The industrial revolution made mass production possible with the help of power-driven machines. Mills driven by waterwheels existed in ancient times, but the construction of identical, replaceable machinery—the machine production of machines—revolutionized industry and enabled the coordination of production on a vast scale, starting first in England's cotton textile mills at the end of the eighteenth century. The market for such textiles was capitalist, though the demand for many early mass-produced goods, such as muskets and uniforms, was government-driven.

The origins of capitalism are hotly debated among historians. Because the world's first cities, five thousand years ago, created markets, merchants, money, and private ownership of capital, some historians refer to an ancient capitalism. In this text, capitalism refers to those societies whose markets, merchants, money, and private ownership became central to the way society operated. As such, Mesopotamia, Rome, and Sung dynasty China, which had extensive markets and paper money a thousand years ago, were not among the first capitalist societies. Smaller societies in which commercial interests and merchant classes took hold to direct political and economic matters were the capitalist forerunners. Venice, Florence, Holland, and England, the mercantile states of the fifteenth to seventeenth centuries, exemplify commercial capitalism or mercantile capitalism. Thus, the shift to industrial capitalism was more than a change in scale; it was also a transition from a trade-based economy to a manufacturing-based economy, a difference that meant an enormous increase in productivity, profits, and prosperity.

**THINKING HISTORICALLY**

Distinguishing Historical Processes

When two different historical processes occur simultaneously and in mutually reinforcing ways, like the spread of agriculture and languages—or capitalism and industrialization—we might confuse one process of change with the other. This confusion makes it difficult to see exactly what causes what. Here you will be encouraged to distinguish between the latter two historical processes. As you read these selections, keep in mind that capitalism is an economic system that spreads markets, commerce, and the interests of private capital, but industrial revolution was a transformation in technology. How did these two very different processes coincide in the nineteenth century? In what ways were they moving toward different ends, causing different effects, or benefiting different interests?

**ARNOLD PACEY**

**Asia and the Industrial Revolution, 1990**

Here a modern historian of technology demonstrates how Indian and East Asian manufacturing techniques were assimilated by Europeans, particularly by the English successors of the Mughal Empire, providing a boost to the industrial revolution in Britain. In what ways was Indian technology considered superior prior to the industrial revolution? How did European products gain greater markets than those of India?

**THINKING HISTORICALLY**

Notice how the author distinguishes between capitalism and the industrial revolution. Was India more industrially advanced than capitalist? Did the British conquest of India benefit more from capitalism, industry, or something else?

**Deindustrialization**

During the eighteenth century, India participated in the European industrial revolution through the influence of its textile trade, and through the investments in shipping made by Indian bankers and merchants. Developments in textiles and shipbuilding constituted a significant industrial movement, but it would be wrong to suggest that India was on the verge of its own industrial revolution. There was no steam engine in India, no coal mines, and few machines. Expanding industries were mostly in coastal areas. Much of the interior was in economic decline, with irrigation works damaged and neglected as a result of the breakup of the Mughal Empire and the disruption of war. Though political weakness in the empire had been evident since 1707, and a Persian army heavily defeated Mughal forces at Delhi in 1739, it was the British who most fully took advantage of the collapse of the empire. Between 1757 and 1803, they took control of most of India except the Northwest. The result was that the East India Company now administered major sectors of the economy, and quickly reduced the role of the big Indian bankers by changes in taxes and methods of collecting them.

Meanwhile, India's markets in Europe were being eroded by competition from machine-spun yarns and printed calicoes made in Lancashire, and high customs duties were directed against Indian imports into

Britain. Restrictions were also placed on the use of Indian-built ships for voyages to England. From 1812, there were extra duties on any imports they delivered, and that must be one factor in the decline in shipbuilding. A few Indian ships continued to make the voyage to Britain, however, and there was one in Liverpool Docks in 1839 when Herman Melville arrived from America. It was the *Irresistible* from Bombay and Melville commented: “Forty years ago, these merchantmen were nearly the largest in the world; and they still exceed the generality.” They were “wholly built by the native shipwrights of India, who... surpassed the European artisans.”

