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Candice Goucher, Charles LeGuin, and Linda Walton, *In the Balance: Themes in Global History* (Boston: McGraw-Hill, 1998), selections from chapter 16, “Dual Revolutions: Capitalist Industrialism and the Nation State”; also pages 912–17.

Abstract: This essay discusses the European origins of capitalist industrialism as it developed between the eighteenth and twentieth centuries. It looks first at the technologies, institutions, and demographic changes that characterized the rise of capitalist industrialism, and then moves to the impact those changes had on society. Finally, it considers the long-term effects of technological change, especially the ways those changes have impacted the environment.

Introduction

The industrial revolution was closely tied to the economic system of capitalism, the use or investment of money to make profits. The earliest form of capitalism was agricultural, where wealth was both made from the land and invested in its improvement and expansion. Localized, self-sufficient agriculture was only gradually replaced with market-oriented agriculture, which required capital investment. Commercial capitalism developed with the late-medieval revival of cities and trade and flourished as a result of global exploration, trade, and colonization beginning in the sixteenth century. Before the sixteenth century, the power of monarchs depended on their relationship with an agrarian-military aristocracy; with the development of commercial capitalism, monarchs were supported by their merchant partners in mercantilism.

By the late eighteenth century, the investment of capital in industry, much of it derived from commerce and agriculture, began the vast expansion that would make industrial capitalism the dominant form of capitalism by the end of the nineteenth century. Older forms of capitalism were gradually subsumed in finance capitalism, in which bankers and financiers invested in industry, commerce, and even agriculture. Finance capitalists combined huge corporations and immense concentrations of money in economic activities that were increasingly global and intertwined with the expansion of European nation states in the Americas, Asia, and Africa.

The Revolution of Capitalist Industrialism in the Atlantic World

Capitalist industrialism took shape in the late eighteenth and early nineteenth centuries along the Atlantic frontier of western Europe and, perhaps earliest and most successfully, in England. The two decades of political upheaval that began in Europe with the French Revolution in 1789 and lasted until Napoleon’s exile to St. Helena in 1814 especially affected processes of

capitalist industrialization in England and to a somewhat lesser degree in France. Demands made by the lengthy war in which they (and the rest of Europe) were engaged between 1792 and 1815 encouraged expansion of the industrial sectors of both countries.

Capitalist industrialism was the result of many factors, including government-encouraged economic growth, new large-scale marketing, the availability of surplus capital, and technological innovations that had cumulatively developed since the sixteenth century. It developed earliest in industries such as machine tools, which are basic to all forms of industrial production, and textiles, which supply vast market demands. Enterprises such as mining and metallurgy that were ancillary to machine-tool or textile production were also involved in early capitalist industrial development.

Many of the factors responsible for capitalist industrialism, such as population growth and demographic shifts, technological innovations, and the accumulation of capital for investments in new and risky enterprises, date from the late seventeenth century, a time when the political transformations of the English Civil War and the Glorious Revolution were ushering in profound changes in the English nation state. These political and economic developments were intertwined, and by the eighteenth century, the impact of the industrial revolution was producing dramatic changes in the ways people lived and how they experienced the world around them.

Demographic Changes: Agriculture and Urbanization

An increase in births and a decline in deaths increased the population of England by about 3 million (to 8 million) in the eighteenth century. Population growth evident in his own lifetime led the Reverend Thomas Malthus (1776–1834) to despair in his *Essay on the Principle of Population* (1798) that “the power of population is infinitely greater than the power of the earth to produce subsistence for man.” Increased numbers required increased food production, and the innovations and rapid changes that took place in eighteenth-century agricultural practices constituted what can be called an “agricultural revolution.”

Agricultural Revolution

One aspect of this revolution, the culmination of a long process, was the consolidation of agricultural estates by engrossing (combining smaller into larger parcels of land) and enclosure (which converted arable land into pastures for sheep). Enclosure was vigorously pursued in eighteenth century England when people with capital and influence were able to take over common lands, dispossess small farmers, and consolidate their holdings to create landed estates that were more efficient and that could supply wool for the expanding textile industry. By the early nineteenth century large,

landowning, agricultural capitalists were sufficiently powerful to persuade the government to pass a general enclosure act (1801), providing a formula that standardized, simplified, and thus accelerated the process.

