

Modern Inventions

Great advancements in medicine and technology accompanied the Industrial Revolution in England. Industrialization competition between nations motivated new scientific inventions, which improved factory efficiency and increased productivity. Industrialization and innovation in England spurred the growth of industry in other European countries, as well as the United States, leading to further discoveries. Some major discoveries are listed below.



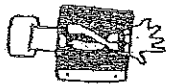
In 1796 Edward Jenner discovered that by injecting someone with a small dose of a disease such as cowpox, it was possible to prevent that person from contracting the full-blown disease in the future. Through developing vaccination, Jenner saved more lives than any other person had in history.



In 1876 Alexander Graham Bell created a revolution in communications with his invention of the telephone.



In 1879 Thomas Edison discovered the light bulb, which resulted in great domestic demand for light bulbs in homes. Electricity began to be used to power motors, which in turn powered railways and machinery.



In 1895, The German Wilhelm Röntgen developed the first x rays, which enabled doctors to see what procedures needed to be done before surgery. Medical schools came to realize the value of using corpses to train medical students to perform surgery, resulting in far better surgeons.

In the next century, the revolutionary age in inventions would continue with such developments as the radio, the car, and later, the television.

Working Conditions and Wages




Until about 1750, most people in Britain lived in small villages and farmed, raised animals, or worked as craftspeople. Farming families also spun wool or wove cloth in their homes to sell at the market. Men, women, and children worked hard every day of the week from morning until night, but most still struggled to earn a living.

As the Industrial Revolution developed through the eighteenth and nineteenth centuries, more and more people moved away from their villages to work in mines and textile factories. A common working day in a factory was 12 to 14 hours long, with short breaks for meals. Workers labored six days a week in 80-degree heat with machinery that needed constant attention. Overseers (managers) fined workers or threatened to fire them if they were not paying close attention to their work at all times. The factories were extremely dirty and dangerous, with low ceilings, locked windows and doors, and poor lighting. Workers risked losing limbs from loud, unguarded machines or getting serious throat or lung infections from the hot, polluted factory air.

A prominent nineteenth-century writer, Charles Dickens, describes the rhythm of life for the factory workers in his book *Hard Times*:

[They were] all equally like one another. All went in and out at the same hours, with the same sound upon the same pavement, to do the same work to whom every day was the same as yesterday and tomorrow, and every year the counterpart of last and the next.

Employers paid low wages and would reduce them if workers were late or business was bad. Some factory owners paid their employees with vouchers for goods at their own stores, where they kept prices very high. Below is a breakdown of the wages paid to workers in the 1780s.

		
men	women	children
10 to 15 shillings per week	5 shillings per week	1 shilling per week

(In the early 1800s, one pound of tea cost 6 shillings, and rent cost 5 shillings a month.)

Child Labor

With the coming of the Industrial Revolution in England in the mid 1700s, children shifted from working on farms or in the home to working in textile factories, brick yards, and coal mines. Once children began working in the factories, parents could no longer watch over them as they had previously when they worked on farms. Poor families could not afford enough food to keep their children healthy, so children had weaker bodies and were more likely to get sick from the dusty air or become deformed from accidents with machines. Factory owners paid children extremely low wages—10 percent of adult males' wages—for long hours and often difficult work.

As concerns about the welfare of children rose in the mid 1800s, Parliament (the English government legislature) held investigations to find out the conditions of children workers. Below is an interview between a parliamentary investigator and factory worker Elizabeth Bentley about her experiences:

What time did you begin to work at a factory? *When I was six years old.*

What was your business in that mill? *I was a little doffer [worker who changes the bobbins on the frames in the spinning machines].*

What were your usual hours of labor in that mill? *From 6 in the morning till 7 at night.*

What time was allowed for your meals? *Forty minutes at noon.*

Had you any time to get your breakfast or drinking? *No, we got it as we could.*

Do you consider doffing a laborious [hard, tiring] employment? *Yes.*

Does [your work] keep you constantly on your feet? *Yes, there are so many frames, and they run so quick.*