Attitudes to India changed markedly after the subcontinent had fallen into British hands. Before this, travellers found much to admire in technologies ranging from agriculture to metallurgy. After 1803, however, the arrogance of conquest was reinforced by the rapid development of British industry. This meant that Indian techniques which a few years earlier seemed remarkable could now be equalled at much lower cost. The idea grew that its proper role was to provide raw materials for the western industry, including raw cotton and indigo dye, and to function as a market for British goods. This policy was reflected in 1813 in the relaxation of the East India Company’s monopoly of trade so that other British companies could now bring in manufactured goods freely for sale in India. Thus the textile industry, iron production, and shipbuilding were all eroded by cheap imports from Britain, and by handicaps placed on Indian merchants.

By 1830, the situation had become so bad that even some of the British in India began to protest. One exclaimed, “We have destroyed the manufactures of India.” pleading that there should be some protection for silk weaving, “the last of the existing manufactures of India.” Another observer was alarmed by a “commercial revolution” which produced “so much present suffering to numerous classes in India.”

The question that remains is the speculative one of what might have happened if a strong Mughal government had survived. Ferdinand Braudel argues that although there was no lack of “capitalism” in India, the economy was not moving in the direction of home-grown industrialization. The historian of technology inevitably notes the lack of development of water-wheels during the eighteenth century both in the iron industry and at gunpowder mills. However, it is impossible not to be struck by the achievements of the shipbuilding industry, which produced skilled carpenters and a model of large-scale organizations. It also trained draughtsmen and people with mechanical interests. It is striking that one of the Wadia shipbuilders installed gas lighting in his home in 1834 and built a small foundry in which he made parts for steam engines. Given an independent and more prosperous India, it is difficult not to believe that a response to British industrialization might well have taken the form of a spread of skill and innovation from the shipyards into other industries.

As it was, such developments were delayed until the 1850s and later, when the first mechanized cotton mill opened. It is significant that some of the entrepreneurs who backed the development of this industry were from the same Parsi families as had built ships in Bombay and invested in overseas trade in the eighteenth century.

**Guns and Rails: Asia, Britain, and America**

Britain’s “conquest” of India cannot be attributed to superior armaments. Indian armies were also well equipped. More significant was the prior breakdown of Mughal government and the collaboration of many Indians. Some victories were also the result of good discipline and bold strategy, especially when Arthur Wellesley, the future Duke of Wellington, was in command. Wellesley’s contribution also illustrates the distinctive western approach to the organizational aspect of technology. Indian armies might have had good armament, but because their guns were made in a great variety of different sizes, precise weapons drill was impossible and the supply of shot to the battlefield was unnecessarily complicated. By contrast, Wellesley’s forces standardized on just three sizes of field gun, and the commander himself paid close attention to the design of gun carriages and to the bullocks which hauled them, so that his artillery could move as fast as his infantry, and without delays due to wheel breakages.

Significantly, the one major criticism regularly made of Indian artillery concerned the poor design of gun carriages. Many, particularly before 1760, were little better than four-wheeled trolleys. But the guns themselves were often of excellent design and workmanship. Whilst some were imported and others were made with the assistance of foreign craftsmen, there was many a brass cannon and mortar of Indian design, as well as heavy muskets for camel-mounted troops. Captured field guns were often taken over for use by the British, and after capturing ninety guns in one crucial battle, Wellesley wrote that seventy were “the finest brass ordnance I have ever seen.” They were probably made in northern India, perhaps at the great Mughal arsenal at Agra.

Whilst Indians had been making guns from brass since the sixteenth century, Europeans could at first only produce this alloy in relatively small quantities because they had no technique for smelting zinc. By the eighteenth century, however, brass was being produced in large quantities.
in Europe, and brass cannon were being cast at Woolwich Arsenal near London. Several European countries were importing metallic zinc from China for this purpose. However, from 1743 there was a smelter near Bristol in England producing zinc, using coke as fuel, and zinc smelters were also developed in Germany. At the end of the century, Britain's imports of zinc from the Far East were only about forty tons per year. Nevertheless, a British party which visited China in 1797 took particular note of zinc smelting methods. These were similar to the process used in India, which involved vaporizing the metal and then condensing it. There is a suspicion that the Bristol smelting works of 1743 was based on Indian practice, although the possibility of independent invention cannot be excluded.

