5.3

Industrial Revolution Begins

One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; . . . and the important business of making a pin is, in this manner, divided into about eighteen distinct operations.

—Adam Smith, *Wealth of Nations* (1776)

Essential Question: What factors contributed to and characterized industrialization in the period from 1750 to 1900?

In addition to new ideas, new technologies were reshaping societies. These technologies led to a dramatic change in society and economies. This change was so dramatic that it is called the **Industrial Revolution.** The rigid structure of early factory work described by Adam Smith, Scottish economist and philosopher, is one of the most enduring images of the Industrial Revolution. **Industrialization,** the increased mechanization of production, and the social changes that accompanied this shift, had their roots in several influences. Among these were the Columbian Exchange and rise of maritime trading empires, increased agricultural productivity, and greater individual accumulation of capital. As the Industrial Revolution spread from Great Britain to Europe and North America, and then to the world, it reshaped society, increasing world population, shifting people from farm to city, and expanding the production and consumption of goods.

Agricultural Improvements

Just before the Industrial Revolution, in the early 1700s, an **agricultural revolution** resulted in increased productivity. **Crop rotation** (rotating different crops in and out of a field each year) and the **seed drill** (a device that efficiently places seeds in a designated spot in the ground) both increased food production. Also, the introduction of the potato from South America contributed more calories to people's diets. As nations industrialized, their populations grew because more food was available to more people. And because of improved medical care, infant mortality rates declined and people lived longer. With these demographic changes, more people were available to work in factories and to provide a market for manufactured goods.

Preindustrial Societies

During the early 18th century, most British families lived in rural areas, grew most of their food, and made most of their clothes. For centuries, wool and flax had been raised domestically, and people spun fabrics they needed.

However, one result of the commercial revolution and the establishment of maritime empires (see Topic 4.5) was that Indian cotton became available in Britain, and before long it was in high demand. Wool and flax could not be produced quickly enough or in a large enough quantity to compete with cotton imports. To compete with Indian cotton, investors in Britain began to build their nation's own cotton cloth industry. Using imported raw cotton produced by slave labor in the Americas, the British developed the **cottage industry** system, also known as the putting-out system, in which merchants provided raw cotton to women who spun it into finished cloth in their own homes.

Home spinning was hard work and pay was low, but cottage industries gave women weavers some independence. While working in their own homes, they were also close to children. But cottage industry production was slow. Investors demanded faster production, spurring the development of technologies and machinery that turned out cloth in more efficient ways.

Growth of Technology

By the mid-eighteenth century, the **spinning jenny** and the **water frame** reduced the time needed to spin yarn and weave cloth. The spinning jenny, invented by **James Hargreaves** in the 1760s, allowed a weaver to spin more than one thread at a time. The water frame, patented by **Richard Arkwright** in 1769, used waterpower to drive the spinning wheel. The water frame was more efficient than a single person's labor, and this mechanization doomed the household textile cottage industry, as textile production was moved to factories big enough to house these bulky machines. Arkwright was thus considered the father of the **factory system**.

Interchangeable Parts In 1798, inventor **Eli Whitney** created a system of **interchangeable parts** for manufacturing firearms for the U.S. military. In Whitney's system, if a particular component of a machine were to break, the broken component could easily be replaced with a new, identical part. Entrepreneurs adapted this method of making firearms to the manufacture of other products. The system of interchangeable parts was a pivotal contribution to industrial technology.

Whitney's system directly led to the **division of labor.** Factory owners no longer had to rely on skilled laborers to craft every component of a product. Instead, with **specialization of labor,** each worker could focus on one type of task. For example, one worker might cast a part, and then another worker would install the part on the finished product. In the early 20th century, Henry Ford expanded the concept of the division of labor, developing the moving **assembly line** to manufacture his Model T automobiles. (Connect: Compare the technological improvements of Islamic and Asian states with those in the Western world during the Industrial Revolution. See Topic 4.1.)

The Growth of British Cities, c. 1800

Britain's Industrial Advantages

Britain had many environmental and geographic advantages that made it a leader in industrialization. Located on the Atlantic Ocean with its many **seaways**, the country was well placed to import **raw materials** and export finished goods.

Mineral Resources Britain also had the geographic luck of being located atop immense coal deposits. Coal was vital to industrialization because when burned it could power the steam engine. The burning of this fossil fuel, an energy source derived from plant and animal remains, was also essential in the process of separating iron from its ore. Iron production (and later steel production) allowed the building of larger bridges, taller buildings, and stronger ships. Coal mining became the major industry of northern and western Britain, including South Wales, Yorkshire, and Lancashire. When the United States industrialized, coal-mining areas developed in West Virginia, Pennsylvania, and Kentucky.

Resources from the Colonies As a colonizing power, Britain also had access to resources available in its colonies, including timber for ships. Largely because of the wealth they accumulated during the trans-Atlantic slave trade,

enough British capitalists had excess **capital** (money available to invest in businesses). Without this capital, private entrepreneurs could not have created new commercial ventures.

Abundant Rivers Britain, the northeastern United States, and other regions also had a natural network of rivers supplemented by publicly funded canals and harbors. These water routes made transport of raw materials and finished products inexpensive.

Strong Fleets Britain also had the world's strongest fleet of ships, including naval ships for defense and commercial ships for trade. These ships brought agricultural products to Britain to be used to make finished products for consumers.

Protection of Private Property A vital factor that aided industrialization in Britain was the legal protection of private property. Entrepreneurs needed the assurance that the business they created and built up would not be taken away, either by other businesspeople or by the government. Not all nations offered these legal guarantees.

Growing Population and Urbanization The increases in agricultural production caused two shifts in society. As farmers grew more food, they could support more people. As they grew it more efficiently, society needed a smaller percentage of the population working in agriculture.

This growing population in rural areas did not remain there. Migration was sometimes the best of bad options. English towns had traditionally allowed farmers to cultivate land or tend sheep on government property known as "the commons." However, this custom ended with the **enclosure movement** as the government fenced off the commons to give exclusive use of it to people who paid for the privilege or who purchased the land. Many farmers became landless and destitute. The enclosure movement was thus instrumental in a wave of demographic change—forcing small farmers to move from rural areas to urban areas such as **Manchester** and **Liverpool.** The people who moved then became the workforce for the new and growing industries.

KEY TERMS BY THEME

TECHNOLOGY: Textiles
spinning jenny
water frame
James Hargreaves
Richard Arkwright
factory system

TECHNOLOGY: Agriculture
agricultural revolution
crop rotation
seed drill

ECONOMY: Manufacturing
Industrial Revolution
industrialization
cottage industry
Eli Whitney
interchangeable parts
division of labor
specialization of labor
assembly line
enclosure movement
capital

ENVIRONMENT: Britain
seaways
raw materials
Manchester
Liverpool