Your labor is very excessive? *Yes; you have not time for anything.*

Suppose you flagged [slowed down] a little, or were too late, what would they do? *Strap [beat] us.*

Are they in the habit of strapping those who are last in doffing? *Yes.*

Constantly? *Yes.*

Girls as well as boys? *Yes.*

Have you ever been strapped? *Yes.*

Severely? *Yes.*

Could you eat your food well in that factory? *No, indeed, I had not much to eat, and the little I had I could not eat it, my appetite was so poor, and being covered with dust; and it was no use to take it home, I could not eat it, and the overlooker took it, and gave it to the pigs.*

Changing Role of Women

Before the industrial era, most women in Britain worked with men on farms and in domestic (home) industries. Women usually managed the dairy, gardens, orchards, and farm animals. They were also primarily responsible for raising children and running the household.

During the Industrial Revolution, many women moved with their families to urban areas and began to work in textile (cloth) mills and other factories. The shift to work in the factories meant women spent long hours away from their children and could only do the housework after 12 to 14 hours of labor outside the home. Women and men no longer worked together as partners, and there was little time to spend with children.

Working conditions in the factories were hazardous. Lace workers wore wooden rods along their backs to support them during the long hours they bent over their work, resulting in deformed ribs and chests. This made women more susceptible (at risk) to lung disease, which also plagued textile factory workers, who breathed the stuffy, dusty air in the mills. Women's long skirts and hair made them more likely to be caught in the machinery and crippled.

Many women worked as domestic (household) servants in the homes of wealthy people. Single women left their homes to serve as cooks, maids, and nurses for children. By the late 1800s, one third of all women employed outside of their homes were domestic workers.

Women were paid one-half to one-third of men's wages, making 5 shillings a week when men made 10 to 15 in 1780. Women had few rights, and most of their earnings by law had to be given to their fathers or husbands. Many factory owners preferred to hire women because they were cheaper employees and more submissive (obedient) since they needed their wages to support children at home. Women were preferred as household workers because it was considered better for women than men to work with children.

Conditions in the Coal Mines

Coal mining was common in England by the beginning of the eighteenth century. Coal was used in place of wood for fueling stoves in the manufacture of bricks, dyes, glass, and other products, and in heating homes. After the steam engine was invented, more coal was needed to heat the water into steam, so more mines were dug deeper into the ground. More workers were also needed to fulfill the rising demand for coal. In 1750 British workers mined 5,000,000 tons of coal. By 1830 miners were producing 23,000,000 tons.

Men, women, and children worked in the mines, and sometimes whole families would work together. Mine workers labored half-naked in the hot underground tunnels cutting coal by hand and dragging it up to the surface. Women and children often had to crawl through narrow underground passages—some as low as 16 to 18 inches in height—pulling coal carts for 10 to 20 miles a day. The mines were damp and dark, and workers risked lung diseases from breathing air full of coal dust. Betty Harris, a “drawer” who pulled a coal cart through the mine passages, described her work:

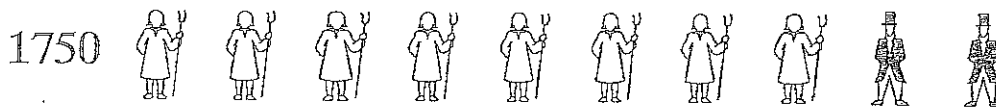
I have a belt around my waist, and a chain passing between my legs, and I go on my hands and feet. The road is very steep, and we have to hold by a rope; and when there is no rope, by anything we can catch hold of. There are six women and about six boys and girls in the pit I work in; it is very had work for a woman. The pit is very wet where I work, and the water comes over our clog-tops always, and I have seen it up to my thighs; it rains in at the roof terribly. My clothes are wet through almost all day long.

Workers in the coal mines had to face the dangers of drowning from underground floods and suffocation from poisonous gases. Frequent explosions were caused when the candle flames miners used to find their way through the mine met with explosive marsh gas. Before 1810, when wooden props were made to support tunnel roofs, cave-ins were also common.

