Industrial Revolution

INTRODUCTION

Industrial Revolution, widespread replacement of manual labor by machines that began in Britain in the 18th century and is still continuing in some parts of the world. The Industrial Revolution was the result of many fundamental, interrelated changes that transformed agricultural economies into industrial ones. The most immediate changes were in the nature of production: what was produced, as well as where and how. Goods that had traditionally been made in the home or in small workshops began to be manufactured in the factory. Productivity and technical efficiency grew dramatically, in part through the systematic application of scientific and practical knowledge to the manufacturing process. Efficiency was also enhanced when large groups of business enterprises were located within a limited area. The Industrial Revolution led to the growth of cities as people moved from rural areas into urban communities in search of work.

The changes brought by the Industrial Revolution overturned not only traditional economies, but also whole societies. Economic changes caused far-reaching social changes, including the movement of people to cities, the availability of a greater variety of material goods, and new ways of doing business. The Industrial Revolution was the first step in modern economic growth and development. Economic development was combined with superior military technology to make the nations of Europe and their cultural offshoots, such as the United States, the most powerful in the world in the 18th and 19th centuries.

The Industrial Revolution began in Great Britain during the last half of the 18th century and spread through regions of Europe and to the United States during the following century. In the 20th century industrialization on a wide scale extended to parts of Asia and the Pacific Rim. Today mechanized production and modern economic growth continue to spread to new areas of the world, and much of humankind has yet to experience the changes typical of the Industrial Revolution.

The Industrial Revolution is called a revolution because it changed society both significantly and rapidly. Over the course of human history, there has been only one other group of changes as significant as the Industrial Revolution. This is what anthropologists call the Neolithic Revolution, which took place in the later part of the Stone Age. In the Neolithic Revolution, people moved from social systems based on hunting and gathering to much more complex communities that depended on agriculture and the domestication of animals. This led to the rise of permanent settlements and, eventually, urban civilizations. The Industrial Revolution brought a shift from the agricultural societies created during the Neolithic Revolution to modern industrial societies.

The social changes brought about by the Industrial Revolution were significant. As economic activities in many communities moved from agriculture to manufacturing, production shifted from its traditional locations in the home and the small workshop to factories. Large portions of the population relocated from the countryside to the towns and cities where manufacturing centers were found. The overall amount of goods and services produced expanded dramatically, and the proportion of capital invested per worker grew. New groups of investors, businesspeople, and managers took financial risks and reaped great rewards.

In the long run the Industrial Revolution has brought economic improvement for most people in industrialized societies. Many enjoy greater prosperity and improved health, especially those in the middle and the upper classes of society. There have been costs, however. In some cases, the lower classes of society have suffered economically. Industrialization has brought factory pollutants and greater land use, which have harmed the natural environment. In particular, the application of machinery and science to agriculture has led to greater land use and, therefore, extensive loss of habitat for animals and plants. In addition, drastic population growth following industrialization has contributed to the decline of natural habitats and resources. These factors, in turn, have caused many species to become extinct or endangered.

GREAT BRITAIN LEADS THE WAY

Ever since the Renaissance (14th century to 17th century), Europeans had been inventing and using ever more complex machinery. Particularly important were improvements in transportation, such as faster ships, and communication, especially printing. These improvements played a key role in the development of the Industrial Revolution by encouraging the movement of new ideas and mechanisms, as well as the people who knew how to build and run them.

Then, in the 18th century in Britain, new production methods were introduced in several key industries, dramatically altering how these industries functioned. These new methods included different machines, fresh sources of power and energy, and novel forms of organizing business and labor. For the first time technical and scientific knowledge was applied to business practices on a large scale. Humankind had begun to develop mass production. The result was an increase in material goods, usually selling for lower prices than before.

The Industrial Revolution began in Great Britain because social, political, and legal conditions there were particularly favorable to change. Property rights, such as those for patents on mechanical improvements, were well established. More importantly, the predictable, stable rule of law in Britain meant that monarchs and aristocrats were less likely to arbitrarily seize earnings or impose taxes than they were in many other countries. As a result, earnings were safer, and ambitious businesspeople could gain wealth, social prestige, and power more easily than could people on the European continent. These factors encouraged risk taking and investment in new business ventures, both crucial to economic growth.

