



The Technologies & Machines That Powered the Industrial Revolution

Vijjika Singh

Received 02 April, 2015; Accepted 08 May, 2015 © The author(s) 2015. Published with open access at www.questjournals.org

“ The Industrial Revolution was another of those extraordinary jumps forward in the story of civilization.”

Stephen Gardiner

The Industrial Revolution began around 1760. Its end is agreed upon as being somewhere between 1820 and 1840. Some historians also regard the period between 1840 and 1870 as the Second Industrial Revolution. Before the Industrial Revolution most manufacturing was done by hand. It was a tedious, laborious life with very little paid by way of attention to the welfare of the workers. Most notable innovations during the Industrial Revolution were the use of steam to power machines, new chemical methods, better extraction of steel from iron ore and development of several machine tools.¹ It is believed that the Industrial Revolution turned primarily agrarian and rural economies to industrial powerhouses. It is also regarded as a socio-economic watershed, as it is supposed to have touched many facets of human life.

The average income of people grew steadily and growth became more sustained than ever before. Some historians, however, are also of the opinion that tangible change to the ordinary lot of people came about only as late as the early twentieth century.² Nearly all historians, almost unanimously acknowledge Great Britain as the epicenter of this revolution. It spread quickly to other parts of Europe and across the Atlantic to North America in a few decades. Most economists regard the revolution as the greatest thing to have happened since selective breeding of edible grasses and domestication of animals.³

The results of the Industrial Revolution were not just economic, but also social and political. It led to an unprecedented expansion of world trade, establishment of the factory system, mass production of goods, increased employment, rise in the standard of living, decline of landed Aristocracy, growth and expansion of democracy, increased government involvement in society, stimulated nationalism and imperialism, growth of capitalism, development and growth of cities, improved status and earning power of women, increase in leisure time, increase in population and stimulation of science and research. The Industrial Revolution also allowed some European and North American countries to increase their per capita GDP substantially; not only compared with other countries of the world but also in comparison to their own incomes a century ago.⁴⁵

The beginning of the Industrial Revolution is linked only to a few innovations. It was only during what is called ‘the second industrial revolution’ that the number of innovations grew substantially. These early innovations were in the field of steam power, textiles and metallurgy (more specifically iron and steel making).⁶

Steam engines were the main force behind the Industrial Revolution and became widespread commercially, driving machinery in factories, mills and mines; powering pumping stations; and propelling transport appliances

¹T S Ashton, *The Industrial Revolution, 1760-1830*, Oxford UP,

²Lucas, Robert E., Jr. (2002). *Lectures on Economic Growth*. Cambridge: Harvard University Press

³McCloskey, Deidre (2004). "Review of *The Cambridge Economic History of Modern Britain*

⁴McNeil, Ian (1990). *An Encyclopedia of the History of Technology*. London: Routledge.

⁵Peter Mathias, *The First Industrial Nation : An economic History of Britain, 1700 – 1914*, Charles Scribner’s Sons, 1970

⁶Eric Bond, Sheena Gingerich, Oliver Archer-Antonsen, Liam Purcell, Elizabeth Macklem (17 February 2003). "The Industrial Revolution– Innovations" industrialrevolution.sea.ca.

such as railway locomotives, ships and road vehicles. Their use in agriculture led to an increase in the land available for cultivation.⁷

Thomas Newcomen, an ironmonger by trade and a Baptist lay preacher by calling, invented the first steam engine as far back as 1712. It was of little use then, as it could only pump water, but the idea of using steam to power machines was born. In Britain by 1800 an estimated 10,000 horsepower was being supplied by steam. By 1815 steam power had grown to 210,000 hp. The next great change in using steam power was brought about by Scotsman James Watt. He collaborated with Englishman Matthew Boulton, and by 1778 his steam engine had been almost perfected. The new design had several improvements but most of all Watt succeeded in producing rotary motion, therefore making his machine suitable for powering not only trains but also Ships and machines. He managed closing off of the upper part of the cylinder causing steam to drive the piston in a reciprocal motion. He also designed a steam jacket and the celebrated separate steam condenser chamber. Watt's engine was such a grand success that Messrs. Boulton and Watt opened the Soho Foundry, solely for the manufacture of such engines, in 1795. By 1783 Watt's engines also started powering Industrial machines that ran on rotary power. The most notable of these machines was a steam powered lathe machine that could accurately turn, hone and fashion parts, with the help of machine tools, that went on to make even bigger and better machines. Most of his engines produced between 5 and 10 horsepower.⁸

In 1807, Robert Fulton, an American, used steam power to create the first steamboat, an invention that would change the way and the speed with which materials could be moved between the colonies of Britain. In the beginning, the ship was more expensive to build and operate than sailing vessels, but it had some advantages. It could take off under its own power and it was more steadfast in storms.⁹

However, the first product that underwent a real 'revolution' was cotton. It went from being a product of the cottage industry to that of mechanized manufacturing. In 1760, the amount of wool traded was thirty times more than cotton, but demand for cotton grew with a change in the upper class fashion, and Britain started to allow more cotton production.¹⁰

This demand was the inspiration for the following four inventions:

John Kay's "flying shuttle"

- John Kay, a Lancashire mechanic, invented the flying shuttle. With strings attached to a picking peg, a single weaver, using only one hand, could now operate the shuttle on the loom. With this invention it took four spinners to keep up with one cotton loom, and ten people to prepare yarn for one weaver. So while spinners were often busy, weavers often waited for yarn. As such, the flying shuttle effectively doubled a weaver's production of cloth.¹¹

