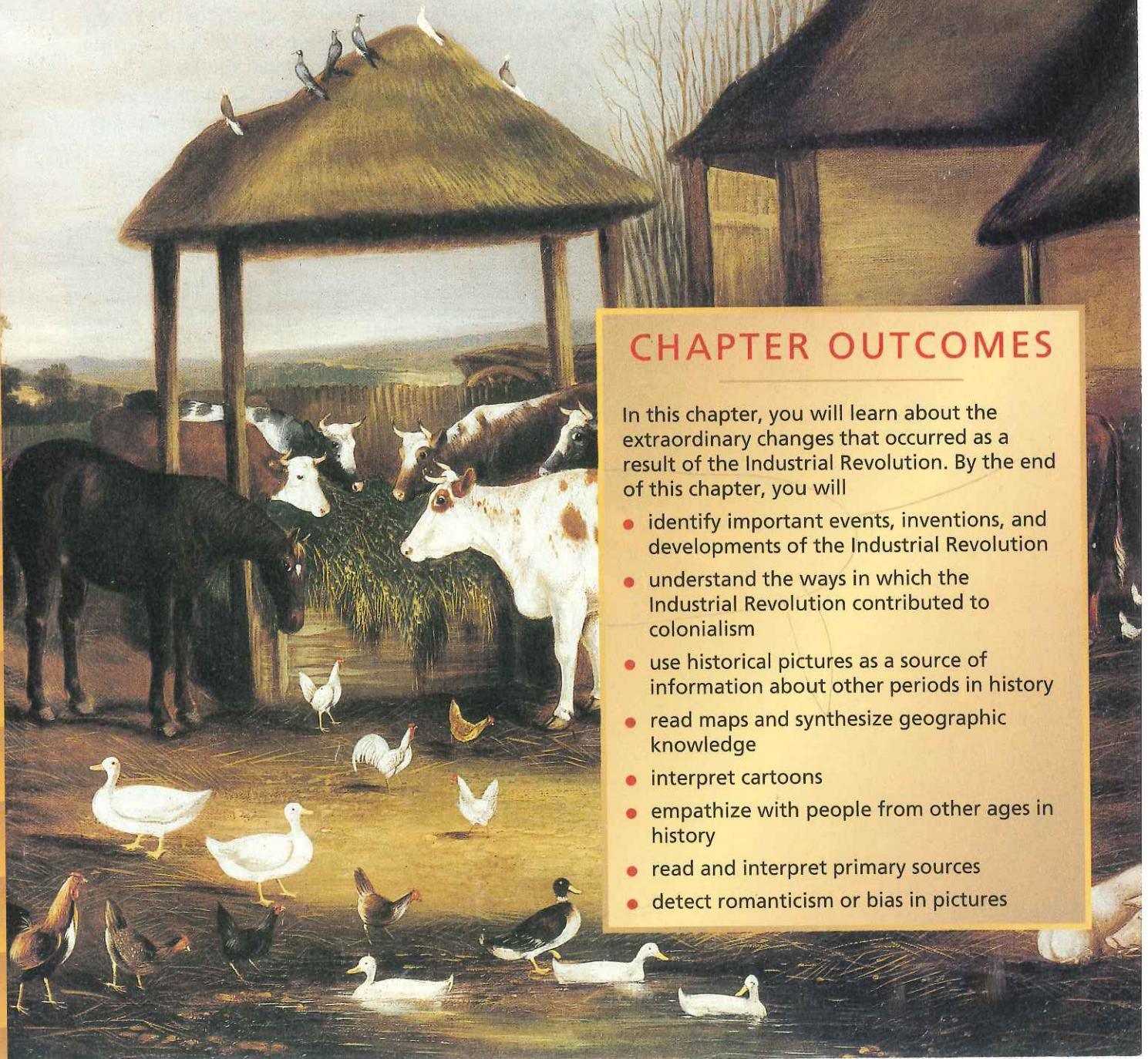


# 5 THE TRIUMPH OF STEAM

## CHAPTER OUTCOMES

In this chapter, you will learn about the extraordinary changes that occurred as a result of the Industrial Revolution. By the end of this chapter, you will

- identify important events, inventions, and developments of the Industrial Revolution
- understand the ways in which the Industrial Revolution contributed to colonialism
- use historical pictures as a source of information about other periods in history
- read maps and synthesize geographic knowledge
- interpret cartoons
- empathize with people from other ages in history
- read and interpret primary sources
- detect romanticism or bias in pictures



# Oliver Twist's Offence

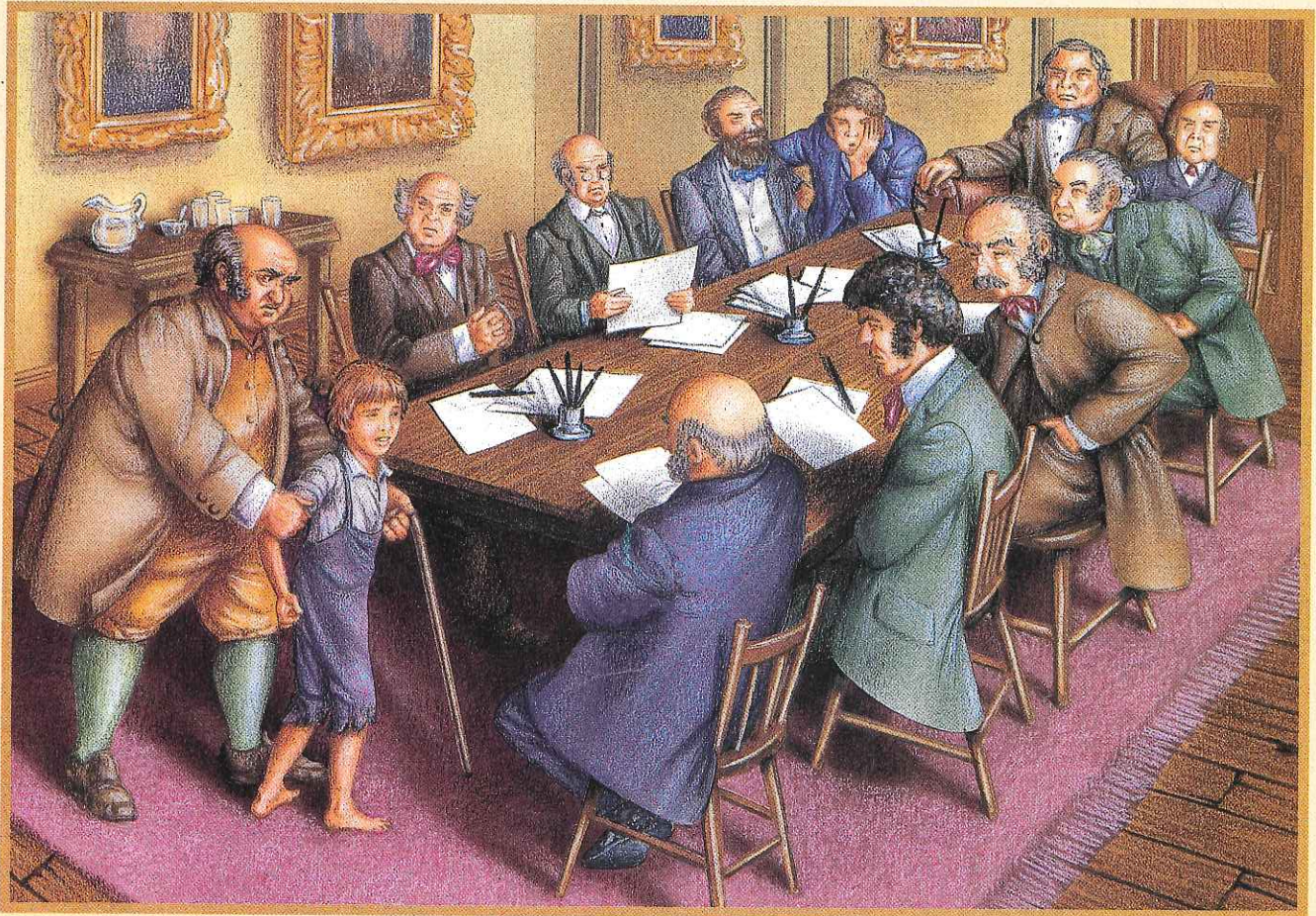
*Oliver Twist was written by the English writer Charles Dickens in 1838. Dickens himself had experienced life in a workhouse. As a young boy, he had worked in a blacking factory while his father was in debtor's prison. The experiences he endured during this time made him feel utterly hopeless, and forever changed Dickens's outlook on the society around him. This excerpt from the novel describes how the orphan, Oliver Twist, is chosen to ask for more food at the workhouse, and the consequences of his action.*

Oliver had not been within the walls of the **workhouse** a quarter of an hour and had scarcely completed the demolition of a second slice of bread when Mr. Bumble, who had handed him over to the care

of an old woman, returned; and telling him it was **board** night, informed him that the board had said he was to appear before it forthwith.