In addition, Great Britain's government pursued a relatively hands-off economic policy. This free-market approach was made popular through Scottish philosopher and economist Adam Smith and his book *The Wealth of Nations* (1776). The hands-off policy permitted fresh methods and ideas to flourish with little interference or regulation.

Britain's nurturing social and political setting encouraged the changes that began in a few trades to spread to others. Gradually the new ways of production transformed more and more parts of the British economy, although older methods continued in many industries. Several industries played key roles in Britain's industrialization. Iron and steel manufacture, the production of steam engines, and textiles were all powerful influences, as was the rise of a machine-building sector able to spread mechanization to other parts of the economy.

A Changes in Industry

Modern industry requires power to run its machinery. During the development of the Industrial Revolution in Britain, coal was the main source of power. Even before the 18th century, some British industries had begun using the country's plentiful coal supply instead of wood, which was much scarcer. Coal was adopted by the brewing, metalworking, and glass and ceramics industries, demonstrating its potential for use in many industrial processes.

A Iron and Coal 1

A major breakthrough in the use of coal occurred in 1709 at Coalbrookedale in the valley of the Severn River. There English industrialist Abraham Darby successfully used coke—a high-carbon, converted form of coal—to produce iron from iron ore. Using coke eliminated the need for charcoal, a more expensive, less efficient fuel. Metal makers thereafter discovered ways of using coal and coke to speed the production of raw iron, bar iron, and other metals.

The most important advance in iron production occurred in 1784 when Englishman Henry Cort invented new techniques for rolling raw iron, a finishing process that shapes iron into the desired size and form. These advances in metalworking were an important part of industrialization. They enabled iron, which was relatively inexpensive and abundant, to be used in many new ways, such as building heavy machinery. Iron was well suited for heavy machinery because of its strength and durability. Because of these new developments iron came to be used in machinery for many industries.

Iron was also vital to the development of railroads, which improved transportation. Better transportation made commerce easier, and along with the growth of commerce enabled economic growth to spread to additional regions. In this way, the changes of the Industrial Revolution reinforced each other, working together to transform the British economy.

A Steam 2

If iron was the key metal of the Industrial Revolution, the steam engine was perhaps the most important machine technology. Inventions and improvements in the use of steam for power began prior to the 18th century, as they had with iron. As early as 1689, English engineer Thomas Savery created a steam engine to pump water from mines. Thomas Newcomen, another English engineer, developed an improved version by 1712. Scottish inventor and mechanical engineer James Watt

made the most significant improvements, allowing the steam engine to be used in many industrial settings, not just in mining. Early mills had run successfully with water power, but the advancement of using the steam engine meant that a factory could be located anywhere, not just close to water.

In 1775 Watt formed an engine-building and engineering partnership with manufacturer Matthew Boulton. This partnership became one of the most important businesses of the Industrial Revolution. Boulton & Watt served as a kind of creative technical center for much of the British economy. They solved technical problems and spread the solutions to other companies. Similar firms did the same thing in other industries and were especially important in the machine tool industry. This type of interaction between companies was important because it reduced the amount of research time and expense that each business had to spend working with its own resources. The technological advances of the Industrial Revolution happened more quickly because firms often shared information, which they then could use to create new techniques or products.

Like iron production, steam engines found many uses in a variety of other industries, including steamboats and railroads. Steam engines are another example of how some changes brought by industrialization led to even more changes in other areas.

A Textiles

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The industry most often associated with the Industrial Revolution is the textile industry. In earlier times, the spinning of yarn and the weaving of cloth occurred primarily in the home, with most of the work done by people working alone or with family members. This pattern lasted for many centuries. In 18th-century Great Britain a series of extraordinary innovations reduced and then replaced the human labor required to make cloth. Each advance created problems elsewhere in the production process that led to further improvements. Together they made a new system to supply clothing.

The first important invention in textile production came in 1733. British inventor John Kay created a device known as the flying shuttle, which partially mechanized the process of weaving. By 1770 British inventor and industrialist James Hargreaves had invented the spinning jenny, a machine that spins a number of threads at once, and British inventor and cotton manufacturer Richard Arkwright had organized the first production using water-powered spinning. These developments permitted a single spinner to make numerous strands of yarn at the same time. By about 1779 British inventor Samuel Crompton introduced a machine called the mule, which further improved mechanized spinning by decreasing the danger that threads would break and by creating a finer thread.

