



The most far-reaching, influential transformation of human culture since the advent of agriculture eight or ten thousand years ago, was the industrial revolution of eighteenth century Europe. The consequences of this revolution would change irrevocably human labor, consumption, family structure, social structure, and even the very soul and thoughts of the individual. This revolution involved more than technology; to be sure, there had been industrial "revolutions" throughout European history and non-European history. In Europe, for instance, the twelfth and thirteenth centuries saw an explosion of technological knowledge and a consequent change in production and labor. However, the industrial revolution was more than technology—impressive as this technology was. What drove the industrial revolution were profound social changes, as Europe moved from a primarily agricultural and rural economy to a capitalist and urban economy, from a household, family-based economy to an industry-based economy. This required rethinking social obligations and the structure of the family; the abandonment of the family economy, for instance, was the most dramatic change to the structure of the family that Europe had ever undergone—and we're still struggling with these changes.

In 1750, the European economy was overwhelmingly an agricultural economy. The land was owned largely by wealthy and frequently aristocratic landowners; they leased the land to tenant farmers who paid for the land in real goods that they grew or produced. Most non-agricultural goods were produced by individual families that specialized in one set of skills: wagon-wheel manufacture, for instance. Most capitalist activity focused on mercantile activity rather than production; there was, however, a growing manufacturing industry growing up around the logic of mercantilism.

The European economy, though, had become a global economy. In our efforts to try to explain why the Industrial Revolution took place, the globalization of the European economy is a compelling explanation. European trade and manufacture stretched to every continent except Antarctica; this vast increase in the market for European goods in part drove the conversion to an industrial, manufacturing economy. Why other nations didn't initially join this revolution is in part explained by the monopolistic control that the Europeans exerted over the global economy. World trade was about making *Europeans* wealthy, not about enriching the colonies or non-Western countries.

Another reason given for the Industrial Revolution is the substantial increase in the population of Europe; this is such an old chestnut of historians that we don't question it. Population growth, however, is a mysterious affair to explain; it most often occurs when

standards of production rise. So whether the Industrial Revolution was started off by a rise in population, or whether the Industrial Revolution started a rise in population is hard to guess. It's clear, though, that the transition to an industrial, manufacturing economy required more people to labor at this manufacture. While the logic of a national economy founded centrally on the family economy and family production is more or less a subsistence economy—most production is oriented around keeping the family alive, the logic of a manufacturing economy is a surplus economy. In a manufacturing economy, a person's productive labor needs to produce more than they need to keep life going. This surplus production is what produces profits for the owners of the manufacture. This surplus economy not only makes population growth possible, it makes it desirable.

England

While it's hard to pinpoint a beginning to the Industrial Revolution, historians generally agree that it basically originated in England, both in a series of technological and social innovations. Historians propose a number of reasons. Among the most compelling is the exponential increase in food production following the enclosure laws of the eighteenth century; Parliament passed a series of laws that permitted lands that had been held in common by tenant farmers to be enclosed into large, private farms worked by a much smaller labor force. While this drove peasants off the land, it also increased agricultural production *and* increased the urban population of England, since the only place displaced peasants had to go were the cities. The English Parliament, unlike the monarchies of Europe, was firmly under the control of the merchant and capitalist classes, so the eighteenth century saw a veritable army of legislation that favored mercantile and capitalist interests.

Because of the strong role of Parliament in English government and the incredible influence of capitalists and mercantilists, social values had also been steadily shifting in England. In continental Europe, the aristocracy represented the fullest embodiment of social values. They believed that they were born with higher virtues than the common people, who, because of their birth would never attain these virtues to the same level. They also believed that the pursuit of money was a characteristic of common people; the mercantile and capitalist revolutions throughout Europe, in England, was achieved by the non-aristocratic classes—it was a middle-class or **bourgeois** revolution.

The diminished role of the aristocracy in English government and society, however, allowed for a steady shift in values; the values of the mercantile and capitalist classes slowly became the norm—the most important of these values was the pursuit of wealth. Adam Smith's *The Wealth of Nations* proposed that the only legitimate goal of national government and human activity is the steady increase in the overall wealth of the nation. This is not an idea that would have flown two hundred years earlier.