A much clearer example of the transfer of technology from India occurred when British armies on the subcontinent encountered rocketts, a type of weapon of which they had no previous experience. The basic technology had come from the Ottoman Turks or from Syria before 1500, although the Chinese had invented rockets even earlier. In the 1790s, some Indian armies included very large infantry units equipped with rockets. French mercenaries in Mysore had learned to make them, and the British Ordnance Office was enquiring for somebody with expertise on the subject. In response, William Congreve, whose father was head of the laboratory at Woolwich Arsenal, undertook to design a rocket on Indian lines. After a successful demonstration, about two hundred of his rockets were used by the British in an attack on Boulogne in 1806. Fired from over a kilometre away, they set fire to the town. After this success, rockets were adopted quite widely by European armies, though some commanders, notably the Duke of Wellington, frowned on such impractical weapons, and they tended to drop out of use later in the century. What happened next, however, was typical of the whole British relationship with India. William Congreve set up a factory to manufacture the weapons in 1817, and part of its output was exported to India to equip rocket troops operating there under British command.

Yet another aspect of Asian technology in which eighteenth-century Europeans were interested was the design of farm implements. Reports on seed drills and ploughs were sent to the British Board of Agriculture from India in 1795. A century earlier the Dutch had found much interest in ploughs and winnowing machines of a Chinese type which they saw in Java. Then a Swedish party visiting Guangzhou (Canton) took a winnowing machine back home with them. Indeed, several of these machines were imported into different parts of Europe, and similar devices for cleaning threshed grain were soon being made there. The inventor of one of them, Jonas Norberg, admitted that he got "the initial idea" from three machines "brought here from China," but had to create a new type because the Chinese machines "do not suit our kinds of grain." Similarly, the Dutch saw that the Chinese plough did not suit their type of soil, but it stimulated them to produce new designs with curved metal mould-boards in contrast to the less efficient flat wooden boards used in Europe hitherto.

In most of these cases, and especially with zinc smelting, rocketts, and winnowing machines, we have clear evidence of Europeans studying Asian technology in detail. With rocketts and winnowers, though perhaps not with zinc, there was an element of imitation in the European inventions which followed. In other instances, however, the more usual course of technological dialogue between Europe and Asia was that European innovation was challenged by the quality or scale of Asian output, but took a different direction, as we have seen in many aspects of the textile industry. Sometimes, the dialogue was even more limited, and served mainly to give confidence in a technique that was already known. Such was the case with occasional references to China in the writings of engineers designing suspension bridges in Britain. The Chinese had a reputation for bridge construction, and before 1700 Peter the Great had asked for bridge-builders to be sent from China to work in Russia. Later, several books published in Europe described a variety of Chinese bridges, notably a long-span suspension bridge made with iron chains.

Among those who developed the suspension bridge in the West were James Finley in America, beginning in 1801, and Samuel Brown and Thomas Telford in Britain. About 1814, Brown devised a flat, wrought-iron chain link which Telford later used to form the main structural chains in his suspension bridges. But beyond borrowing this specific technique, what Telford needed was evidence that the suspension principle was applicable to the problem he was then tackling. Finley's two longest bridges had spanned seventy-four and ninety-three metres, over the Merrimac and Schuykill Rivers in the eastern United States. Telford was aiming to span almost twice the larger distance with his 176-metre Menai Bridge. Experiments at a Shropshire ironworks gave confidence in the strength of the chains. But Telford may have looked for reassurance even further afield. One of his notebooks contains the reminder, "Examine Chinese bridges." It is clear from the wording which follows that he had seen a recent booklet advocating a "bridge of chains," partly based on a Chinese example, to cross the Firth of Forth in Scotland.