Not having a clearly defined notion of what a live board was, Oliver was rather astounded by

this intelligence and was not quite certain whether he ought to laugh or cry. He had no time to think about the matter, however, for Mr. Bumble gave him a tap on the head with his cane to wake him up and another on the back to make



Oliver meets the board of the workhouse.

him lively; and, bidding him follow, conducted him into a large whitewashed room where eight or ten fat gentlemen were sitting around a table. At the top of the table, seated in an armchair rather higher than the rest, was a particularly fat gentleman with a round, red face.

"Bow to the board," said Bumble. Oliver brushed away two or three tears that were lingering in his eyes and, seeing no board but the table, fortunately bowed to that.

"What's your name, boy?" said the gentleman in the high chair.

Oliver was frightened at the sight of so many gentlemen, which made him tremble, and the **beadle** gave him another tap behind which made him cry. These two causes made him answer in a very low and hesitating voice. Whereupon a gentleman in a white waistcoat said he was a fool, which was a **capital** way of raising his spirits and putting him quite at his ease.

"Boy," said the gentleman in the high chair, "listen to me. You know you are an orphan, I suppose?"

"What is that, sir?" enquired poor Oliver.

"The boy *is* a fool—I thought he was," said the gentleman in the white waistcoat.

"Hush!" said the gentleman who had spoken first. "You know you've got no father or mother and that you were brought up by the parish, don't you?"

"Yes, sir," replied Oliver, weeping bitterly.

"What are you crying for?" enquired the gentleman in the

white waistcoat. And to be sure it was very extraordinary. What *could* the boy be crying for?

"I hope you say your prayers every night," said another man in a gruff voice, "and pray for the people who feed and take care of you—like a Christian."

"Yes, sir," stammered the boy.



"Well! You have come here to be educated, and taught a useful trade," said the red-faced gentleman in the high chair.

"So you'll begin to pick **oakum** tomorrow morning at six o'clock," added the surly one in the white waistcoat.

For the combination of both these blessings in the one simple process of picking oakum, Oliver bowed low by the direction of the beadle and was then hurried away to a large ward where, on a rough, hard bed, he sobbed himself to sleep. What a noble illustration of the tender laws of England! They let the **paupers** go to sleep.



The room in which the boys were fed was a large stone hall, with a **copper** at one end out of which the master, dressed in an apron for the purpose and assisted by one or two women, ladled the **gruel** at mealtimes. Of this festive composition each boy had one **porringer**, and no more—except on occasions of great public rejoicing, when he had two ounces [57 grams] and a quarter of bread besides. The bowls never wanted washing. The boys polished them with their spoons till they shone again; and, when they had performed this operation (which

never took very long, the spoons being nearly as large as the bowls), they would sit staring at the copper with such eager eyes as if they could have devoured the very bricks of which it was composed; employing themselves, meanwhile, in sucking their fingers most **assiduously** with the view of catching up any stray splashes of gruel that might have been cast thereon. Boys generally have excellent appetites. Oliver Twist and his companions suffered the tortures of slow starvation for three months; at last they got so **voracious** and wild with hunger that one boy, who was tall for his age and hadn't been used to that sort of thing (for his father had kept a small cook shop), hinted darkly to his companions that, unless he had another basin of gruel **per diem**, he was afraid he might some night happen to eat the boy who slept next him, who happened to be a weakly youth of tender age. He had a wild hungry eye, and they **implicitly** believed him. A council was held; lots were cast who should walk up to the master after supper that evening and ask for more; and it fell to Oliver Twist.

The evening arrived; the boys took their places. The master, in his cook's uniform, stationed himself at the copper; his pauper assistants ranged themselves behind him; the gruel was served out; and a long grace was said over the **short commons**. The gruel disappeared; the boys whispered to each other and winked at Oliver; while his next neighbours nudged him. Child as he was, he was desperate with hunger and reckless with misery. He rose from the table and, advancing to the master, basin

and spoon in hand, said, somewhat alarmed at his own **temerity**:

"Please, sir, I want some more."

The master was a fat, healthy man, but he turned very pale. He gazed in **stupefied** astonishment on the small rebel for some seconds and then clung for support to the copper. The assistants were paralyzed with wonder; the boys with fear.

"What!" said the master at length in a faint voice.

"Please, sir," replied Oliver, "I want some more."

The master aimed a blow at Oliver's head with the ladle; **pinioned** him in his arms; and shrieked aloud for the beadle.

The board were sitting in solemn conclave when Mr. Bumble rushed into the room in great excitement and, addressing the gentleman in the high chair, said:

"Mr. Limbkins, I beg your

pardon, sir! Oliver Twist has asked for more!"

There was a general start. Horror was depicted on every countenance.

"For *more!*" said Mr. Limbkins. "Compose yourself. Bumble, and answer me distinctly. Do I understand that he asked for more, after he had eaten the supper allotted by the **dietary?**"

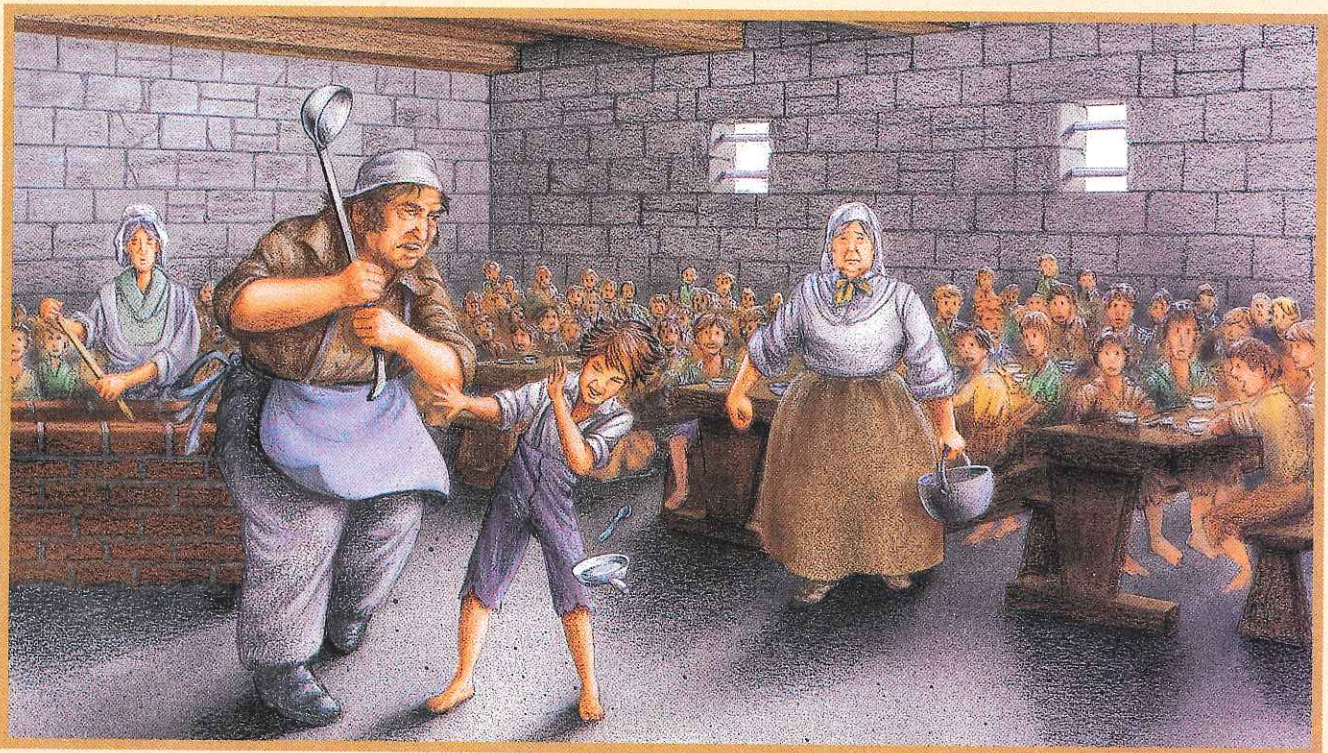
"He did, sir," replied Bumble.

