Industrial Revolution Readings

The fossil fuel revolution was a fundamental breakthrough in human history. It was as significant for our species as the transition to agriculture. Coal contains much higher levels of energy per given weight than equivalent amounts of renewable biomass (wood). Exploiting coal on a large scale, humans were able to burst through the ceiling on economic growth that had been in place since the modern human species appeared about 200,000 years ago.

In 1750, world coal output per year was less than 10 million metric tons. Then things began to change, thanks mainly to steam-powered pump engines, which allowed coal miners to drain the water that tended to accumulate in mine shafts and tunnels. By 1860, the world produced about 130 million tons of coal. In 1900, production rose to an astonishing 1 billion tons, and coal provided 90 percent of total world energy consumption.

Many more people. A second major source of environmental change was population growth. In 1700, world population, according to one estimate, was about 603.4 million. By 1913, it had nearly tripled to about 1.79 billion. The environmental impact of this dramatic population increase, combined with the surges in economic growth and energy consumption, was colossal. Let us consider some major factors.

At first, the population increase was disproportionately concentrated in western Europe, where numbers increased from 81.4 million in 1700 to 261 million in 1913, despite the emigration of millions of Europeans to overseas states and colonies. Later in the era, the populations of Asia and Latin America also increased dramatically. For example, Asia's population (excluding Japan) grew from 374.8 million in 1700 to 925.9 million in 1913, an increase of nearly two and a half times.

World Population Trends in Millions[1]

	1700	**1870**	**1913**
Western Europe	81.4	187.5	261.0
Asia	374.8	730.6	925.9
Africa	61.0	90.4	124.7
Latin America	12.0	40.0	80.5
United States	1.0	40.2	97.6
World	603.4	1,270.0	1,791.0

In some isolated regions, notably Siberia, Australia, many Pacific islands, and some areas of tropical rainforest, indigenous populations declined. This was mainly because outsiders introduced infectious diseases to which the inhabitants had weak immunities. Epidemics were sometimes locally catastrophic, comparable to the Great Dying in the Americas relative to population size. In the late eighteenth century, for example, a pestilence on the Siberian peninsula of Kamchatka carried off as many as 75 percent of the local inhabitants. When European settlers started arriving in New Zealand in 1840, the indigenous Maori population may have numbered 100,000 or more. By 1858, it declined to 56,000, owing mainly to diseases that Europeans brought with them.

Rapid urbanization accompanied world population growth. In 1800, only nine cities in the world had a population of 1 million or more. By 1900, twenty-seven cities had more than 1 million people. The proportion of the world's people who lived in cities, rather than in rural areas, increased from 2 percent in 1800 to 10 percent in 1900.

Mass migrations. Steamships and railroads made major migrations of peoples possible in Big Era Seven. More than 50 million people emigrated from Europe (including Russia) during the era, two-thirds of them permanently. Most of them were looking for work, opportunity, and the prospect of higher living standards than they had enjoyed in their native lands. Their destinations were mainly the world's temperate zones: Canada, the United States, Algeria, and Siberia in the Northern Hemisphere; Chile, Argentina, Uruguay, South Africa, Australia, and New Zealand in the Southern Hemisphere. Indigenous peoples resisted these newcomers, but in many places they were eventually demographically swamped by them. For example, the population of the territory that now constitutes the United States may have been as high as 10 million in 1500, and those people were all American Indians. According to the 2000 census, by contrast, the population classified as American Indian or Native Alaskan numbered just over 2 million, a number representing only about 0.7 percent of the total population of 281.4 million. These overseas migrations of Europeans also had a significant environmental impact. This is because Europeans and their descendants possessed both sophisticated machine technology and expectations of relatively high standards of living. Therefore, they tended to exploit natural resources more intensively than did the peoples they replaced.

Another pattern of migration continued from the previous Big Era. Between 1750 and 1870, about 1.7 million Africans were moved involuntarily to the Americas, most of them destined to work on sugar and coffee plantations in Brazil or the Caribbean. After 1800, however, the proportion of people of African descent living in the Americas declined relative to the number of people of European ancestry. This happened because so many more Europeans migrated to the Americas in the nineteenth century than did before 1800. Also, the average life span of African slaves was significantly lower than that of European immigrants to the Americas.