Throughout the textile industry, specialized machines powered either by water or steam appeared. Row upon row of these innovative, highly productive machines filled large, new mills and factories. Soon Britain was supplying cloth to countries throughout the world. This industry seemed to many people to be the embodiment of an emerging, mechanized civilization.

The most important results of these changes were enormous increases in the output of goods per worker. A single spinner or weaver, for example, could now turn out many times the volume of yarn or cloth that earlier workers had produced. This marvel of rising productivity was the central economic achievement that made the Industrial Revolution such a milestone in human history.

B Changes in Society

The Industrial Revolution also had considerable impact upon the nature of work. It significantly changed the daily lives of ordinary men, women, and children in the regions where it took root and grew.

B Growth of Cities

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One of the most obvious changes to people’s lives was that more people moved into the urban areas where factories were located. Many of the agricultural laborers who left villages were forced to move. Beginning in the early 18th century, more people in rural areas were competing for fewer jobs. The rural population had risen sharply as new sources of food became available, and death rates declined due to fewer plagues and wars. At the same time, many small farms disappeared. This was partly because new enclosure laws required farmers to put fences or hedges around their fields to prevent common grazing on the land. Some small farmers who could not afford to enclose

their fields had to sell out to larger landholders and search for work elsewhere. These factors combined to provide a ready work force for the new industries.

New manufacturing towns and cities grew dramatically. Many of these cities were close to the coalfields that supplied fuel to the factories. Factories had to be close to sources of power because power could not be distributed very far. The names of British factory cities soon symbolized industrialization to the wider world: Liverpool, Birmingham, Leeds, Glasgow, Sheffield, and especially Manchester. In the early 1770s Manchester numbered only 25,000 inhabitants. By 1850, after it had become a center of cotton manufacturing, its population had grown to more than 350,000.

In preindustrial England, more than three-quarters of the population lived in small villages. By the mid-19th century, however, the country had made history by becoming the first nation with half its population in cities. By 1850 millions of British people lived in crowded, grim industrial cities. Reformers began to speak of the mills and factories as dark, evil places.

B 2 Effects on Labor

The movement of people away from agriculture and into industrial cities brought great stresses to many people in the labor force. Women in households who had earned income from spinning found the new factories taking away their source of income. Traditional handloom weavers could no longer compete with the mechanized production of cloth. Skilled laborers sometimes lost their jobs as new machines replaced them.

In the factories, people had to work long hours under harsh conditions, often with few rewards. Factory owners and managers paid the minimum amount necessary for a work force, often recruiting women and children to tend the machines because they could be hired for very low wages. Soon critics attacked this exploitation, particularly the use of child labor.

The nature of work changed as a result of division of labor, an idea important to the Industrial Revolution that called for dividing the production process into basic, individual tasks. Each worker would then perform one task, rather than a single worker doing the entire job. Such division of labor greatly improved productivity, but many of the simplified factory jobs were repetitive and boring. Workers also had to labor for many hours, often more than 12 hours a day, sometimes more than 14, and people worked six days a week. Factory workers faced strict rules and close supervision by managers and overseers. The clock ruled life in the mills.

By about the 1820s, income levels for most workers began to improve, and people adjusted to the different circumstances and conditions. By that time, Britain had changed forever. The economy was expanding at a rate that was more than twice the pace at which it had grown before the Industrial Revolution. Although vast differences existed between the rich and the poor, most of the population enjoyed some of the fruits of economic growth. The widespread poverty and constant threat of mass starvation that had haunted the preindustrial age lessened in industrial Britain. Although the overall health and material conditions of the populace clearly improved, critics continued to point to urban crowding and the harsh working conditions for many in the mills.

II I THE INDUSTRIAL REVOLUTION IN THE UNITED STATES

The economic successes of the British soon led other nations to try to follow the same path. In northern Europe, mechanics and investors in France, Belgium, Holland, and some of the German states set out to imitate Britain’s successful example. In the young United States, Secretary of the Treasury Alexander Hamilton called for an Industrial Revolution in his *Report on Manufactures* (1791). Many Americans felt that the United States had to become economically strong in order to maintain its recently won independence from Great Britain. In cities up and down the Atlantic Coast, leading citizens organized associations devoted to the encouragement of manufactures.