* Fuel from soft coal. [Ed.]
ADAM SMITH

The Wealth of Nations, 1776

An Inquiry into the Nature and Causes of the Wealth of Nations might justly be called the bible of free-market capitalism. Written in 1776 in the context of the British (and European) debate over the proper role of government in the economy, Smith’s work takes aim at mercantilism, or government supervision of the economy. Mercantilists believed that national economies required government assistance and direction to prosper.

Smith argues that free trade will produce greater wealth than mercantilist trade and that free markets allocate resources more efficiently than the government. His notion of laissez-faire (literally “let do”) capitalism assumes neither that capitalists are virtuous nor that governments should absolve themselves entirely from the economy. However, Smith does believe that the greed of capitalists generally Negates itself and produces results that are advantageous to, but unimagined by, the individual. “It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner,” Smith writes, “but from their regard of their own interest. We address ourselves not to their humanity, but to their self-love, and never talk to them of our own necessities, but of their advantage.”

Each person seeks to maximize his or her own gain, thereby creating an efficient market in which the cost of goods is instantly adjusted to exploit changes in supply and demand, while the market provides what is needed at the price people are willing to pay “as if by an invisible hand.”

According to Smith, what is the relationship between money and industry, and which is more important? What would Smith say to a farmer or manufacturer who wanted to institute tariffs or quotas to limit the number of cheaper imports entering the country and so minimize competition? What would be the decision of a government official who wanted to protect an important domestic industry? What would he say to a worker who complained about low wages or boring work? What would Smith think about a “postindustrial” or “service” economy in which few workers actually make products? What would he think of a prosperous country that imported more than it exported?

THINKING HISTORICALLY

The Wealth of Nations was written in defense of free capitalism at a moment when the industrial revolution was just beginning. Some elements of Smith’s writing suggest a preindustrial world, as in the quotation about the butcher, brewer, and baker mentioned earlier. Still, Smith was aware how new industrial methods were transforming age-old labor relations and manufacturing processes. In some respects, Smith recognized that capitalism could create wealth, not just redistribute it, because he appreciated the potential of industrial technology.

As you read this selection, note when Smith is discussing capitalism, the economic system, and the power of the new industrial technology. In his discussion of the division of labor, what relationship does Smith see between the development of a capitalist market and the rise of industrial technology? To what extent could the benefits that Smith attributes to a free market be attributed to the new system of industrial production?

Book 1

Of the Causes of Improvement in the Productive Powers of Labour,
and of the Order According to Which Its Produce Is Naturally
Distributed among the Different Ranks of the People

Chapter 1: Of the Division of Labour

The greatest improvement in the productive powers of labour, and the
greater part of the skill, dexterity, and judgment with which it is any-
where directed, or applied, seem to have been the effects of the division
of labour.

The effects of the division of labour, in the general business of so-
ciety, will be more easily understood by considering in what manner it
operates in some particular manufactures. . . .

To take an example, therefore, from a very trifling manufacture: but
one in which the division of labour has been very often taken notice of, the
trade of the pin-maker; a workman not educated to this business (which
the division of labour has rendered a distinct trade), nor acquainted
with the use of the machinery employed in it (to the invention of which
the same division of labour has probably given occasion), could scarce,
perhaps, with his utmost industry, make one pin in a day, and certainly
could not make twenty. But in the way in which this business is now
carried on, not only the whole work is a peculiar trade, but it is divided
into a number of branches, of which the greater part are likewise peculiar
trades. One man draws out the wire, another straightens it, a third cuts it,
a fourth points it, a fifth grinds it at the top for receiving the head; to
make the head requires two or three distinct operations; to put it on is a
peculiar business, to whiten the pins is another; it is even a trade by itself
to put them into the paper, and the important business of making a pin
is, in this manner, divided into about eighteen distinct operations, which,
in some manufactories, are all performed by distinct hands, though in others the same man will sometimes perform two or three of them. I have seen a small manufactory of this kind where ten men only were employed, and where some of them consequently performed two or three distinct operations. But though they were very poor, and therefore but indifferently accommodated with the necessary machinery, they could, when they exerted themselves, make among them about twelve pounds of pins in a day. There are in a pound upwards of four thousand pins of a middling size. Those ten persons, therefore, could make among them upwards of forty-eight thousand pins in a day. Each person, therefore, making a tenth part of forty-eight thousand pins, might be considered as making four thousand eight hundred pins in a day. But if they had all wrought separately and independently, and without any of them having been educated to this peculiar business, they certainly could not each of them have made twenty, perhaps not one pin in a day; that is, certainly, not the two hundred and forty, perhaps not the four thousand eight hundredth part of what they are at present capable of performing, in consequence of a proper division and combination of their different operations.