Urbanization

New agricultural machinery, which reduced the need for human agricultural labor; new crops; and new methods of improving fields and cultivation were as important as enclosure in responding to the market needs of expanding populations and increasing urbanization. Increased numbers of people dispossessed of their lands by the agricultural revolution sought employment in the cities. The marked increase in urban populations in the second half of the eighteenth century complemented industrial expansion by providing a useful supply of labor and by increased market demand for manufactured as well as agricultural products. The inability of traditional modes of production to satisfy the growing needs of expanding populations led to the investment of capital in the technology and organization of industry as well as agriculture.

Technology and Capital

Many of the technological innovations essential to the capitalist industrial revolution were the result of experiments and tinkering by craftsmen and artisans. Consistent developments of textile machinery, beginning with an improved loom (John Kay, 1733) and continuing with swifter methods of spinning (James Hargreaves, 1764) provided the basis of the revolution in textile production. The distinctive technological feature of the capitalist industrial revolution, however, was the rotary steam engine perfected by James Watt (1736–1813), a trained instrument maker. The combination of such technological innovation with the investment of wealth—some of which was rooted in the Atlantic plantation economy and slavery—was essential to the capitalist industrial revolution and helps explain why it was first successfully launched in England.

The use of power-driven machinery under factory conditions, a feature that characterizes the industrial revolution, was made possible by venture capitalists who were willing and able to invest substantial sums in innovations and take risks in the quest for profits. Not all capitalists, however, were willing to take risks involved in developing new modes of production. As long as the traditional, labor-intensive methods of production were profitable, most capitalists continued to invest in them, rather than in machine-operated factory production. Labor-intensive industry remained a major mode of production well past 1800, even as machine production increased.

The Factory System

The distinctive institution of the capitalist industrial revolution was the factory system of production, whereby workers were herded together in buildings for fixed hours of labor at power-driven machines. Factories were, however, slow to replace domestic industry, where workers spun and wove in their own homes, using their own spinning wheels and looms. Except in cotton spinning and weaving, as late as the 1830s many employers continued to find domestic industry more profitable and to prefer small shop production to large factory enterprise. Traditional workers also tended to resist the reorganization of the workplace.

As factories multiplied, younger trainees, many of them women, who had no commitment to older modes of production, replaced traditional artisans and older workers. Factory work meant a loss of the artisan's independence and often a readjustment of family relationships, since production moved outside the home and altered the roles of individual workers. In 1831 a government committee in England investigating child labor in the textile industry uncovered the grim circumstances of daily life for many young children condemned to work in the mills to supplement family income. Twenty-three-year-old Elizabeth Bentley described her work in a textile mill at the age of 6, laboring from 5:00 in the morning to 9:00 at night, with meager portions of poor quality food to sustain her.

Many people compared the factory to the workhouse, where people were sent to work off debt. Many factory owners, who believed themselves morally as well as physically justified in controlling and disciplining their workers, introduced strict work codes that regulated every aspect of the factory day as well as after-hours activities. Despite the reluctance of some entrepreneurs and the resistance of some workers, by the middle of the nineteenth century the factory system had become the common mode of production, and capitalist industrialists who owned the factories organized and controlled the economic, cultural, and even religious life of factory communities.

Transportation and Communication

Improvements in transportation affected industrial production of every type. Efficient and cheap movement of goods was instrumental in providing supplies necessary for the growth of production and satisfying the market demand necessary to sustain it. For example, landed aristocrats who wanted to profit from mineral deposits on their land and needed a way to transport the minerals often funded extensive canal building programs in England from 1760 onward. Canals decreased the costs of transportation, and similar improvements in roads, bridges, and harbors furthered the success of English industrialism in the eighteenth century. The English transportation network was superior to that of continental Europe, where internal tolls also hindered

the movement of goods. Such tariffs had disappeared in England well before the beginning of the nineteenth century, but they were not eliminated in France until 1790 or in Germany until 1834.

By 1829 a practical steam locomotive was developed by George Stephenson in England, and shortly thereafter railway construction proceeded rapidly. In England alone railway mileage grew from 49 miles in 1830 to 15,300 in 1870. By the end of the century, Europe was knit together by a network of rail lines, and by 1905 travelers could go from Paris to Moscow and on to Vladivostok on the Pacific via the lengthy trans-Siberian railway.

Equally important to industrial growth in Europe was the development of practical ocean-going steamships, which made non-European parts of the world readily available as sources of raw materials and markets for finished products of European factories. As early as 1785, a steamboat had plied the Potomac River in the United States, but it was the success of Robert Fulton's Clermont on the Hudson River in 1807 that proved the feasibility of the commercial steamboat. In 1819 the *Savannah*, using steam power as a supplement to its sails, crossed the Atlantic to Liverpool, and in 1840 Samuel Cunard inaugurated a regular trans-Atlantic passenger steamship line.