"That boy will be hung," said the gentleman in the white waistcoat. "I know that boy will be hung."

Nobody **controverted** the **prophetic** gentleman's opinion. An animated discussion took place. Oliver was ordered into instant confinement; and a bill was next morning pasted on the outside of the gate, offering a reward of five pounds to anyone who would take Oliver Twist off the hands of the parish.

◆ ◆ ◆  
For a week ... Oliver remained a close prisoner in the dark and solitary room to which he had been consigned by the wisdom and mercy of the board .... He only cried bitterly all day; and, when the long dismal night came on, spread his little hands before his eyes to shut out the darkness, and, crouching in the corner, tried to sleep; **ever and anon** waking with a start and tremble and drawing himself closer and closer to the wall, as if to feel even its cold hard surface were a protection in the gloom and loneliness which surrounded him.

Let it not be supposed by the enemies of "the system" that, during the period of his solitary **incarceration**, Oliver was denied the benefit of exercise, the pleasure of society, or the advantages of religious consolation. As for exercise, it was nice cold weather, and he was allowed to perform his



The reaction to Oliver's request for more food

**ablutions** every morning under the pump in a stone yard in the presence of Mr. Bumble, who prevented his catching cold and caused a tingling sensation to pervade his frame by repeated applications of the cane. As for society, he was carried every day into the hall where the boys dined and there sociably flogged as a public warning and example. And, so far from being denied the advantages of religious **consolation**, he was kicked into the same apartment every evening at prayer-time and there permitted to listen to, and console his mind with, a general **supplication** of the boys containing a special clause, therein inserted by authority of the board, in which they **entreated** to be made good, virtuous, contented, and obedient, and to be guarded from the sins and vices of Oliver Twist....

**workhouse:** a house in which poor people are lodged and sent to work

**board:** the people who direct a particular business, in this case, the workhouse

**beadle:** the person in day-to-day charge of the workhouse

**capital:** excellent (British slang)

**oakum:** loose fibres picked from old ropes that are used to caulk ships

**pauper:** a person with no money at all



Oliver in solitary confinement

**copper:** large boiler used for cooking or laundering

**gruel:** a light, thin liquid made by boiling a cereal such as oatmeal in water

**porringer:** one-handed metal bowl or cup

**assiduously:** attentively

**voracious:** extremely hungry

**per diem:** per day

**implicitly:** implied, not openly stated

**short commons:** small amount of food

**temerity:** reckless boldness

**stupefied:** to be struck senseless

**to pinion:** to bind or hold fast

**dietary:** a regulated allowance of food

**to controvert:** to dispute or deny

**prophetic:** giving warning of what is to come

**ever and anon:** now and again

**to incarcerate:** to imprison

**ablution:** washing

**to console:** to comfort

**to supplicate:** to beg

**to entreat:** to beg

## ACTIVITIES

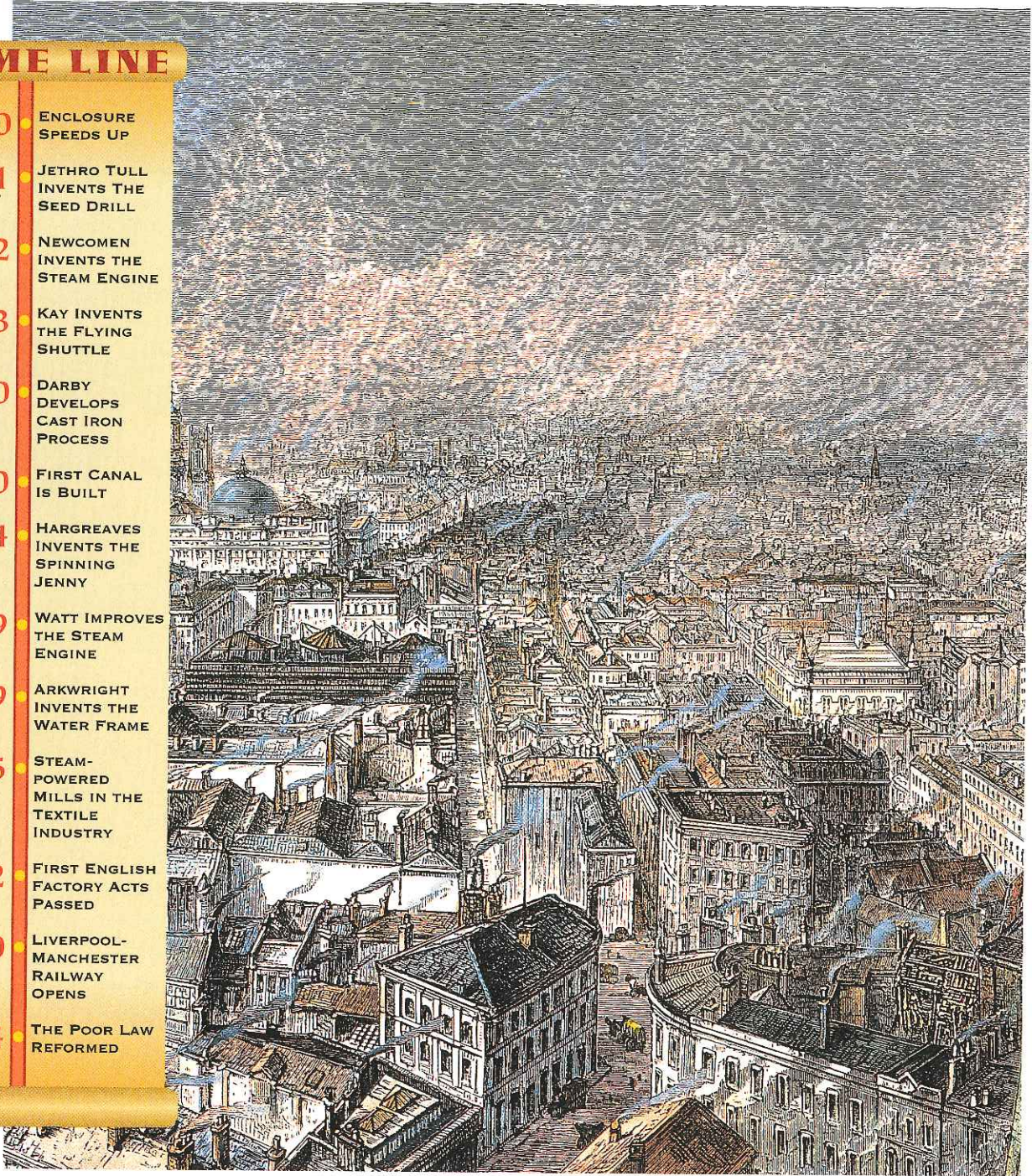
1. This short excerpt shows how Dickens used humour to draw attention to a serious situation. In particular, he used irony. Irony is using language that appears to mean one thing on the surface, when the writer actually means the opposite. Find three examples of irony and explain the double meaning of each.
2. Dickens is famous for the names he gave to his characters—Uriah Heap, Mr. Gradgrind, and Little

Dorrit are a few examples. Often these names help us to visualize the person. Does the name "Bumble" help you to visualize the beadle? Describe Bumble, and explain why Dickens gave him this name.

3. In this excerpt, we learn a lot about the workhouse from Oliver's point of view. What point of view did the board members have towards the workhouse?