The Industrial Revolution unfolded in the United States even more vigorously than it had in Great Britain. The young nation began as a weak, loose association of former colonies with a traditional economy. More than three-quarters of the labor force worked in agriculture in 1790. Americans soon enjoyed striking success in mechanization, however. This was clear in 1851 when producers from many nations gathered to display their industrial triumphs at the first World’s Fair, at the Crystal Palace in London. There, it was the work of Americans that attracted the most attention. Shortly after that, the British government dispatched a special committee to the United States to study the manufacturing accomplishments of its former colonies. By the end of the century, the United States was the world leader in manufacturing, unfolding what became known as the Second

Industrial Revolution. The American economy had emerged as the largest and most productive on the globe.

A American Advantages

The United States enjoyed many advantages that made it fertile ground for an Industrial Revolution. A rich, sparsely inhabited continent lay open to exploitation and development. It proved relatively easy for the United States government to buy or seize vast lands across North America from Native Americans, from European nations, and from Mexico. In addition, the American population was highly literate, and most felt that economic growth was desirable. With settlement stretched across the continent from the Atlantic Ocean to the Pacific Ocean, the United States enjoyed a huge internal market. Within its distant borders there was remarkably free movement of goods, people, capital, and ideas.

The young nation also inherited many advantages from Great Britain. The stable legal and political systems that had encouraged enterprise and rewarded initiative in Great Britain also did so, with minor variations, in the United States. No nation was more open to social mobility, at least for white male Protestants. Others—particularly African Americans, Native Americans, other minorities, and women—found the atmosphere much more difficult. In the context of the times, however, the United States was relatively open to change. It quickly adopted many of the technologies, forms of organization, and attitudes shaping the new industrial world, and then proceeded to generate its own advances.

One initial American advantage was the fact that the United States shared the language and much of the culture of Great Britain, the pioneering industrial nation. This helped Americans transfer technology to the United States. As descriptions of new machines and processes appeared in print, Americans read about them eagerly and tried their own versions of the inventions sweeping Britain.

Critical to furthering industrialization in the United States were machines and knowledgeable people. Although the British tried to prevent skilled mechanics from leaving Britain and advanced machines from being exported, those efforts mostly proved ineffective. Americans worked actively to encourage such transfers, even offering bounties (special monetary rewards) to encourage people with knowledge of the latest methods and devices to move to the United States.

The most dramatic early example of a successful technical transfer is the case of Samuel Slater. Slater was an important figure in a leading British textile firm who sailed to the United States masquerading as a farmer. He eventually moved to Rhode Island, where he worked with mechanics, machine builders, and merchants to create the first important textile mill in the United States. Slater had worked as an apprentice under Richard Arkwright, and Slater’s mill used Arkwright’s innovative system of mechanized spinning. The firm of Almy, Brown, and Slater inspired many imitators and gave birth to a vast textile industry in New England.

The lure of the open, growing United States was strong. Its opportunities attracted knowledgeable, ambitious individuals not only from Britain but from other European countries as well. In 1800, for example, a young Frenchman named Eleuthère Irénée du Pont de Nemours brought to the United States his knowledge of the latest French advances in chemistry and gunpowder making. In 1802 he founded what would become one of the largest and most successful American businesses, E. I. du Pont de Nemours and Company, better known simply as DuPont.

B American Challenges

Soon the United States was pioneering on its own. Because local circumstances and conditions in the United States were somewhat different than those in Britain, industrialization also developed somewhat differently. Although the United States had many natural resources in abundance, some were more plentiful than others. The profusion of wood in North America, for example, led Americans to use that material much more than Europeans did. They burned wood widely as fuel and also made use of it in machinery and in construction. Taking advantage of the vast forest resources in their country, Americans built the world’s best woodworking machines.

Transportation and communication were special challenges in a nation that stretched across the North American continent. Economic growth depended on tying together the resources, markets, and people of this large area. Despite the general conviction that private enterprise was best, the government played an active role in uniting the country, particularly by building roads. From 1815 to 1860 state and local governments also provided almost three-quarters of the financing for canal construction and related improvements to waterways.

When the British began building railroads, Americans embraced this new technology eagerly, and substantial public money was invested in rail systems. By 1860 more than half the railroad tracks

in the world were in the United States. The most critical 19th-century improvement in communication, the telegraph, was invented by American Samuel F. B. Morse. The telegraph allowed messages to be sent long distances almost instantly by using a code of electronic pulses passing over a wire. The railroad and the telegraph spread across North America and helped create a national market, which in turn encouraged additional improvements in transportation and communication.

