted the growth of new industries. Some of these innovations, or new ideas, helped businesses to grow and become more efficient. Others made daily life easier for many Americans.

The Age of Steel Before the Civil War, the nation's railroads ran on iron rails that wore out quickly. Railroad owners knew that rails made of steel—a mixture of iron, carbon, and sometimes other metals—were stronger and would last longer. Steel, however, was difficult and costly to make.

In 1872, a Scottish immigrant named Andrew Carnegie went to England to study a less expensive method of making steel, a method invented by Henry Bessemer. Carnegie owned a company that made iron bridges for railroads. He knew that his bridges would be better if they were made of steel. Carnegie was so impressed by the Bessemer process that he brought it back to the United States. "The day of iron has passed," he announced. "Steel is king!"

Carnegie was right. Within a decade, steel was replacing iron in rails, locomotives, and bridges. Other industries took advantage of steel, which was less expensive than iron. Steel nails, needles, and knives became common household items.

The nation's major steel plants in 1900 were located near or in regions with rich deposits of iron and coal. Railroads shipped ore to mills and finished steel to customers.



Many steel companies competed fiercely to supply steel for such products. To remain the leader, Carnegie hired scientists to improve the quality of his company's steel. He employed good managers to make his steel mill run efficiently. His recipe for success was "adopt every improvement, have the best machinery, and know the most."

To keep costs low, Carnegie set out to control every step in the steelmaking process. He purchased iron mines to supply his ore, coalfields to fire his furnaces, and railroads to ship his finished steel to customers.

To reduce his competition, Carnegie also bought up several

rival steel companies. He then combined them all to form the giant Carnegie Steel Company. By 1900, Carnegie Steel produced a quarter of the nation's steel.

Electric Power In 1876, Thomas Edison opened an “invention factory” in New Jersey. With a team of workers, he set out to create a “minor” invention every ten days and a major one “every six months or so.”

Edison succeeded brilliantly. More than any other inventor, he helped turn electricity into an everyday source of light and power. His workshop turned out the first practical electric lightbulb, the phonograph (record player), the motion picture projector, and many other inventions.

In 1882, Edison built the first electrical power station and distribution system in New York City. His team invented everything the system required, including generators, regulators, meters, switches, light sockets, fuse boxes, and underground electric cables. When he finally turned the generator on, electricity began to flow to homes, stores, and factories. The age of electricity had begun.

By 1900, some 25 million lightbulbs were glowing across the country. Many factories were replacing waterwheels and steam engines with electric motors. Streetcars powered by electricity carried workers and shoppers along city streets. New electric-powered devices, such as washing machines and vacuum cleaners, were making housework easier.



Collection of the New-York Historical Society, negative #2946.

Thomas Edison's invention of the lightbulb transformed the nation and gave birth to the age of electricity. In this picture of New York in the late 1880s, electric lines formed a crisscross canopy over the street. At night, these buildings glowed with electric light.

mass production the use of interchangeable parts and assembly lines to make large quantities of identical goods

The Telephone The telephone was invented by a Scottish immigrant, Alexander Graham Bell. In 1876, as he was getting ready to test his “talking machine,” Bell spilled acid on himself. “Watson—come here—I want to see you,” he commanded his assistant. Thomas Watson, who was in another room, heard every word over Bell’s telephone.

Bell’s invention worked so well that, by 1915, Americans were communicating with one another over 9 million telephones. All these telephones made American industry more efficient and competitive by allowing producers, sellers, and customers to communicate quickly and easily.

New Production Methods New methods of organizing work were also making businesses more efficient. Factory owners adopted Eli Whitney’s idea of assembling a wide variety of products from interchangeable parts. They also used the assembly line. In a shoe factory, for example, one worker operated a heel-cutting machine. Another operated a sole-cutting machine. Another made shoelaces. Still other workers assembled, labeled, and packaged the shoes.

Henry Ford was one person who foresaw the great potential in the assembly line. Ford created a moving assembly line to mass-produce automobiles. In Ford plants, workers stood in place all day, while a conveyor brought the work to them. After each worker did one or two tasks, the belt moved the product to the next worker’s station.

These techniques of **mass production** enabled workers to produce more goods per day at a lower cost. As prices dropped, more Americans could afford to buy manufactured products. More customers meant more factories. By 1900, almost four times as many Americans worked in factories as had a generation earlier.