## TIME LINE

- 1700 • ENCLOSURE SPEEDS UP
- 1701 • JETHRO TULL INVENTS THE SEED DRILL
- 1712 • NEWCOMEN INVENTS THE STEAM ENGINE
- 1733 • KAY INVENTS THE FLYING SHUTTLE
- 1750 • DARBY DEVELOPS CAST IRON PROCESS
- 1760 • FIRST CANAL IS BUILT
- 1764 • HARGREAVES INVENTS THE SPINNING JENNY
- 1769 • WATT IMPROVES THE STEAM ENGINE
- 1769 • ARKWRIGHT INVENTS THE WATER FRAME
- 1785 • STEAM-POWERED MILLS IN THE TEXTILE INDUSTRY
- 1802 • FIRST ENGLISH FACTORY ACTS PASSED
- 1830 • LIVERPOOL-MANCHESTER RAILWAY OPENS
- 1834 • THE POOR LAW REFORMED



*The earth was made for Dombey and Son to trade in, the sun and the moon were made to give them light. Rivers and seas were made to float their ships...*

—CHARLES DICKENS

Charles Dickens caught the spirit of the Industrial Revolution—that humankind had entered a bold new era of progress in which the exploitation of the earth’s resources would greatly improve the material well-being of humanity.

## INTRODUCTION

Not all **revolutions** are violent. Some revolutions happen as a result of new inventions and new ways of doing things. After 1700, the ways of growing food, and manufacturing and transporting goods changed completely in Great Britain. This change was great enough to be labelled a revolution, usually called the “Industrial Revolution.” The changes in agriculture and industry that occurred during the years after 1700 affected all members of society in fundamental ways and completely transformed the face of society. This process has continued during the twentieth century. Your grandparents and parents watched society change as a result of the invention of the car, the airplane, television, and satellites. You are participating in the enormous changes that computer **technology** is creating in society.

The technologies of the Industrial Revolution transformed the old, traditional ways of farming. New towns and cities filled with people seeking employment in factories, where any number of new products could be made quickly and cheaply. Great Britain's economy grew enormously, and many people became very wealthy. Not everyone benefited, however. The majority of people who worked in factories endured long, hard hours in unsafe conditions for

very little pay. Cities became even more dirty, crowded, and disease-ridden. Even small children had to work in dangerous and cruel conditions. The history of the Industrial Revolution is also the history of working peoples' struggle to enjoy some of the benefits of the new technologies for themselves.

The economy of the world became **global**, as the Industrial Revolution spread to other countries. Countries became linked in complex trading arrangements. Some countries were linked through colonial ties; the colonies supplied raw materials and bought manufactured goods from the “**mother**” country. Other countries followed Great Britain's example, and became **industrialized** themselves.

The Industrial Revolution also changed the ways in which humans interacted with nature. Until then, although humans had imposed technology on nature, it had never been done on the huge scale that industrialization brought about. At the time, most people looked on this as a sign of progress. They were not aware of the problems that could follow such large-scale **exploitation** of the earth's resources. Pollution, **global warming**, and the depletion of the **ozone layer** are results of the Industrial Revolution that the world must now find ways of coping with.

**revolution:** a complete change in something; the overthrow of a government

**technology:** new inventions; the science of industry

**global:** world-wide

**“mother” country:** in the language of colonialism, the colonizing power was often referred to as the “mother” country—a sexist reference no longer in use

**industrialized:** an economy based on industry, not agriculture

**to exploit:** to use

**global warming:** an increase in the world's temperature

**ozone layer:** a layer of gas above the Earth's surface that protects human beings from harmful rays of the sun

## WHY BRITAIN?

The Industrial Revolution first took place in Great Britain. It was many years before other European countries followed the British example. There

are many reasons why Britain led the world in industrialization.

Britain contained all the essential elements for industrialization. It had a good supply of people who were

**labour supply:** a supply of workers

**Test Act:** an act forbidding anyone except members of the Church of England from holding political office or entering the professions

**capital:** money used to invest in business

**raw materials:** the essential materials needed in an industry to make a product

**inefficient:** unproductive; inadequate in performance

**commons:** land held to be used by everyone

willing to work—in other words, a **labour supply**. The British population had grown rapidly since the 1600s, and the increased population needed work. In addition, because of new developments in farming technology, many former farmers now needed new kinds of work. There were many unemployed people wandering the countryside or moving to cities in search of employment.

The British middle class, who were mostly landowners and business people, had influence in the government as a result of the Glorious Revolution. (See Chapter 2 for an account of this.) Because of their importance in government, they were able to get parliament to pass laws that helped business grow.

Moreover, religious groups, such as the Puritans, were barred by the **Test Act** from positions in government, the church, or the army. These were the official positions of power in Britain. To compensate for this lack of official power, these people devoted themselves to business and industry. They became wealthy, and could invest their

money in new businesses. This kind of money is called **capital**, and it is essential for industrialization. When the British colonized India, enormous amounts of treasure were stolen and shipped back to Britain—more capital to support industrialization.

Great Britain also gained an early technological advantage over other countries. The British government encouraged the numerous scientific advances and technological inventions that were being made during this time.

Britain also had large deposits of **raw materials**, such as coal. Coal provided a cheap source of power for the new machines needed in industry. Furthermore, Britain had many colonies. British companies could import raw materials from these colonies and then sell the finished products back to the colonies. Everything needed for industry to grow—a labour supply, a stable and pro-business government, capital, technology, good transportation, and raw materials—was present in Great Britain from 1700 on. Together, these made the Industrial Revolution possible.

## AN AGRICULTURAL REVOLUTION—SINKING MONEY INTO THE EARTH

*Enclosure thou art a curse upon the  
land,*

*And tasteless was the wretch who  
thy existence plann'd.*

—OLIVER GOLDSMITH

**T**he strip-farming methods used in medieval times, where farmers had many small and scattered strips of land to farm, were very **inefficient**.

During Tudor times, landowners began to consolidate the small strips into large fields. This movement was called “enclosure.” Larger fields meant that farmers spent less time working the land and could work it more profitably. The process of enclosure speeded up enormously after 1700.

At the same time, the large areas of land held by villages as **commons**—land which could be used by anyone



# Using Pictures to Draw Conclusions

Social historians often use historical pictures to understand how a landscape, or cityscape, changed over time. These can assist historians in compiling the evidence necessary to form **conclusions** about the lives of the people who lived in a particular location at a particular time.

A good painting or drawing is like a snapshot of a time. In addition to the obvious elements of the painting, however, artists often **unconsciously** include many details of great value to historians. These can be just as important as the obvious information presented by the painting. Historians can use this

unconscious information to draw conclusions about the time in question, along with other sources of information.

Examine the painting on this page. The painting, done by an unknown artist in the 1700s, shows Dixton Manor, the estate of an important family. Dixton Manor had many enclosed fields. Look carefully. This picture tells us a lot about enclosure.