Another challenge in the United States was a relative shortage of labor. Much more than in continental Europe or in Britain, labor was in chronically short supply in the United States. This led industrialists to develop machinery to replace human labor.

C Changes in Industry

Americans soon demonstrated a great talent for mechanization. Famed American arms maker Samuel Colt summarized his fellow citizens' faith in technology when he declared in 1851, "There is nothing that cannot be produced by machinery."

C 1 Continuous-Process Manufacturing

An important American development was continuous-process manufacturing. In continuous-process manufacturing, large quantities of the same product, such as cigarettes or canned food, are made in a nonstop operation. The process runs continuously, except for repairs to or maintenance of the machinery used. In the late 18th century, inventor Oliver Evans of Delaware created a remarkable water-powered flour mill. In Evans's mill, machinery elevated the grain to the top of the mill and then moved it mechanically through various processing steps, eventually producing flour at the bottom of the mill. The process greatly reduced the need for manual labor and cut milling costs dramatically. Mills modeled after Evans's were built along the Delaware and Brandywine rivers and Chesapeake Bay, and by the time of the American Revolution (1775-1783) they were arguably the most productive in the world. Similar milling technology was also used to grind snuff and other tobacco products in the same region.

As the 19th century passed, Americans improved continuous-process technology and expanded its use. The basic principle of utilizing gravity-powered and mechanized systems to move and process materials proved applicable in many settings. The meatpacking industry in the Midwest employed a form of this technology, as did many industries using distilling and refining processes. Items made using continuous-process manufacturing included kerosene, gasoline, and other petroleum products, as well as many processed foods. Mechanized, continuous processing yielded uniform quantity production with a minimum need for human labor.

C 2 The American System

In a closely related development, by the mid-19th century American manufacturers shaped a set of techniques later known as the American system of production. This system involved using special-purpose machines to produce large quantities of similar, sometimes interchangeable, parts that would then be assembled into a finished product. The American system extended the idea of division of labor from workers to specialized machines. Instead of a worker making a small part of a finished product, a machine made the part, speeding the process and allowing manufacturers to produce goods more quickly. This method also enabled goods of much more uniform quality than those made by hand labor. The American system appeared first in New England in the manufacture of clocks, locks, axes, and shovels. Around the same time, the federal armories used an advanced version of this same system to produce large numbers of firearms, coining the term *armory practice.*

Soon a group of knowledgeable mechanics and engineers spread the American system. Many industries began to use special-purpose machines to produce large quantities of similar or even interchangeable parts for assembly into finished goods. The American system was used by inventor and manufacturer Cyrus Hall McCormick to produce his innovative reapers; Samuel Colt used it to make revolver pistols; and inventor Isaac Merrit Singer produced his popular sewing machines using this system. These kinds of products won prizes and attracted much attention at the Crystal Palace exhibition of 1851.

D The Second Industrial Revolution

As American manufacturing technology spread to new industries, it ushered in what many have called the Second Industrial Revolution. The first had come on a wave of new inventions in iron making, in textiles, in the centrally powered factory, and in new ways of organizing business and work. In the latter 19th century, a second wave of technical and organizational advances carried industrial society to new levels. While Great Britain had been the birthplace of the first revolution, the second occurred most powerfully in the United States.

With the second revolution came many new processes. Iron and steel manufacturing was transformed in the 1850s and 1860s by vastly more productive technologies, the Bessemer process and the open-hearth furnace. The Bessemer process, developed by British inventor Henry Bessemer, enabled steel to be produced more efficiently by using blasts of air to convert crude iron into steel. The open-hearth furnace, created by German-born British inventor William Siemens, allowed steelmakers to achieve temperatures high enough to burn away impurities in crude iron.

In addition, factories and their production output became much larger than they had been in the first stage of the Industrial Revolution. Some industries concentrated production in fewer but bigger and more productive facilities. In addition, some industries boosted production in existing (not necessarily larger) factories. This growth was enabled by a variety of factors, including technological and scientific progress; improved management; and expanding markets due to larger populations, rising incomes, and better transportation and communications.

American industrialist Andrew Carnegie built a giant iron and steel empire using huge new plants. John D. Rockefeller, another American industrialist, did the same in petroleum refining. Soon there were enormous advances in science-based industries—for example, chemicals, electrical power, and electrical machinery. Just as in the first revolution, these changes prompted further innovations, which led to further economic growth.