The Triangle Factory **Mass Production in New York**

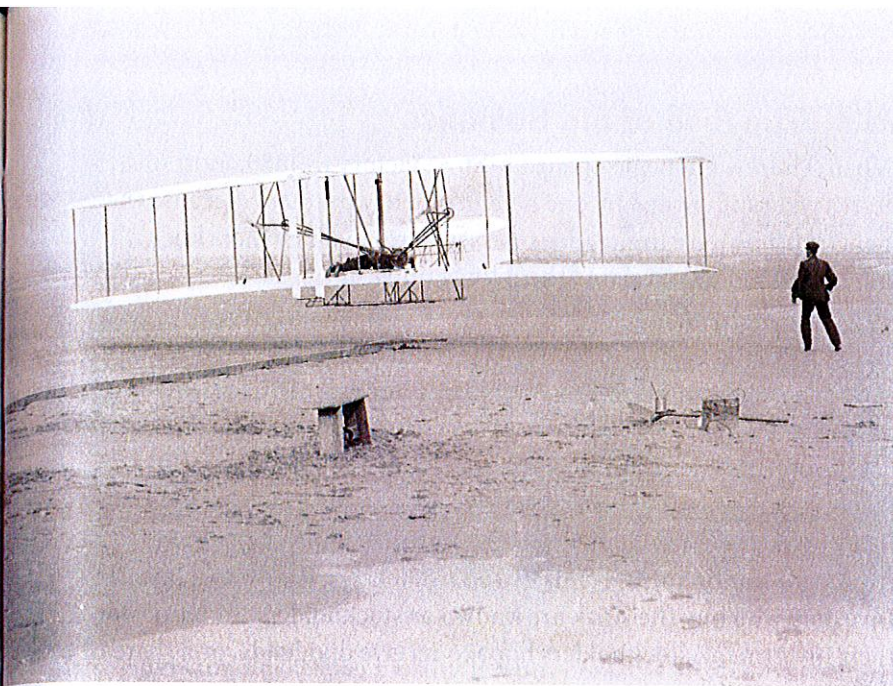
The Triangle Shirtwaist Factory was just one of many new businesses that took advantage of improved technology to mass-produce a quality product at a good price. The Triangle Factory specialized in a style of women’s blouse known as a shirtwaist. A shirtwaist had puffy sleeves, a neat collar, front buttons, and a snug waist. Women liked shirtwaists so much that by 1909, New York

City had more than 500 factories that made only this style of blouses.

Sam Bernstein, the production manager at the Triangle Shirtwaist Factory, loved watching his workers use the newest tools and production methods. Each person at the cutting tables had a special steel knife. This knife could slice through many layers of fabric at a time. This meant that

a worker could cut dozens of sleeves, fronts, and backs at one time.

On another floor of the building, Bernstein could hear the whirring of 240 sewing machines. The machines were neatly laid out in 16 tightly packed rows. Flexible belts connected each machine to a rotating axle running down each row just above the floor. This axle, which was spun by an electric motor, delivered power to the machines. The machines clattered loudly as



Lying flat on the lower wing of the 1903 Wright flyer, Orville Wright begins the first successful airplane flight in history as his brother Wilbur runs alongside during takeoff. The Wright brothers designed and built the flyer out of wood and cloth. It was powered by a gasoline engine of the Wrights' own design.

Air Transport While Henry Ford was turning out cars on the assembly line, brothers Orville and Wilbur Wright were experimenting with flying. In 1903, with his brother Wilbur running alongside, Orville successfully piloted the first “flying machine” in Kitty Hawk, North Carolina. Although the flight was only 12 seconds in duration, it sparked worldwide interest in flying.

By the late 1920s, an industry based on air travel had emerged. The U.S. postal service used planes to transport mail across the country while the military used planes for exploration and scouting. At the same time, wealthy Americans took their first commercial flights across the country.

women sewed the pieces of shirtwaists together.

Piles of finished blouses were then lifted to the floor above by electric freight elevators. There, two rows of workers gave the shirtwaists a final pressing. Finally, shipping clerks packed the shirtwaists into boxes for shipment.

Usually, the factory almost ran itself. But if a problem occurred, the company's switchboard operator could reach Bernstein by telephone on any of the factory's three floors.



Sewing machines, seamstresses, bobbins, and piles of cloth crowd this factory. Imagine working here in the heat of summer.