**conclusion:** a deduction or inference

**unconsciously:** unaware

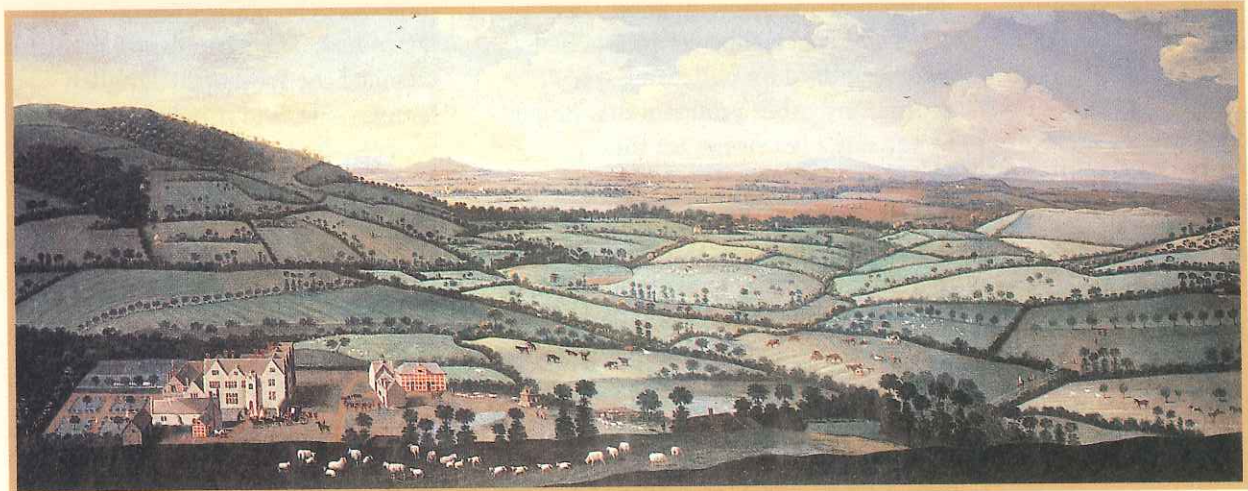


Figure 5-1 Dixton Manor

## YOUR TURN

1. Have you been able to pick out the unconscious information the artist included in the painting of Dixton Manor? In this case, you have to look carefully at the ground. If you do, you can see the remains of old ridge-and-furrow agriculture—the strips once worked by individual farmers under the feudal system. At one time, this same view would also have included several villages.
2. Assume that it took four strips to support a family of five. What conclusions can you draw about the number of people who were displaced by enclosure?
3. Look at other paintings and drawings in this chapter and in other chapters of this book. Find one or two that give unconscious information in the details of the painting, and explain how this evidence can help modern historians understand the time period.

in the village—started to be turned into private property. Parliament passed laws making it possible for the commons to be divided up. In theory, all villagers were equally entitled to this land, but, in fact, only the better-off could afford to pay the fees required to obtain commons land. The result was that the amount of land available for farming increased a great deal, but in most cases, only the more wealthy farmers were able to take advantage of the enclosures.

Poor farmers were left in very unfortunate circumstances. The loss of the commons land was a particular hardship to them because they no longer had anywhere to graze their cows and sheep. The commons had also been used for collecting wood, acorns, and other products that helped to eke out a better life for their families. Many small farmers were driven to despair by the enclosures, and had no choice but to sell their farms to richer landowners, who could afford to take advantage of the situation.

In addition, enclosure led to a whole new attitude toward agriculture. Farming became a business, and people began to farm to earn a profit rather than just to support themselves. Large landowners

were able to take advantage of technological innovations in farming techniques that occurred at this time. New plants and animals were introduced, and farming became much more mechanized.

Most of the small farmers who sold their land at this time spent the money they had received quickly. Sometimes they could become farm labourers, but often farming families had no choice but to go to the city to look for work. The cities were flooded with unemployed farmers and their families. On the other hand, the new city populations could be fed because the enclosed farms produced much more food than the old-fashioned, small farms had. The agricultural revolution changed the look of the English countryside, and it helped to create and support the Industrial Revolution.

### DID YOU KNOW?

*In 1790, the rural population of Britain was twice as high as the urban population. By 1840 this had reversed, and the urban population was twice as high as the rural population.*

**to graze:** to feed on growing plants, such as grass

**breed:** a group of animals distinguished by particular characteristics

## NEW BREEDS

Many English landowners saw that better farm animals would bring higher profits. Gradually, new breeds of cattle and sheep replaced the old, medieval types. These new breeds of animals produced more meat—and, in the case

**Figure 5-2** The Gloucester Old Spot Pig, the result of years of careful selective breeding



of sheep, thicker wool—than in earlier times. It is a surprising fact, but until the agricultural revolution, people did not raise sheep or cattle primarily for meat. They raised cattle for milk and sheep for wool—and ate the ones they slaughtered in the fall because they lacked enough **fodder** to keep all the animals alive over the winter.

The new breeds of animals were hardier and did not catch diseases as easily. However, the new animals were expensive and, at first, in short supply. Keeping them over the winter was also expensive. Soon, many farmers were caught in a money crunch. They could not afford new and better animals and plants, and they could not compete with those farmers and landlords who did have enough money to invest in the new breeds.

## NEW CROPS AND TECHNOLOGIES

As landowners became committed to raising food for profit, they became willing to invest money in farming techniques that had the potential to make them even richer. As business people, they understood that they had to accept the occasional failure and take financial risks if new ways of farming were to be found. Their goal was to make an acre of land produce more crop—and more money—while lowering their own costs of raising crops.

Jethro Tull and Lord Townshend (nicknamed “Turnip Townshend”) were two innovators who helped make agriculture more profitable. Jethro Tull was an English inventor who tried to understand the way soil helped plants grow. He found that when soil was well broken up, or cultivated, and enriched with **manure**, or fertilizer, crops grew much better. Tull invented a planting machine, called a “seed drill,” which

could be pulled by horses. The seed drill planted seeds neatly in rows and was faster and much less wasteful than the old method of **broadcasting** seed. Many more seeds sprouted, instead of being eaten by birds and animals. Planting in uniform rows made weeding and crop maintenance much easier. The seed drill solved the problem of waste and made it possible to farm with fewer people.

“Turnip Townshend” was an English lord who had also been an important politician. Like most members of parliament of the time, he was also a wealthy landowner. Townshend had a great interest in agriculture and when he retired he devoted himself to making the farms on his estate more profitable. He found that by growing four crops—turnips, barley, grasses, and wheat—in rotation (turnips one year, barley the second year, grasses the third year, and wheat the fourth year, and then repeating the cycle) four times as much crop could be produced. Land no longer needed to be kept fallow to recover its nutrients, because the new crops of turnips and clover released nitrogen into the soil.

In addition, turnips and clover could be used as inexpensive fodder to feed animals over the winter. This made it even easier to build and maintain large herds of animals. Enclosure, improved animal breeds,

### DID YOU KNOW?

One young man who inherited a farm in 1776 used all the new agricultural methods available to him. In 1776, his farm earned £2000 a year; by 1816, it earned £20 000 a year. What percentage increase in revenue does this represent?

**fodder:** animal food

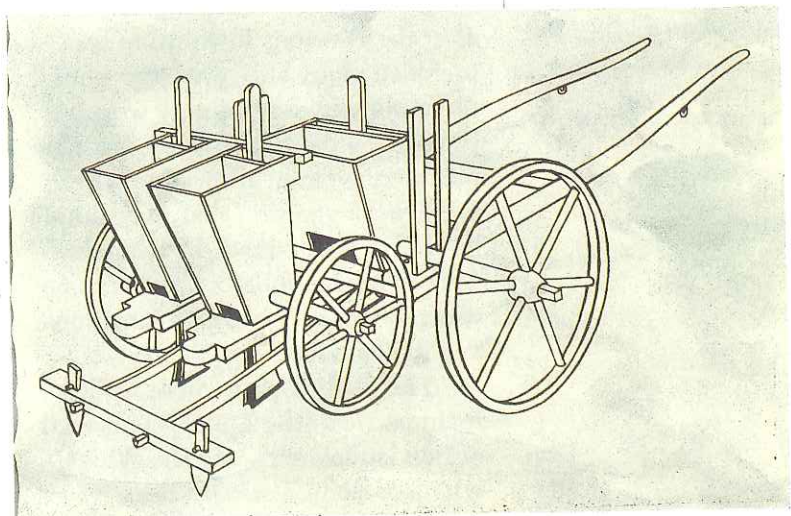
**manure:** animal droppings used to fertilize land

**to broadcast:** to sow seeds by throwing them over a field by hand

### DID YOU KNOW?

During medieval times, one-third of farming land was always in fallow—meaning that no crops were grown on this land. Reducing the need to leave fields fallow increased agricultural production by one-third.

**Figure 5-3** This seed drill was invented in 1701 by Jethro Tull.



cultivation, fertilization, careful seeding, and crop rotation all made farms much more productive. The agriculture of France and other European countries was backward in comparison.

With enclosure, the population of many towns grew very quickly, especially in the centre part of England—an area called “the

Midlands.” Towns such as Manchester and Liverpool changed from sleepy little country towns into bustling cities, filled by the many farming families who no longer had farms. The growth of cities and towns was possible because improvements in agriculture increased the amount of food and made it possible for fewer farmers to feed large city populations.