Mercantilism had thrived in England in ways that it hadn't on the continent. In particular, the English had no internal tariffs or duties on commerce, which wasn't true of any of the continental European states. Moving goods around in continental Europe was an expensive affair as you had to pay taxes and duties every hundred miles or so; moving goods around in England was cheap, and profits soared. In addition, England had come to monopolize overseas trade. Every time England fought a war in the eighteenth century it always acquired new overseas territory. It completely monopolized trade with the North American colonies—in fact, one-half of all British exports went to America in the 1780's—but it also began to control the South American and, most importantly, the Indian trade. All this trade produced the largest merchant marine in the world as well as a navy to protect this merchant marine fleet. Like Periclean Athens, England shot to the forefront of the new capitalist economy primarily through its navy.

The technological innovations followed these social and economic changes. The first major technological innovation was the cotton gin. Cotton is a plant grown in America and India; it was a small industry through much of the seventeenth century but exploded in the

middle of the eighteenth. Most cotton was produced in British colonies; because it was a labor-intensive agriculture, it fueled the traffic in African slaves to the colonies—the cotton shroud that fell over the history of Africa. The first innovation in cotton manufacture was the fly-shuttle, which greatly speeded up the process of weaving cotton threads into cloth. That wasn't enough, though, for cotton had to be stretched out or spun into threads to begin with; this process was done slowly, one thread at a time, by a machine called a spinning wheel. This slow process was mechanized by James Hargreaves, a carpenter, in what is usually pointed to as one of the typological major technological innovations of the Industrial Age: the "spinning jenny." Patented in 1767, the spinning jenny was a series of simple machines rather than a single machine, and it spun sixteen threads of cotton simultaneously. These two qualities: multiple machines in a single machine as well as a machine that was designed not just to speed up work, but to do the work of several laborers simultaneously, was the hallmark of all subsequent technological innovations. In 1793, the American, Eli Whitney, invented the cotton gin which mechanized the separating of seeds from cotton fibers. These innovations made cotton incredibly cheap and infinitely expandable; since cotton clothing was tougher than wool, the manufacture of cotton clothing shot through the roof. By the end of the eighteenth century, the manufacture of thread and cloth was slowly moving out of the family economy and into large factory mills, though this transition would not be fully realized until the middle of the nineteenth century.

While the spinning jenny is frequently pointed to as the first, major technological innovation of the industrial revolution, the invention that really drove the revolution in the eighteenth century was invented several decades earlier: the steam engine. Along with the growth in the cotton industry, the steel industry began to grow by leaps and bounds. This was largely due to a quirk in English geography: England sits on vast quantities of coal, a carbon based mineral derived from ancient life forms. Coal burns better and more efficiently than wood and, if you have lots of coal, is infinitely cheaper. The English figured out that they could substitute coal for wood in the melting of metals, including iron, and blissfully went about tearing coal from the ground while manufacturers in Europe looked on jealously.

Mining coal, however, was not an easy task. As you drew more and more coal out of the ground, you had to mine deeper and deeper. The deeper the mine, the more it fills with water. In 1712, Thomas Newcomen built a simple steam engine that pumped water from the mines. It was a single piston engine, and so it used vast amounts of energy. Because of its inefficiency, nobody could think of any use for it besides pumping water.

Until a Scotsman named James Watt added a separate cooling chamber to the machine in 1763; this cooling chamber condensed the steam so the cylinder itself didn't have to be cooled. Patented in 1769, Watt's steam engine had the efficiency to be applied to all kinds of industries. He was not, however, good at doing business and it was only when he had teamed up with the businessman, Matthew Boulton, that the steam engine began to change the face of English manufacture. By 1800, Watt and Boulton sold 289 of these new engines; by the middle of the next century, the steam engine replaced water as the major source of motive power in England and Europe. The changes that the steam engine wrought, however, is a story for another day.

And it is here, with 289 steam engines pumping and steaming around England that we'll leave the story of the Industrial Revolution—half-completed, you might say. The nineteenth century saw the exporting of the Industrial Revolution to Europe in the decades after 1830, and the explosion of factory-based, technology driven manufacture. The Age of Absolutism and the waning years of the Enlightenment saw Europe just beginning a new phase in its history, one that would irreparably sever it from the traditions and certainties of the past.

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