In every other art and manufacture, the effects of the division of labour are similar to what they are in this very trifling one; though, in many of them, the labour can neither be so much subdivided, nor reduced to so great a simplicity of operation. . . .

Chapter 3: That the Division of Labour Is Limited by the Extent of the Market

As it is the power of exchanging that gives occasion to the division of labour, so the extent of this division must always be limited by the extent of that power; or, in other words, by the extent of the market. When the market is very small, no person can have any encouragement to dedicate himself entirely to one employment, for want of the power to exchange all that surplus part of the produce of his own labour which is over and above his own consumption, for such parts of the produce of other men's labour as he has occasion for.

There are some sorts of industry, even of the lowest kind, which can be carried on nowhere but in a great town. A porter, for example, can find employment and subsistence in no other place. A village is by much too narrow a sphere for him. . . .

Chapter 5: Of the Real and Nominal Price of Commodities, or Their Price in Labour, and Their Price in Money

Every man is rich or poor according to the degree in which he can afford to enjoy the necessaries, conveniences, and amusements of human life. But after the division of labour has once thoroughly taken place, it is but a very small part of these with which a man's own labour can supply him. The far greater part of them he must derive from the labour of other people, and he must be rich or poor according to the quantity of that labour which he can command, or which he can afford to purchase. The value of any commodity, therefore, to the person who possesses it, and who means not to use or consume it himself, but to exchange it for other commodities, is equal to the quantity of labour which it enables him to purchase or command. Labour, therefore, is the real measure of the exchangeable value of all commodities. . . .

Chapter 7: Of the Natural and Market Price of Commodities

. . . When the quantity of any commodity which is brought to market falls short of the effectual demand, all those who are willing to pay the whole value of the rent, wages, and profit, which must be paid in order to bring it thither, cannot be supplied with the quantity which they want. Rather than want it altogether, some of them will be willing to give more. A competition will immediately begin among them, and the market price will rise more or less above the natural price, according as either the greatness of the deficiency, or the wealth and wanton luxury of the competitors, happen to animate more or less the eagerness of the competition. Among competitors of equal wealth and luxury the same deficiency will generally occasion a more or less eager competition, according as the acquisition of the commodity happens to be of more or less importance to them. Hence the exorbitant price of the necessaries of life during the blockade of a town or in a famine.

When the quantity brought to market exceeds the effectual demand, it cannot be all sold to those who are willing to pay the whole value of the rent, wages, and profit, which must be paid in order to bring it thither. Some part must be sold to those who are willing to pay less, and the low price which they give for it must reduce the price of the whole. The market price will sink more or less below the natural price, according as the greatness of the excess increases more or less the competition of the sellers, or according as it happens to be more or less important to them to get immediately rid of the commodity. The same excess in the importation of perishables will occasion a much greater competition than in that of durable commodities; in the importation of oranges, for example, than in that of old iron.

When the quantity brought to market is just sufficient to supply the effectual demand, and no more, the market price naturally comes to be either exactly, or as nearly as can be judged of, the same with the natural price. The whole quantity upon hand can be disposed of for this price,
individual, therefore, endeavours as much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value; every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good. It is an affectation, indeed, not very common among merchants, and very few words need be employed in dissuading them from it.

What is the species of domestic industry which his capital can employ, and of which the produce is likely to be of the greatest value, every individual, it is evident, can, in his local situation, judge much better than any statesman or lawgiver can do for him. The statesman who should attempt to direct private people in what manner they ought to employ their capitals would not only load himself with a most unnecessary attention, but assume an authority which could safely be trusted, not only to no single person, but to no council or senate whatever, and which would nowhere be so dangerous as in the hands of a man who had folly and presumption enough to fancy himself fit to exercise it.