## ACTIVITIES

1. What are the essential ingredients of industrialization? Draw a circle in your notebook and label the circle “industrialization.” Draw lines radiating out from the circle to represent the essential elements needed for industrialization to occur. Explain how each of these elements contributed to industrialization.
2. Write a letter to your local member of parliament from the point of view of a poor farming family. Explain the consequences of enclosure for your family.
3. Pretend you are a prosperous eighteenth-century English landowner. Write a letter to your friends in London describing some of the experiments you are trying on your farm. Explain why you are trying them, and the results you expect to get from them.

## AN ECONOMIC REVOLUTION

**entrepreneur:** a person who runs a business, taking the risk in order to earn a profit

**franchise:** the right to vote

**self-interest:** action in one's own interest, rather than in another's

England had a pro-business government. Although only people with wealth and power could get seats in parliament, after the Glorious Revolution this included many **entrepreneurs** from the middle class. Ordinary working people still did not have the **franchise**. Nor were women allowed to vote. Even the suggestion that they should be able to vote—made by women such as Mary Wollstonecraft among others—was considered a dangerous and foolish idea.

The English parliament had two main parties—the Tories, composed of rich landowners, and the Whigs, who represented middle-class

business people. The business people caused the government to follow an economic policy called *laissez-faire*.

The *laissez-faire* policy meant that business and industry would be as free as possible from government regulation. The theory was that competition and **self-interest** would provide the greatest good for the greatest number of people. In other words, if people were free to pursue profit without too many government regulations, they would be motivated to make their industries bigger. In turn, this would create a wealthy and productive economy. The wealth created by the businesses would benefit everyone in society. Business

people who supported laissez-faire were opposed to any government regulations that would hurt their ability to pursue a profit. This was not always good for the workers, because it meant the business owners wanted to keep the wages paid to workers as low as possible, in order to increase profits.

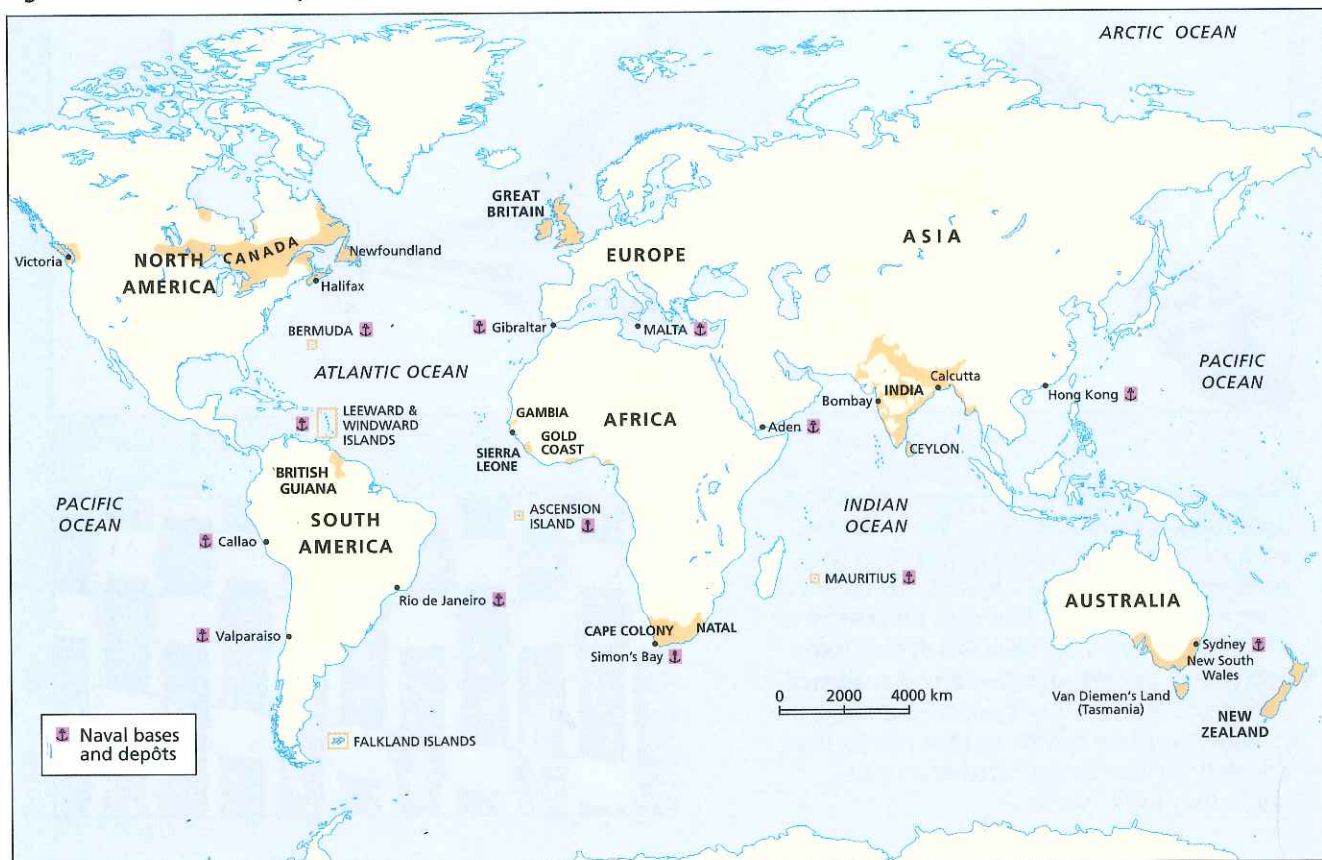
In addition to the government's laissez-faire policies, industry in Great Britain was helped by a whole range of new technologies that greatly improved industrial processes. Inventions in the textile industry, in the coal and iron industries, in ceramics, and in many other fields completely changed those industries. Also, a source of power was found that would revolutionize, first, Great Britain's industry, and then the world's. Under such conditions, business and industry grew enormously.

## THE TEXTILE INDUSTRY

The textile industry was an important part of the Industrial Revolution, and it helped make Great Britain into a rich and powerful country. Textiles are cloth and cloth products. Today, of course, many textiles are made from **synthetic** fibres, many of which are made from oil. Until the twentieth century, however, all cloth was made from plant or animal fibres—wool from sheep, silk from silk worms, and linen from flax. Britain's climate and geography suited the raising of sheep, so that wool had been an extremely important industry in Britain for a long time. Enclosure, for the first time, had made it possible and profitable to maintain enormous herds of sheep. British wool could be harvested fairly cheaply and turned into cloth in nearby communities.

**synthetic:** made by humans

Figure 5-4 Areas colonized by Britain in 1850



### DID YOU KNOW?

Britain's demand for cotton meant that many people in the southern United States became cotton farmers. This greatly increased the number of slaves in the United States, because slaves were used to work in the cotton fields.

**demand:** desire for particular goods

British wool was high quality wool, and British woolen cloth was in high **demand** in Europe and elsewhere.

The textile industry was a major factor in Britain's desire to acquire new colonies. A cotton as well as a wool industry developed. Cotton from the former colonies in the southern United States was supplemented by cotton from newly conquered India, which also supplied natural dyes.

Many of the important inventions during the early days of the Industrial Revolution had to do with the

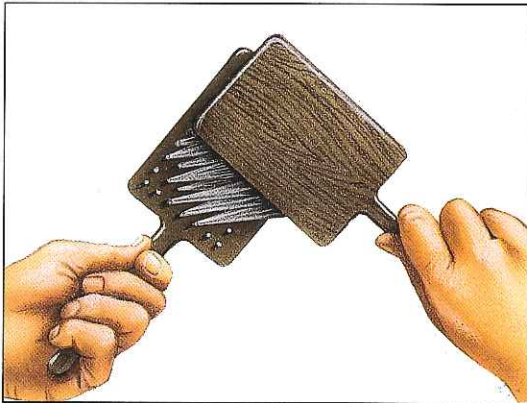
manufacture of cloth. Many people in Britain were involved in the textile industry, either as investors or as textile workers. Inventions that could speed up the process of making cloth could make the inventor a fortune. Several inventors, John Kay and James Hargreaves, for example, literally went from "rags to riches" because their inventions improved profits in the textile industry.