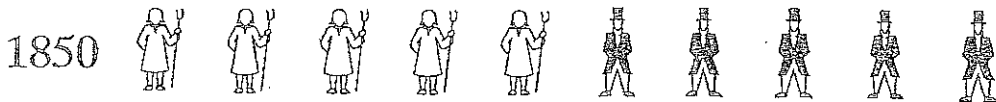
Urbanization

In the mid 1700s, more than half of the population in Britain lived and worked on farms. Between 1750 and 1851, the population increased dramatically. At the same time, the enclosure of open fields into compact farms displaced many small farming families. These families often moved to towns to find work in factories and workshops.

As industry grew, more people moved into urban areas, creating huge population increases in the cities. The figures on the change in the rural and urban populations are as follows:



8 out of every 10 English people lived in the country.



5 out of every 10 English people lived in the country.

Factory owners rushed to build workers' housing, which was dark, poorly constructed, and badly ventilated. Houses were built back to back in long rows, and people lived in cramped conditions. Poor families had only a basement or an outhouse to sleep in, and orphans and the unemployed were forced to live on the street. Twenty families shared one toilet and water pump. Without proper sewers or trash collection, garbage littered the streets, so diseases like typhoid, measles, and cholera spread quickly. Crime was also a persistent problem since there was no official police force.

Extremely hard work, combined with the harsh living conditions of the workers in the cities, led to much shorter life expectancy for city-dwellers, as can be seen below:



In 1842 a farmer in a rural area could expect to live 38 years.



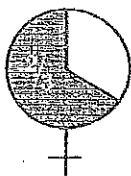
In 1842 a worker in the city of Manchester could expect to live only 17 years.

Education

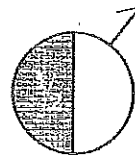
During the 1700s, few children received any formal education. Although some wealthy people sponsored Charity Schools for poor children, many working-class children still were not able to attend school. Often this was because they did not have enough clothing or were forced to work or beg on the streets during the day to help support their families. Those children who were fortunate enough to attend school tended to receive only minimal education.

Elementary schools were run by older women or men who were poor and could not find other employment. They would simply put a sign in their window saying "SKOOL." Wealthier schools could afford paper notebooks, while poorer schools made children practice the alphabet by forming letters with sticks in a pile of sand on the floor.

The nineteenth century led to changes and advances in education. The government became worried about the large number of children working in factories all day and began providing more financial support to schools. Laws enacted during the nineteenth century increasingly mandated (ordered) that children be educated for a certain number of hours per day, and insisted that all students learn the basic skills of reading, writing, and arithmetic. In 1833 children aged 9 to 13 had to receive two hours of education a day by law; by 1880 six hours of education were made mandatory for all 5- to 10-year-old children. However, even with these acts, the majority of workers could not read or write. The graphs below show the literacy rates around 1850:



Fraction of women who
could not read or write

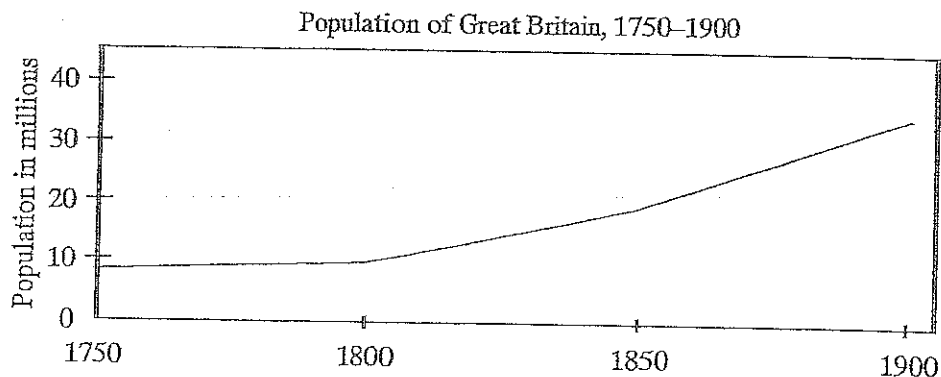


Fraction of men who
could not read or write

In response to the new, competitive world of industry, technical schools began to develop. This new type of secondary school provided technical and industrial training for young people who had finished grammar school and were waiting to begin an apprenticeship a few years later. This effectively increased the ability of children to become skilled industrial workers in the new age of manufacturing and technology.