A third pattern was the migration of Asian laborers. Between 1830 and 1913, some 30 to 40 million Indians and about 15 million Chinese left their countries to seek

work in mines and on plantations in European colonies and Latin American countries, as well as in Southeast Asia, the Pacific islands, and South Africa. In the earlier decades of the century, many Asians migrated under contracts of indenture, which offered them free or cheap transport in return for a specified number of years of employment. Many of indentured migrants were treated unfairly and left worse off than they had been at home. Many Asians migrated to the U.S., Canada, and Australia to build railroads. Many became permanent settlers, though others eventually returned home.

By one estimate, more than 100 million people world-wide were involved in long-distance migrations during Big Era Seven. Finally, we must also mention the millions more who migrated within the lands of their birth to seek work and opportunity in cities or other regions of economic growth. Internal migrations were an important aspect of change in India, China, Russia, the Ottoman empire, Africa, and Latin America.

Environmental impact of industrialization and migration. The Industrial Revolution transformed the ability of humans to reshape the world's environment. Deforestation increased on a global scale. So too did water pollution from chemical and agricultural discharges into lakes and streams, and atmospheric pollution from the burning of huge amounts of coal. The advent of railroads and steamships also hastened the diffusion of plants and animals to new parts of the world. This was an extension of the Columbian Exchange of biota that occurred in the previous Big Era. The spread of new plants, such as maize, wheat, and cassava into areas where they had previously been unknown, underwrote large population increases. But environmentally adverse consequences also occurred. For example, in 1859 a farmer in Australia introduced a few rabbits for hunting. Within a few years rabbits were hopping across the continent by the millions, ravaging crops as they went. By 1950, Australia's rabbit population numbered 500 million and continued to wreak havoc on agriculture.

Despite the global economic advances of Big Era Seven, several major famines occurred. In fact, famines intensified as a result of increased global economic integration, which sometimes devastated peasant societies and sharpened social inequalities. In 1846-49, for example, a series of regional blights ruined potato harvests in Ireland and Eastern Europe. The resulting food deficit provoked many deaths and mass migrations. Even more distressing were the famines of 1876-1902, which historians have linked to climatic conditions produced by the El Niño Southern Oscillation (ENSO), a cyclical warming of sea surface temperatures combined with changes in sea level pressure in the southern Pacific basin. Although grain was available to feed the hungry, colonial economic policies justified its continued export to industrial countries for profit. Millions died in parts of Africa, Asia, and Latin America, and countless millions more were reduced to poverty. Some historians believe that the late nineteenth century famines, coming when they did, were instrumental in producing the gap in living standards that subsequently divided the developed from the underdeveloped world.

In Big Era Seven, autocatalytic change prevailed as ecological, economic, political, and technological developments fed upon one another and merged into a single global process, the modern revolution. This revolution was global in scope and fundamentally irreversible.

As peoples around the world, especially elite groups with power and wealth, attempted to understand and influence the multitude of new developments that constituted the modern revolution, the doctrines of liberalism came to the fore, first of all in Europe and the United States. The term "liberal" refers basically to an attitude that favors individual rights, free markets, representative government, and progress. In Big Era Seven, liberalism took the form of a complex "package" of ideas and plans of action.

In the economic sphere, liberalism called for such reforms as establishment of the rule of law in societies, the sanctity of private property, and the improvement of communications, including railroads, steamship lines, telegraphs, and modern port facilities. Liberal economic reformers believed the market to be the ultimate governor of human relations, and they insisted that both property and labor be released from the outmoded restrictions of medieval times.

In politics, liberal reformers called for republican, that is, representative, government characterized by democratic participation, constitutions, and legislatures. They also demanded the separation of church and state and an end to policies that allowed churches to be exempt from taxes and to control primary education.