One of the first important inventions in the textile industry was the "flying shuttle," invented by John

## The Making of Cloth

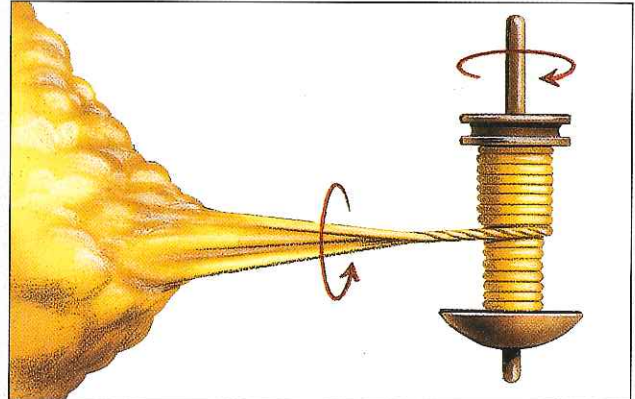
1

Raw textile fibre always needed some preparation. Cotton had to be cleaned of seeds and other plant materials, and wool from sheep had to be cleaned of the debris the sheep had picked up.



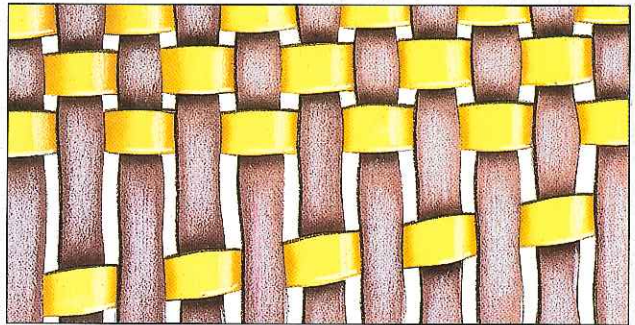
2

The cotton or wool fibres needed to be drawn out by a spinner and twisted together to make a continuous, rope-like thread. Before the Industrial Revolution, spinners used a spinning wheel, or a distaff—which was a pole, often with a weight, that could be twirled to make thread.



3

Once the thread was created, a weaver turned the thread into cloth. Weaving was done on a loom, which allowed the weaver to set up a web of strands of yarn from the top to the bottom of a frame. A shuttle was then used to pass yarn from side to side through the vertical strands of yarn. Because of the way the loom operated, the up-and-down yarn strands and the side-to-side strands were interlocked together. In other words, they were "woven."

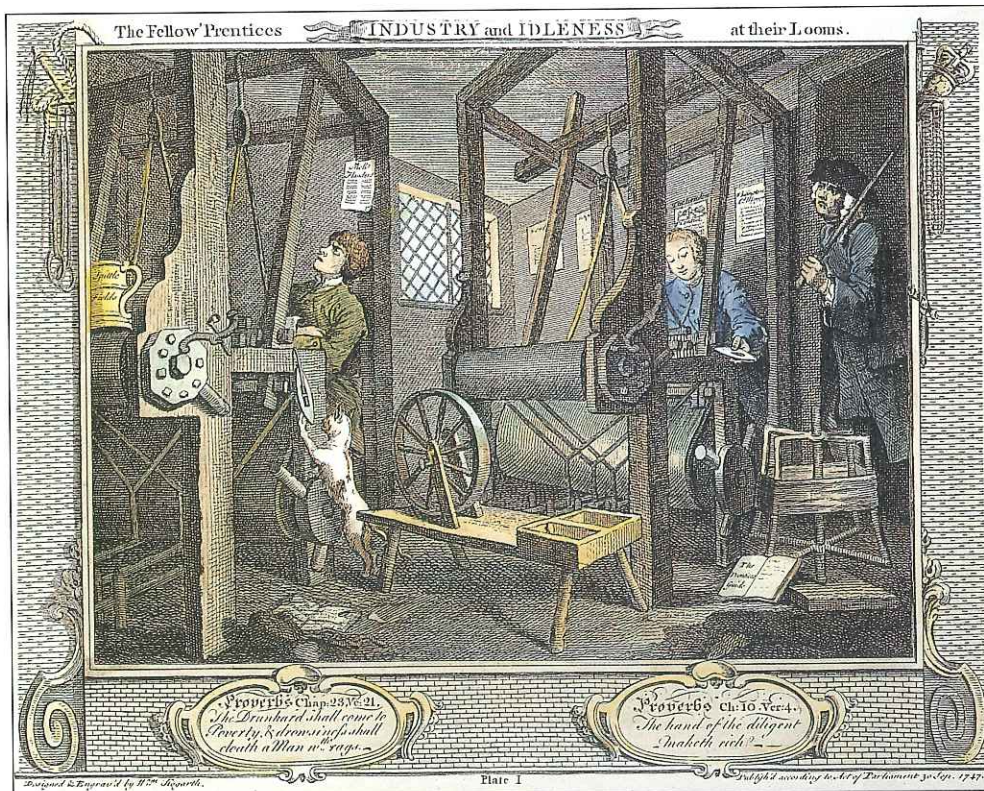


Kay in 1733. This device made weaving much faster, and allowed large looms to be operated by only one person. On a small loom, the weaver could throw the shuttle from one hand to the other across the threads, but on a large loom two people were needed. John Kay's invention, however, used springs and levers to pull the shuttle back after it had crossed the threads. This made weaving on a large loom much faster. Of course, it also put one of the two shuttle throwers out of a job.

Weaving used up yarn faster than the spinners could produce it; the flying shuttle made the problem of yarn supply even worse. It was obvious to many people that inventions that could make spinning faster would quickly be accepted. Inventors hurried to fill the need for more thread. Many people tried to invent spinning machines, but without success. In 1764, however, James Hargreaves built the Spinning Jenny, which he named for his wife.

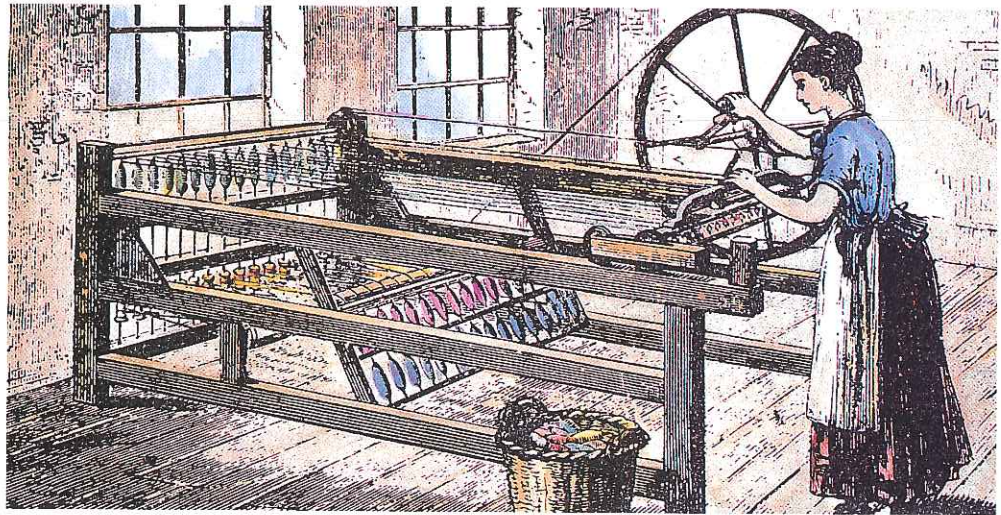
The Spinning Jenny was an ingenious device, driven by a hand-cranked wheel, which allowed a spinner to spin off a number of threads at the same time. This meant that one spinner could now do the work of several spinners. Hargreaves was himself a poor spinner. Because of this, he tried to keep his invention a secret, using it only to produce yarn for himself. This proved to be impossible, and the existence of the new machine soon became known. One day, an angry mob of spinners broke into Hargreaves's house and destroyed the original Spinning Jenny. Forced to move away, Hargreaves soon found partners and set up his own spinning factory. He became a very wealthy man and had no sympathy for other textile workers.

The Spinning Jenny was an important improvement for the spinning part of the textile industry. The need for spun yarn was so great that Spinning Jennies were soon being used all over England.



**Figure 5-5** *The Fellow Prentices at Their Looms*, by William Hogarth. This engraving from 1747 shows two apprentice weavers working at their looms, watched by the master holding a stick. The boy closest to the door is holding a shuttle in his left hand ready to throw it through the yarn to the other side. Yarn is wrapped around a large spool. There is also a spinning wheel in the room. Such pictures help us learn about the conditions under which people worked and about the machines they used. How would you find out if this shop was typical of the period?