It was in the automobile industry that continuous-process methods and the American system combined to greatest effect. In 1903 American industrialist Henry Ford founded the Ford Motor Company. His production innovation was the moving assembly line, which brought together many mass-produced parts to create automobiles. Ford’s moving assembly line gave the world the fullest expression yet of the Second Industrial Revolution, and his production triumphs in the second decade of the 20th century signaled the crest of the new industrial age.

D 1 Organization and Work

Just as important as advances in manufacturing technology was a wave of changes in how business was structured and work was organized. Beginning with the large railroad companies, business leaders learned how to operate and coordinate many different economic activities across broad geographic areas. During the first phase of the Industrial Revolution, many factories had grown into large organizations, but even by 1875 few firms coordinated production and marketing across many business units. Leaders such as Carnegie and Rockefeller changed this, and firms grew much larger in numerous industries, giving birth to the modern corporation.

Within the business unit, Americans pioneered novel ways of organizing work. Engineers studied and modified production, seeking the most efficient ways to lay out a factory, move materials, route jobs, and control work through precise scheduling. Industrial engineer Frederick W. Taylor and his followers sought both efficiency and contented workers. They believed that they could achieve those results through precise measurement and analysis of each aspect of a job. Taylor’s *The Principles of Scientific Management* (1911) became the most influential book of the Second Industrial Revolution. By the early 20th century, Ford’s mass production techniques and Taylor’s scientific management principles had come to symbolize America’s place as the leading industrial nation.

D 2 Changes in Agriculture

As it had done in Britain, industrialization brought deep and often distressing shifts to American society. The influence of rural life declined, and the relative economic importance of agriculture dwindled. Although the amount of land under cultivation and the number of people earning a living from agriculture expanded, the growth of commerce, manufacturing, and the service industries steadily eclipsed farming’s significance. The proportion of the work force dependent on agriculture shrank constantly from the time of the first federal census in 1790. From that time until the end of the 19th century, farm workers dropped from about 75 percent of the work force to about 40 percent.

New technology was introduced in agriculture. The scarcity of labor and the growth of markets for agricultural products encouraged the introduction of machinery to the farms. Machinery increased productivity so that fewer hands could produce more food per acre. New plows, seed drills, cultivators, mowers, and threshers, as well as the reaper, all appeared by 1860. After that, better harvesters and binding machines came into use, as did the harvester-threshers known as combines. Farmers also used limited steam power in the late 19th century, and by about 1905 they began using gasoline-powered tractors. At about the same time, Americans began to apply science systematically to agriculture, such as by using genetics as a basis for plant breeding. These techniques, plus fertilizers and pesticides, helped to increase farm productivity.

E Changes in Society

As in Britain, the Industrial Revolution in the United States led to major social changes. Urban population grew, rural population declined, and the nature of labor changed dramatically.

E 1 Growth of Cities

As a result of the shift in economic importance from agriculture to manufacturing, American cities grew both in number and in population. From 1860 to 1900 the number of urban areas in the United States expanded fivefold. Even more striking was the explosion in the growth of big cities. In 1860 there were only 9 American cities with more than 100,000 inhabitants; by 1900 there were 38. Like the British critics of the preceding century, many Americans viewed these industrial and commercial centers as dark and dirty places crowded with exploited workers. But whatever the drawbacks of city life, urban growth in the United States was unstoppable, fueled both by the movement of rural Americans and a swelling tide of immigrants from Europe. In 1790 only about 5 percent of the American population lived in cities; today more than 75 percent does. This long-term trend is characteristic of societies experiencing industrialization and is evident today in regions of Asia and Latin America that are now undergoing an industrial revolution.

E 2 Effects on Labor

Industrialization brought to the United States conflicts and stresses similar to the ones encountered in Britain and in Europe. Those who had a stake in the traditional economy lost ground as mechanized production replaced household manufacturing. Often, skilled workers found their income and their status under attack from the new machines and the relentless division of labor. Businesses had always enjoyed considerable power in their relationships with the labor force, but the balance tipped even more in their favor as firms grew larger.

In order to counter the power of business, workers tried to form trade unions to represent them and bargain for rights. Initially they had only limited success. Occasional strikes, sometimes violent, appeared as signs of underlying tensions. Until the Great Depression of the 1930s, skilled craft workers were almost the only groups able to sustain unions. The most successful of these unions were those in the American Federation of Labor. They did not seek fundamental social or economic change, such as socialists advocated; instead they accepted industrial society and concentrated on improving the wages and working conditions of their members.