Rapid transportation was accompanied by even more rapid means of communication, as people began to gather news of events from every part of the world and with increasing synchronicity. As early as 1820 André-Marie Ampère (1775–1836), a French physicist, used electromagnetism to send a message over wire; by 1837 Samuel F. B. Morse (1791–1872) patented a practical system of electric telegraphy in the United States. In 1851 an undersea telegraph cable across the English Channel provided instantaneous communication between London and Paris, and in 1866 a trans-Atlantic cable successfully established telegraphic communication between Britain and North America. Ten years later, the Canadian Alexander Graham Bell successfully exhibited his telephone and, with improvements and modifications, it was adopted throughout America and subsequently in Europe.

Technology and Industrialization

Demands for supplies and for finished goods doubled every few years with the expansion of global markets. For example, iron production, basic to the machine age, increased 100-fold in the nineteenth century. Innovations in metallurgy, an important aspect of the eighteenth-century beginnings of capitalist industrialization, continued in the nineteenth century. An English engineer, Henry Bessemer (1813–1883), patented a process for the efficient conversion of iron to hard steel in 1856, and about the same time William Siemens (1823–1883), a German who had settled in England, perfected an alternative process. Steady progress in discovering and using new

technologies was essential to increasingly mechanized industrial production in the latter part of the nineteenth century.

Many new industries appeared in the decades after 1850, and this tendency accelerated in the twentieth century. Innovations resulted in the alliance of industry with science and engineering, and technical schools and institutions of applied science became widespread. Precision tools and implements multiplied on demand, and new processes led to a proliferation of market products, some specifically connected with heavy industrial production but many, and increasingly, geared to the consumer market.

Among the more important new industries appearing in the second half of the nineteenth century were those connected to new sources of power such as electricity. Dynamos and motors were improved and multiplied, and new kinds of engines resulted in the development of industrial production unheard of during the initial eighteenth-century phase of the capitalist industrial revolution. This status was especially true of the internal combustion engine, which would result in the twentieth-century triumph of motorized vehicles and, among other things, cause the world production of petroleum to leap 1000 percent in the first thirty years of the twentieth century.

Consumer Industries

At the same time a conspicuous growth of essential consumer industries occurred, producing aids to individual comfort that greatly improved both the style and standard of material life, first in much of the western world and ultimately around the globe. For example, in 1879 Thomas A. Edison (1847–1931) patented the greatest of his inventions, the incandescent lamp, which would rapidly become a necessary luxury. Artificial fabrics, such as rayon, patented by the French chemist Hilaire Chardonnet (1836–1924), and artificial dyes made finery widely and cheaply available.

Refrigeration, first used on ships in 1877, added immeasurably to the availability and variety of foodstuffs. The world became the garden for urban industrial workers who could not raise their own food in rapidly expanding cities where they were confined. An Englishman might sit down to a meal gathered from five continents, and commoners who could afford to do so indulged in foods and supplies that even kings of an earlier age could not have imagined. Coal- and oil-burning furnaces kept people warm and comfortable, and trains, ships, trams, bicycles, and in time the automobile kept the population mobile.

Finance Capitalism

Expansion of industrial production would not have been possible without continued improvements in agriculture and finance capital. Capital accumulation by partnerships or joint-stock companies, sufficient to finance

early capitalist industrial enterprises such as metallurgy and textiles, was inadequate for the demands of later industrialization and trade. New means of augmenting capital were devised, leading to the formation of trusts or cartels (as trusts were designated in Germany).

Trusts and Cartels

Trusts and cartels were permanent, legally agreed upon combinations of businesses (industries, financial institutions, merchants, and the like) seeking to establish monopolies that would eliminate competition and control production and marketing. Such financial and legal combinations promised reduction of overhead expenses, increased the amount of capital available for investment, and expanded profits for those who had a share in them. Capitalist industrialism approached its apex by the end of the nineteenth century when trusts and cartels became increasingly global in their structure and operations, enabling businessmen to gather requisite financing for industrial growth by continuously increasing profits.

The Impact of Capitalist Industrialism on Society

The concentrated impact of mature capitalist industrialism on the lives of average people in the centers of western European culture was clearly discernible by the early twentieth century. A century earlier farmers had plowed their fields much as they had done for 2000 years. The horse was the swiftest means of land transportation, and the sail served for speedy water travel. The swiftest way to send a message was by signal from one hilltop to the next. These traditional practices were as widespread as they were aged, but they were rapidly replaced by nineteenth-century innovations in transportation, communication, and production.