Changing Class Structure

An enormous population boom accompanied the Industrial Revolution, as the following graph demonstrates:



This in turn created a great demand for employment, and many people moved to cities to find work. Before the Industrial Revolution, class structure in England was formed primarily around occupational groups—artisans, merchants, and farmers. In farming villages, people were divided into the landowning elite and the peasantry, and the middle class included only a small number of people.

The age of industry brought with it changes in class structure. Ownership of land ceased to be the chief distinction between social classes. A new social class developed: the industrial capitalists (owners of wealth used in business) who organized, oversaw, and ran the factories. These people came from a variety of backgrounds—some were born into wealthy families, others were inventors, farmers, or merchants. All managed to become rich and powerful through their adaptability to fast changes, leadership, and energy.



Related to the industrial capitalists was a growing urban middle class. This included people in long-established professions, such as doctors and lawyers, as well as the new merchants, shopkeepers, factory clerks, and managers who arose as a result of large-scale industrialization.



A less fortunate effect of the Industrial Revolution was the growth of the urban poor, a much larger group. These were poverty-stricken workers who congregated in the slums around factories and lived in appalling conditions. It was extremely difficult for children of working-class parents to move to a higher class. Upward mobility required education, which was often a luxury not available to children working in factories.



Industrial Production

As the first industrialized country, Britain had an important head start that helped it become the world's industrial leader. In the beginning, technology and new machinery were relatively inexpensive, and the British economy was prosperous enough to support investments in them. Later, the young British industries had a monopoly (complete control in the market) on their products and reaped great profits, thus allowing them to finance further growth and development. Britain dominated world industry in the nineteenth century. By the time other European nations tried to catch up, British industries were very strong, and it was expensive to buy the new machinery and technology all at once.



Cotton was Britain's greatest industry, and merchants all over the world purchased British cotton cloth.



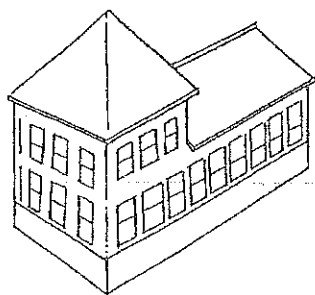
Inventions like the steam engine pushed ahead the coal industry, and innovations in iron smelting and a new demand for iron tools in factories fueled the growth of the British iron industry. Soon England was the world's greatest iron and coal manufacturer.



Railways were developing alongside industry. Henry Bessemer's discovery of a new process by which iron could be relatively easily converted into steel resulted in tremendous growth for the British steel industry. While in 1830 only 70 miles of steel railway tracks existed in Britain, by 1870 15,000 miles had been built. This improved communication between areas of the country tremendously.

Modern Buildings

Architecture became modernized due to the Industrial era. In response to overcrowded populations in industrial towns, developers built row houses and multi-story tenements (apartment buildings). The urban middle class, which arose as a result of industrialization, lived in homes reflective of newfound wealth and security. In London, they built sturdy five- or six-story townhouses and spacious apartments. The upper class separated itself from the industrial slums. They built their homes to the west of factories so that the smog from the factory smokestacks would blow away from them.



The best areas of these new industrial cities benefited from innovations in architecture. Instead of churches, buildings such as city halls, stock exchanges, and opera houses were erected to usher in the modern era. Perhaps the most grandiose architectural triumph was the construction of the Crystal Palace in London. This enormous building made of glass and iron housed international contributions to the "Exhibition of the Works of Industry of All Nations" held in 1851. The Great Exhibition, whose purpose was to celebrate the age of industrialization, attracted six million visitors to London.