James Hargreaves' "spinning jenny"

- James Hargreaves patented the "spinning jenny," in 1774 a device, which allowed one person to spin many threads at once, further increasing the amount of finished cotton that a worker could produce. By turning a single wheel, a worker could now spin eight threads at once, a number that was later increased to eighty.¹²

Richard Arkwright's "water frame"

- Also in 1764, Richard Arkwright created the "water frame" to produce yarn faster. The "Spinning-Frame," (its earlier version), was too large to be operated by hand. After experimenting with other sources of power, he decided to employ the power of a water wheel, and his machine became known as the water frame. Rollers produced yarn of the correct thickness, while a set of spindles twisted fibers together. The machine was able to produce a thread far stronger than any other available at the time.^{11 12}

⁷University of Rochester, NY, *The growth of the steam engine* online history resource, chapter one".
history.rochester.edu.

⁸Lira, Carl (2001). "Biography of James Watt". egr.msu.edu.

⁹Buckman, David Lear (1907). *Old Steamboat Days on The Hudson River*. The Grafton Press.

¹⁰Haberman, Arthur. *The Making of the Modern Age*. Toronto: Gage Publishing, 1984.

¹¹Simkin, John, "Encyclopedia of British History," <http://www.spartacus.schoolnet.co.uk/industry.html>, 12 February 2003.

¹²Gernhard, Rempel. "The Industrial Revolution,"
mars.acnet.wnec.edu/~grempe/courses/wc2/lectures/industrialrev.html, 8 February 2003.

Samuel Crompton's "Crompton's mule"

- In 1779, Samuel Crompton combined both the spinning jenny and the water frame to create a machine known as "Crompton's mule," which produced large amounts of fine, strong yarn.^{11 12}

With the advent of these machines yarn and thread could be made faster and better, and the era of cotton cloth had arrived. By 1812, the cost of making cotton yarn had dropped by nine-tenths and the number of workers needed to turn wool into yarn had been reduced by four-fifth. The addition of these inventions to the work force moved the stress from the production to the supply of raw cotton. Within just a 35-year period, more than 100,000 power looms with 9,330,000 spindles were put into service in England and Scotland. Britain took advantage of the Americas' available new cotton, using it to help absorb the demand. By 1830, the importation of raw cotton had increased to eight times its past rate and half of Britain's exports were refined cotton.¹³

A primary change in metallurgy during the Industrial Revolution was the replacement of wood by coal. Coal had higher calorific value and was significantly easier to mine than first chopping wood and then turning it into charcoal. Additionally coal was also more abundant than wood.¹⁴ Based on innovations by Sir Clement Clerke and others from 1678, coal reverberatory furnaces called cupolas were now used for smelting. The quality of Coal available with Britain during Industrial Revolution was perfect for turning into Coke, a kind of charcoal that is obtained with destructive distillation of low-sulphur bituminous coal.

In 1709, Abraham Darby used coke to fire his blast furnaces at Coalbrookdale. The pig iron he made went on to be converted to cast iron and this was used to make several bridges and structures. By 1784, Henry Cort had developed two significant iron-manufacturing processes; *Rolling* and *Puddling*. These innovations made Hammering redundant and made the process of making iron much faster and more efficient.¹⁵

James Beaumont Neilson, in 1828 patented the *Hot Blast* process. It was the most significant improvement in saving energy for the manufacturing of Pig Iron. Later in 1855, Henry Bessemer patented the Bessemer process for making steel from iron and the manufacturing of Steel is considered to mark the commencement of the 'Second Industrial Revolution'. A number of industries prospered on account of supply of cheaper and better iron and steel. The most significant were the industries making nails, hinges, wire and other hardware items. The developed machine tool industry also allowed for innovations, and steel casings and fixtures, that were not possible up until then, became quite commonplace.¹⁶

The other industries that developed during this period were Chemicals, Cement, Glass Making, Agriculture, Mining, Gas Lighting and Paper Machine.¹⁷ From Britain, the wave of Industrial Revolution spread to Continental Europe, the United States and to a great extent even Japan. This was followed by the 'Second Industrial Revolution'.

Summarily, the Industrial Revolution also had lasting effects on working conditions, living conditions, Urbanization, public health and safety, working class families and the role of women. A new middle class emerged and wealth spread from a few, to many more.¹⁸ The British Empire reached the zenith of its spread and glory and the world, as we knew it, never remained the same.

However, a vast majority of countries, particularly in Asia and Africa had to wait for another century (or more) before their populations could reap the benefits of liberty and technology. To quote Bill Gates: "If you go back to 1800, everybody was poor. I mean everybody. The Industrial Revolution kicked in and a lot of countries benefited, but by no means everyone."¹⁹

¹³"Industrial Revolution: The Industrial Revolution in Great Britain," *The Columbia Electronic Encyclopedia*, www.factmonster.com/ce6/history/A0858818.html, 8 February 2003.

¹⁴Landes, David S. (1969). *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. Cambridge, New York: Press Syndicate of the University of Cambridge.

¹⁵Landes pp 91

¹⁶Griffin, Emma (2010). *Short History of the British Industrial Revolution*. Palgrave.

¹⁷Wikipedia, Industrial Revolution

¹⁸webs.bcp.org

¹⁹Bill Gates' Interview by Jeffery Kluger, Jan 21, 2014, Time Magazine