Economic trends. In the first phase of the Industrial Revolution (1750-1840), entrepreneurs and workers harnessed coal and steam power to drive industrial machinery and vastly increase production. This development occurred first in England. Railroads drastically lowered the cost of land transportation, while greatly increasing the volume of goods and persons transported, as well as the speed at which they were moved. Consequently, railroads were especially important in large countries such as the United States and Russia. Railroad construction also propelled coal and steel industries and facilitated the expansion of markets. After 1840, and especially after 1860, steam-generated electricity powered industrial machinery.

Also, the modern world economy became increasingly organized on the basis of an international division of labor. This meant that colonial possessions and other rural regions of the world produced mainly raw materials for export. In return, they imported finished goods from the metropolitan country (the one that controlled the colony) and from industrializing regions generally.

Around 1800, for example, sugar was the world's most important commercial crop. It was produced by slave labor and made great profits for sugar merchants, plantation owners, and financiers, mainly in Europe. By the 1830s, sugar was supplanted by cotton as the leading market crop. This happened mainly owing to the industrial mechanization of cotton textile production. In the Americas, cotton continued to be

produced by slaves; in countries like Egypt and India, peasants grew it for small returns. Since British soil could not produce cotton, factories had to import all of it from India, Egypt, and the southern United States. British manufacturers inundated the world market with cotton products. For British manufacturers, this was good liberal practice because the market was allowed to determine whether Indians bought local or European cottons. The market, however, drove down prices of handloom cotton in India and destroyed the livelihood of local spinners and weavers there. Many of those artisans ended up growing raw cotton and selling it to merchants for export to European factories.

When necessary, however, European powers were willing to gain economic advantages using strategies that contradicted the free market. In the previous big era, Asians had been mostly unwilling to import European goods because they did not want or need them. This had been a key economic weakness for European manufacturers and merchants. As a result of the Opium War (1839-1842), however, Britain used naval force to compel the Chinese government to open its market to opium grown in India, then a British colony. This traffic enabled Britain to balance its trade with China for the first time in history. Following the war, the British government imposed a series of treaties on China that gave Britain favored and unequal trading privileges. British merchants regarded this course of events as a case of practical liberal reform, but it led to a large flow of silver out of China to pay for opium, which weakened the already strained Chinese economy. It also led to debilitating opium addictions for millions of Chinese.

In the second half of the era, European and American governments followed suit, establishing, by armed intervention, privileged enclaves in Southeast Asia and China. In 1854, Japan also had to sign an unequal treaty with the United States and then with major European powers. These unequal treaties were the norm not only for European trade with Asia but also with Latin America and the Middle East. States wishing to trade with Britain had to set low tariffs on British imports and adopt legal and other measures favorable to British interests. In the course of the nineteenth century, other European countries, as well as the United States, imposed similarly unfavorable commercial treaties on many countries.

Following the discovery of gold in California in 1849 and later discoveries in Australia, Alaska, and South Africa, a new cycle of global economic growth set in. The increased availability of this precious metal led in 1878 to the establishment of the gold standard, which fixed the value of all currencies in terms of gold. For the first time, there was a single global financial market, which liberals regarded as a progressive reform. For others, the gold standard set up terms of trade that led to the impoverishment of their countries.

Between 1880 and 1914, the world economy underwent a second major wave of expansion. Global growth increased threefold, world trade fourfold, and international investment eightfold. The modern communications revolution, including the building

of railroads in Africa, Asia, and Latin America, the global expansion of steamship travel, the laying of the trans-oceanic telegraph cables, and the invention of the telephone, greatly enhanced the movement of peoples, goods, and capital worldwide. The mechanization of agriculture in both Europe and temperate regions where Europeans settled made it possible to produce, process, and transport food more cheaply and efficiently. The steel and chemical industries emerged as a new focus of production and profit just when innovations in the textile industry were slowing down.

The era also saw major economic consolidation. In accord with liberal principles that valued accumulation of private capital and the sanctity of property, new cartels and trusts were formed whose wealth dwarfed any business organizations previously known in history. Two examples were U.S. Steel and Unilever Brothers. The dark side of wealth accumulation was that increased integration of the world market made economies more vulnerable to financial crashes that could wipe out vast sums in a moment.