Urban Industrial Society

By the end of the nineteenth century, the integration of manufacturing processes, enlargement of factory units, and the amalgamation of firms into virtual monopolies held a decisive grip on industrial societies. As a result, urbanization continued at an increasingly rapid rate. In 1870 there were only about 70 cities in Europe of over 100,000 in population; by 1900 there were nearly 200. London and Paris were joined by Berlin, Vienna, Moscow, and St. Petersburg as cities of a million or more inhabitants.

Urban capitalist industrial society became hierarchically complex, and imbalance appeared between the managers and owners of production who controlled profits and the workers, producers of goods without which there would be no profits, whose only share of profit was a wage determined by management. Wealth and expanded productivity had made material

existence vastly more comfortable, luxurious, and amusing, but only for some and in some places.

The Middle Class

As productivity expanded and wealth increased during the nineteenth century, a European (and American) urban middle class secured its position between wage-earning workers and their employers. The middle class consisted of professionals, small businesspeople (merchants and specialist manufacturers), and service providers. The middle class enjoyed the profits of expanding markets and wealth though it tended to be protective and unadventurous with its profits.

The middle class was an important source of increasing demand that encouraged the expansion of production and markets, since it was both willing and able to take advantage of the new products, both manufactured goods and agricultural products. Accordingly, the standard of living of the middle classes of western and central Europe and the United States seems to have steadily improved in the nineteenth century. The middle class was, however, as subject to the uncertain fluctuations of productivity and market conditions as wage earners were, and it was not uncommon for some middle-class people to be forced to become wage earners.

The Working Class

Wage earners, crowded into rapidly growing urban centers, experienced lives of degradation. In 1839 French socialist Flora Tristan (1803–1844) described conditions in the slum area of St. Giles in London, known as “Little Dublin,” where 150,000 people lived in the neighborhood at the center of the city:

Picture, if you can, barefoot men, women, and children picking their way through the foul morass; some huddled against the wall for want of anywhere to sit, others squatting on the ground, children wallowing in the mud like pigs . . . I saw children *without a stitch of clothing*, barefoot girls and women with babies at their breast, wearing nothing but a torn shirt that revealed almost the whole of their bodies; I saw old men cowering on dung hills, young men covered in rags.

Though urban life in Great Britain began to improve after mid-century, when parliament passed local government and public health legislation, conditions for the urban industrial working class improved slowly. As late as 1883 a pamphlet described the degradation of working people who lived in the heart of London in “pestilential human rookeries . . . where tens of thousands are crowded together amidst horrors which call to mind what we have heard of the middle passage of the slave ship.”

Improvements in the lives of workers that resulted from increased wages and the availability of more products were compromised by the rising cost of living. Real wages improved only slightly and continued to fluctuate in

response to market forces (costs and profits). The uncertain and difficult lives of the laboring majority (urban workers and peasants) improved only slowly. Inequalities multiplied and were reflected in the vastly different perceptions and experiences of those affected by capitalist industrialism. The benefits of capitalist industrialism were more readily available to businessmen, financiers, and industrialists than to laborers; benefits were more apparent to Europeans than to others who lived outside of Europe. Expansion of industrial capacity allied with fuller exploitation of global raw materials led to severe bouts of overproduction: from 1873 to 1893 there was a severe depression in prices and a crisis in profits, investment, and growth. This global depression was a retardation rather than a reversal of overall growth, but it highlighted clear difficulties in urban capitalist industrialism, notably the surplus of workers in times of recession and the human costs of underemployment.

Industrialization and Emigration

Unemployment and underemployment were related to demographic as well as economic factors. The population of Europe doubled between 1750 and 1850, and it continued to expand. Improved production encouraged population growth, but basically it resulted from a declining mortality rate associated with respite from widespread and terrible epidemics. Increasing numbers of Europeans began to emigrate abroad by the middle of the nineteenth century (more than 375,000 annually, most of them going to North America, but some going to South America, Australia, and South Africa). The exodus reached its peak during and following the 1873–1893 depression, with more than 900,000 Europeans leaving their homeland each year. This emigration alleviated European population pressures somewhat; it also resulted in the spread and increase of Europeans around the world: from a global percentage of 22 percent of all emigrants in 1800 to a peak of 35 percent in 1930.

Responses to Capitalist Industrialism

In England the concepts that would become basic to capitalist industrial development in the nineteenth century were contained in the *laissez-faire* (“let it alone”) ideas of Adam Smith. In his *Wealth of Nations*, Smith asserted that a free-market economy determined by supply and demand would produce an abundance unimaginable under the controlled economy of mercantilism. Smith also suggested that specialization, or assigning different tasks to different production units, was one way to increase production, an idea that was reflected in the industrial factory.