Eventually the United States digested the tensions and dislocations caused by the coming of industry and the growth of cities. The government began to enact regulations and antitrust laws to counter the worst excesses of big business. The Sherman Antitrust Act of 1890 was created to prevent corporate trusts, monopoly enterprises formed to reduce competition and allow essentially a single business firm to control the price of a product. Laws such as the Fair Labor Standards Act, enacted in 1938, mandated worker protections, including the maximum 8-hour workday and 40-hour workweek. Above all, the rising incomes and high rates of economic growth proved calming. Material progress convinced most Americans that industrialization had been a positive development, although the challenge of balancing business growth and worker rights remains an issue to this day.

I V THE INDUSTRIAL REVOLUTION AROUND THE WORLD

After the first appearance of industrialization in Britain, many other nations eagerly pursued similar changes. In the 19th century the Industrial Revolution spread not only to the United States, but

also to Germany, France, Belgium, and much of the rest of western Europe. Often, skilled British workers and knowledgeable entrepreneurs moved to other countries and taught the manufacturing techniques they had learned in Britain.

Change happened somewhat differently in each setting because of varying resources, political conditions, and social and economic circumstances. In France, industrial development was somewhat delayed by political turmoil and a lack of coal, but the central government played a more active role in development than Britain's had. Both countries created railroad networks, for example, but the British did so entirely through private companies, while the French central government funded much of its country's railways. Craft production, in which people make decorative or functional items by hand, also remained a more significant element in the French economy than it did in Britain. In some industries, such as furniture manufacturing, the extent of mechanization was not as great as it had been in Great Britain.

In Germany the central government's role was also greater than it had been in Great Britain. This was partly because the German government wanted to hasten the process and catch up with British industrialization. Germany used its rich iron and coal resources to develop heavy industry, such as iron and steel manufacture. It also proved to be an environment that encouraged big businesses and cooperation among large firms. The German banking sector, for example, was dominated by a few large banks that coordinated efforts to increase industry.

In Russia, the government made repeated efforts to enable industrialization, sometimes hiring foreigners to build and operate whole factories. On the whole, however, industrialization spread more slowly there, and the Russian economy remained overwhelmingly agricultural for a long time. Even in largely industrialized areas, such as western Europe and the United States, some areas lagged behind in industrial development. Southern Italy, Spain, and the American South remained largely agrarian until much later than their neighbors. In Asia, industrialization varied, although as a whole it came much later than Western European development.

In Japan, the first industrial Asian nation, the central government made industrialization a national goal during the late 19th century. Industrialization in some areas of China began in the early 20th century and increased near the end of the century. Other Asian and Pacific Rim countries, such as South Korea and Taiwan, began to industrialize after the 1960s.

In Southeast Asia, sub-Saharan Africa, India, and much of Latin America—areas that were colonies of Western nations, or that were dominated by other nations for long periods—industrialization was much more delayed than in many other areas. The legacies of colonialism made widespread change difficult because the society and economy of colonies were heavily controlled by and dependent on the parent country.

Although different cultures produced distinctive variations of an industrial revolution, the similarities are striking. Mechanization and urbanization were central to each area in which the Industrial Revolution succeeded, as were accompanying tensions and disruptions. In most societies, the truly revolutionary changes came during the first 75 to 100 years after the process of industrialization began. After that, factory production dominated manufacturing, and most people moved to cities.

V COSTS AND BENEFITS

The modern, industrial societies created by the Industrial Revolution have come at some cost. The nature of work became worse for many people, and industrialization placed great pressures on traditional family structures as work moved outside the home. The economic and social distances between groups within industrial societies are often very wide, as is the disparity between rich industrial nations and poorer neighboring countries. The natural environment has also suffered from the effects of the Industrial Revolution. Pollution, deforestation, and the destruction of animal and plant habitats continue to increase as industrialization spreads.

Perhaps the greatest benefits of industrialization are increased material well-being and improved healthcare for many people in industrial societies. Modern industrial life also provides a constantly changing flood of new goods and services, giving consumers more choices. With both its negative aspects and its benefits, the Industrial Revolution has been one of the most influential and far-reaching movements in human history.