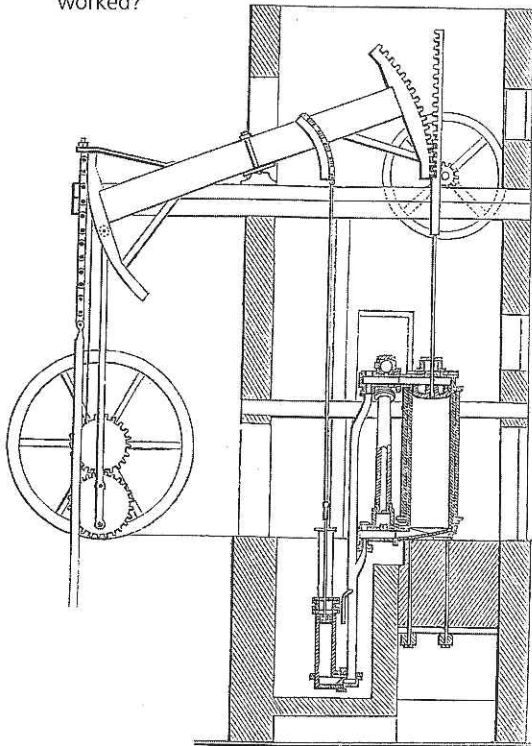
**Figure 5-6** By using many spindles, the Spinning Jenny allowed a spinner to make yarn much faster than by the old methods.



**to seep:** to trickle slowly

**compressed steam:** steam under pressure

**Figure 5-7** James Watt's double-rotating steam engine, 1769. Steam engines made many things possible—large machines, locomotives, and large ocean-going ships made of steel. The steam engine was at the heart of many machines, and coal was used to produce the steam. Can you see how it worked?



Other ways of improving spinning were also invented. Richard Arkwright developed the Water Frame, a way of spinning yarn using rollers. This machine improved the strength of the yarn being spun and was even faster than the Jenny.

Arkwright also became very wealthy as a result of his invention. Later, Samuel Compton built a machine he called a "mule." The mule combined the best features of the Water Frame and the Spinning Jenny. Many other inventions followed, all designed to improve the spinning process.

Once a plentiful supply of good quality yarn was available, it was possible to mechanize weaving even more. This led to enormous looms, which could no longer be powered by human labour. Such large machines also needed large buildings to house the machines and the labourers needed to work them. Many new factories were built. The textile industry became a factory industry dependent upon power.

## THE STEAM MACHINE

Other industries also became dependent upon a secure source of power. Many industries close to a source of running water could use water wheels to run machines, as long as the factory was not too big. But the lack of power was a major problem for many factory owners.

The first breakthrough in providing power for factories—and for other industries—came as a result of problems with water that **seeped** into deep coal mines. This water had to be pumped out before the miners could work, and the deeper underground the mines went, the harder it was to pump water out. Part of the problem was solved when Thomas Newcomen invented a machine that harnessed the power of **compressed steam**. This machine—or engine—used steam to pump the water out of the mines.

But Newcomen's engine did not work very well, and it was only the first step in solving the growing power needs of industry. The real breakthrough came when James Watt, a Scottish machine-maker, figured out a way to get the maximum use out of the steam being produced in Newcomen's engine. Watt's new



steam engine was much more practical and efficient, producing power with relatively little waste. Used first to pump water out of mines, Watt adapted the engine so that it could drive machines. In so doing, Watt had solved the problem of powering the factory age.

## THE IRON AND COAL INDUSTRIES

The iron and coal industries were also important to the Industrial Revolution. They began to grow much faster after 1750, when Abraham Darby invented a process for making better **cast iron**. Improvements by other inventors followed quickly. Soon cast-iron products were available everywhere, largely because they were much easier and cheaper to produce than other metal products. Cast iron could be used for all sorts of things, from pots and pans to the supports needed to hold up bridges. Larger and larger cast-iron factories were built. England became the world's leading producer of cast iron.

The coal industry was closely linked to the iron industry because coal is used in its manufacture. Darby used coke—a form of coal that has been heated to burn off the sulphur that coal contains—to make better iron. As the iron industry grew, the coal industry grew with it. The steam engine also used coal, provoking even greater growth in the coal industry.

Everyone burned coal for heat in the cold, damp English winter. England had large deposits of coal in many areas, so it was a relatively cheap fuel. Coal deposits were often far underground, and mines were dangerous places to work—coal produces methane gas, which explodes very easily. Coal dust is also highly toxic. Coal miners worked from the dark of early morning to the dark of night, and saw the sun only one day a week. Miners usually died young, in accidents or from “Black Lung,” which is a disease caused by breathing coal dust. Wages were as low as mine-owners could make them. Without coal, however, there would not have been an Industrial Revolution

### DID YOU KNOW?

*Until relatively few years ago, the buildings of most larger European cities were black with grime from coal smoke, and their air was badly polluted. London, for example, sometimes had “killer fogs,” dense clouds of moisture and coal-smoke pollution. What changes were necessary before these problems could be solved?*

**cast iron:** molten iron poured into a mould to make a product

## ACTIVITIES

1. Make a list of the positive and negative aspects of laissez-faire economic theory.
2. Explain what the textile industry is, and why it became important in Britain. In what ways was the textile industry a global industry? How did it spur the growth of colonies?
3. Imagine you are one of the spinners who protests the invention of the Spinning Jenny. Write a letter to a newspaper explaining your reasons. Your letter should show that you understand the implications of the invention. It should also give good reasons why you think its use should not be allowed.
4. Identify and explain the importance of three other inventions of the Industrial Revolution. Show how one invention lead to another.
5. Make up an epitaph for a young coal miner, detailing the cause of death and the circumstances. Were such people heroes of the Industrial Revolution? Explain your opinion.

# TRANSPORTATION—FROM MARKET TO MARKET

**market:** those wishing to purchase goods

**toll:** a fee for using a road

The Industrial Revolution could happen only if the products factories made could be cheaply transported to people who needed them—to the **market**, in other words. At the other end, factories also needed tonnes and tonnes of raw materials of every kind. Some raw materials had to be brought from colonies on the other side of the world.

In 1700, England's transportation system was very poor indeed. It was almost impossible to travel quickly or easily for long distances. Many roads were still "medieval" and became no more than muddy tracks in bad weather. Although goods could be sent by sea, or along the rivers, whole areas of the country could not be reached this way. Good transportation was desperately needed.

Roads in 1700 were so bad that in many places goods had to be carried on pack-horses for long distances. Each pack-horse could only carry 100 or 200 kilograms, and they had to be loaded just right. Pack-horses often slipped or dumped their loads. Horses used for transport had to be regularly

fed and rested, and this slowed progress considerably. Long stretches of good road—where large wagons could be used—were needed before the factory system could develop completely.

One of the first strategies for improving roads was the turnpike system. This was a way of getting roads built at no cost to the government. Private companies were allowed to build a section of road and to charge **tolls** to anyone who used it.

One of the most successful turnpike engineers was James Macadam. Macadam built roads that would not become muddy. The roads were built of three layers of graded stone, with the largest stones on the bottom and fine granite gravel on the surface. The surface of the road would shed water because the sides of the road sloped away from the center. Macadam roads were a vast improvement on earlier roads. Soon, the Macadam technique was being used everywhere. Today's gravel roads in British Columbia are Macadam roads.

With new roads, regular stagecoaches could carry passengers and mail relatively quickly from town to town. Goods could be transported by wagons, the equivalent of modern transport trucks.

New roads alone did not solve the transportation problems of the Industrial Revolution. Investors also began to build canals in the 1700s. Soon a network of waterways linked the different parts of Great Britain. Canals—narrow, artificial water channels—were built to link rivers together. The canals carried raw materials and goods to the big industrial cities, reducing the cost of shipping by three-quarters.

**Figure 5-8** A Macadam road in Delta, BC. Macadam roads were later improved by the addition of tar to the surface layer of gravel. The resulting surface was called "tarmac."

