# The Age of Invention

## Industrial Innovations

From 1865 to 1905 the United States experienced huge industrial growth. This time period is called the Second Industrial Revolution. This new era of industrial growth began with many discoveries and inventions that changed manufacturing, transportation, and the everyday lives of Americans.

### Steel

In the late 1800s an abundance of steel helped spur the second period of industrialization. Steel was used to build machinery that produced goods and to build railroad tracks, bridges, and tall city buildings. Before the mid-1800s, the process of changing iron ore into steel was too expensive. In the 1850s Henry Bessemer and William Kelly developed a method called the Bessemer process that could produce more steel for less money. Because of this process, American steel production rose rapidly.

The increased availability of steel caused its widespread use. The railroad industry began replacing iron rails with stronger steel ones. Builders began to use steel to construct bridges and large, multistory buildings. Steel does not rust, which made it an ideal material for everyday items such as nails and wire.

### Oil

Like the advances in steel production, the development of a process to refine oil also affected industrial practices. By the 1850s a process to refine crude oil was developed. With this process, crude oil could be turned into kerosene, which could be burned in lamps for produce light or used as a fuel.

Although kerosene remained a primary product of oil refining, by 1880 refiners had developed other petroleum products that increased the uses for oil. Refiners developed waxes and lubricating oil for use in new machines.

**Electricity**

Shortly after inventing the lightbulb 1879, in 1882 Thomas Edison opened one of the world's first electric power plants in New York City. Edison's New York plant used direct current electricity. This meant that the plant could only deliver electricity to the homes and offices in a very small area around the plant.

George Westinghouse and Nikola Tesla made additional advances beginning in the late 1880s. They developed a transformer that could transmit high-voltage alternating current over long distances. The development of the alternating current allowed the use of electricity in urban households and industries to expand. By the end of the century, electric lights had begun to replace gaslights. The availability of electrical power also made possible many other major changes, including the replacement of horse-drawn vehicles by electric streetcars in many cities.

**Transportation**

Innovations in the steel and oil industries lead to advancements in the transportation industry. New technology in the late 1800s resulted in expansion of the American railroad network and new discoveries contributed to air flight and the automobile. These developments in transportation made travel much easier and brought Americans into closer contact with each other.

**Railroads**

The availability of cheap steel impacted railroad expansion. Cheaper steel encouraged railroad companies to lay thousands of miles of new track. The rapid increase of railroad lines led to a more efficient network of rail transportation. The country's first transcontinental railroad was completed in 1869. By 1900 almost a half-dozen major railroads crossed the Great Plains to the Pacific coast. Smaller lines connected the major lines to outlying areas. This huge railroad grid joined every state and linked remote towns to urban areas.

Other innovations further improved rail transportation. Bigger, more efficient locomotives made it possible to pull larger loads at faster speeds. George Westinghouse developed a compressed air brake. It increased railroad safety by allowing the locomotive and all its cars to stop at the same time. Changes in track design also improved rail service. Double sets of tracks allowed trains traveling in opposite directions to pass each other. The adoption of a standard distance between rails in the 1870s made rail transportation faster and cheaper. Passengers and freight no longer had to be transferred from train to train each time they reached a different line.

The growth of railroads had many consequences. Railroads increased western settlement by making travel affordable and easy. They also caused urban growth. Railroad companies provided many of the country's jobs and they also spurred the growth of other industries.

**The Horseless Carriage**

The innovations in oil refining led to advances in the development of motors and the creation of a new mode of transportation. The horseless carriage, a self-

propelled vehicle, had a steam engine mounted to a three-wheeled carriage. The use of steam power for early automobiles was expensive and inefficient for the small amount of power needed for these carriages.

Efforts to develop a gasoline-powered engine led to the creation of a more practical self-propelled vehicle. Innovations in oil refining led to the invention of the first internal combustion engine powered by gasoline in 1876. The 1890s brought further innovations to the horseless carriage. By the turn of the century, more Americans had begun to use the carriages in their daily lives, but their use was limited because only wealthy citizens could afford them. Nevertheless, automobile production quickly became a large commercial industry.

**Airplanes**

The internal combustion engine also led to advances in flight. Using small gasoline engines, Orville and Wilbur Wright, developed one of the first working airplanes. The Wright brother had experimented with glider designs. On December 17, 1903 Orville Wright made the first piloted flight in a powered plane.

The Wright brothers' first flight received little public attention or press coverage. However, as word of their achievement spread, a surge of related inventions and patents by other engineers demonstrated the importance of this new form of transportation.

**Communications**

Just as developments in transportation made traveling easier and brought people together, innovations in communications technology also brought Americans into closer contact. These advances also furthered the growth of American industry.

**Telegraph**

One of the most significant advances in communications in the 1800s was the telegraph. Samuel Morse developed the telegraph as a means of communicating over wires with electricity. Using Morse's dot-and-dash code, a telegraph operator could send a business order to a distant location in minutes.

The telegraph grew along with the railroad. Telegraph companies established offices in trains stations and strung telegraph wire on poles alongside the railroad lines. Telegraphs sent information for businesses, the government, newspapers, and private citizens.

**Telephone**

Patented by Alexander Graham Bell in 1876, the telephone had an even greater impact than the telegraph. Bell demonstrated his invention at the Philadelphia Centennial Exposition. Businesses quickly found the telephone indispensable. by the end of the 1800s more than a million telephones had been installed in American offices and homes.

Bell Telephone Company eventually became American Telephone and Telegraph, one of the nation's largest and longest lasting monopolies. Early telephones required operators to connect callers. Many women filled these new jobs.

**Typewriter**

Christopher Sholes developed the typewriter in 1867. By allowing users to quickly produce easily legible documents, the typewriter revolutionized communications. Although other typewriter designs had preceded Sholes' design, his

was the first to be marketed.  Sholes' keyboard design, with only a few changes, is still used today in typewriters and computers.

The invention of the typewriter soon gave rise to the use of typing pools. These business departments were made up of workers whose main task was to type. women made up the majority of workers in the typing pools.  The pools offered may working-class women the opportunity to move into a skilled profession for the first time.