To give the monopoly of the home market to the produce of domestic industry, in any particular art or manufacture, is in some measure to direct private people in what manner they ought to employ their capitals, and must, in almost all cases, be either a useless or a hurtful regulation. If the produce of domestic can be brought there as cheap as that of foreign industry, the regulation is evidently useless. If it cannot, it must generally be hurtful. It is the maxim of every prudent master of a family never to attempt to make at home what it will cost him more to make than to buy. The tailor does not attempt to make his own shoes, but buys them of the shoemaker. The shoemaker does not attempt to make his own clothes, but employs a tailor. The farmer attempts to make neither the one nor the other, but employs those different artificers. All of them find it for their interest to employ their whole industry in a way in which they have some advantage over their neighbours, and to purchase with a part of its produce, or what is the same thing, with the price of a part of it, whatever else they have occasion for.

What is prudence in the conduct of every private family can scarce be folly in that of a great kingdom. If a foreign country can supply us
with a commodity cheaper than we ourselves can make it, better buy it of them with some part of the produce of our own industry employed in a way in which we have some advantage. The general industry of the country, being always in proportion to the capital which employs it, will not thereby be diminished, no more than that of the abovementioned artificers; but only left to find out the way in which it can be employed with the greatest advantage. It is certainly not employed to the greatest advantage when it is thus directed towards an object which it can buy cheaper than it can make.

3

The Sadler Report of the House of Commons, 1832

Although, for many factory owners, children were among the ideal workers in the factories of the industrial revolution, increasingly their exploitation became a concern of the British Parliament. One important parliamentary investigation, chaired by Michael Sadler, took volumes of testimony from child workers and older people who had worked as children in the mines and factories. The following is a sample of that testimony: an interview with a former child worker named Matthew Crabtree who had worked in a textile factory. The Sadler Commission report led to child-labor reform in the Factory Act of 1833.

What seem to be the causes of Crabtree's distress? How could it have been alleviated? If the owner were asked why he didn't pay more, shorten the working day, provide more time for meals, or provide medical assistance when it was needed, how do you think he would have responded? Do you think Crabtree would have been in favor of reduced hours if it meant reduced wages?

THINKING HISTORICALLY

To what extent are the problems faced by Crabtree the inevitable results of machine production? To what extent are his problems caused by capitalism? How might the owner of this factory have addressed these issues?


Friday, 18 May 1832—Michael Thomas Esquire, in the Chair

Mr. Matthew Crabtree, called in; and Examined.

What age are you?—Twenty-two.

What is your occupation?—A blanket manufacturer.

Have you ever been employed in a factory?—Yes.

At what age did you first go to work in one?—From 6 to 9 in the morning.

How long did you continue in that occupation?—Sixteen hours.

Will you state the hours of labour at the period to the factory, in ordinary times?—From 6 in the morning to 9 in the evening.

With what intervals for refreshment and rest?—Yes.

Then you had no resting time allowed in which to fast, or what is in Yorkshire called your "drinking?"

When trade was brisk what were your hours?—No.

Sixteen hours?—Yes.

With what intervals at dinner?—An hour.

How far did you live from the mill?—About a mile.

Was there any time allowed for you to go to the mill?—No.

Did you take it before you left your home?—No.

During those long hours of labour could you ever get you awake?—I seldom did awake spontaneously but when I was lifted out of bed, sometimes asleep, by my master.

Were you always in time?—No.

What was the consequence if you had been commonly beaten.

Severely?—Very severely, I thought.

In whose factory was this?—Messrs. Hague.

Will you state the effect that those long hours of your health and feelings?—I was, when we were commonly very much fatigued at night, when I was not allowed to sit down. I sometimes had to work so tired that I fell asleep.

I did eat I vomited.

Did this labour destroy your appetite?—I believe it did.

In what situation were you in that mill?—I believe I was always in the same.

Will you state to this Committee whether there was serious employment for children, or not?—It is but a common employment.

Piece work is continually running to an end.

The main meal, in the afternoon. Not the evening sup-