The Manchester School

David Ricardo (1772–1823) was the leader of the Manchester School, a group of critics whose “gloomy science” of economics sought to explain and justify the impact of English capitalist industrialism. By accepting Smith’s belief in a free market economy and Malthus’s belief that the size of a population was related to the level of subsistence, Ricardo concluded that the dilemma of the industrial revolution – the rich growing richer and the poor growing poorer – was inevitable, since the number of workers in a free market economy was always sufficient to keep wages low and profits high. Ricardo’s “iron law of wages” asserted that wages would stabilize at the subsistence level because increased wages would lead to an increase in the working population, which in turn would cause increased competition in the labor market and drive down wages.

Robert Owen’s Industrial Community

Robert Owen (1771–1858) was a practicing and successful capitalist industrialist who sought to mitigate the most disturbing effects of capitalist industrialism: a decline in personal contact between employer and employee that characterized the factory mode of production and resulted in the alienation of laborer from employer. Owen’s solution was not to return to precapitalist, preindustrial society, but to create a paternalistic industrial communalism based on the mutual interests of workers and employers. His scheme was implemented in communities such as New Lanark in Scotland and New Harmony in Indiana. The New Lanark factory community contained a mill and cooperative housing and stores. Free schooling was provided, for Owen believed that educated workers were better workers. Though inadequate leadership and internal dissension led in time to the failure of Owen’s experiments, his ideas and efforts, which deviated from the strict *laissez-faire* ideals of the Manchester School, indicated possibilities for closing the gaps between employers and their employees.

John Stuart Mill

John Stuart Mill’s (1806–1873) father had been a fanatical disciple of Jeremy Bentham (1784–1832), the formulator of the philosophy of Utilitarianism, which argued that the goal of society should be the greatest good for the greatest number of people. Utilitarianism attacked unrestrained capitalist industrialism, and Mill in turn continually questioned the economic structure and social patterns of nineteenth-century England. In opposition to the Manchester School, he approved of labor unions as a means by which workers could improve their conditions through collective bargaining. Mill proposed that more equal distribution of property and wealth could be accomplished by heavy taxes on land and by levies on inherited wealth.

Progress, Mill insisted, lay in a better distribution of material goods and in social justice, including equal rights for women, which he championed.

French Social Critics

One of the early French critics to begin a dialogue on achieving justice in capitalist industrial societies was Count Henri de Saint-Simon (1760–1825). He accepted that an economy based on industrial production would ensure a future of abundance that would put an end to human want. Though of an ancient noble family, Saint-Simon viewed the aristocracy as an idle class whose privileges were unjustified. For him, privilege should belong only to those who work to produce, those whom he called *industriels* – agriculturalists, manufacturers, and merchants. Society, he proclaimed, should be organized for the promotion and well-being of the most numerous and poorest class. In his last work, *The New Christianity* (1825), Saint-Simon undertook to reform society on the basis of Christian ethics.

Among those strongly attracted to Saint-Simon's ideas were professionals, including bankers and engineers; intellectuals; and some working-class women. By the 1830s about 200 women identified themselves as Saint-Simonians, an early example of the appeal that alternative visions of industrial society had for women, who were often its most oppressed victims. In 1832 a group of Saint-Simonian women published their own newspaper, *The Free Woman*, which printed only articles written by women and declared that "With the emancipation of women will come the emancipation of the worker." Although their movement collapsed, other feminist movements continued to offer criticism and alternatives to capitalist industrialism in the later nineteenth century.

Charles Fourier (1772–1837), another French critic of capitalist industrialism, differed from Saint-Simon by rejecting industrialism. Fourier proposed a visionary reorganization of society as an alternative to the industrial society that Saint Simon sought to make just and rational. Particularly alarmed by large-scale centralized production, which he saw as a threat to small enterprise, Fourier proposed as a substitute his own conception of a community based on an agrarian handicraft economy. In his vision labor would be necessary but also attractive and joyous, and life would be long, attractive, and happy.

The utopian vision of society proposed by Saint-Simon and Fourier did not have the wide appeal to the working masses that other more practical strategies did. Pierre-Louis Proudhon (1809–1865), a self-educated printer who wrote *What Is Property?* in 1840, was a working-class critic of capitalist industrial society. For Proudhon, property was theft, profit stolen from the worker with the connivance of the state. Proudhon proposed a cooperative society of independent equals based on common ownership. Because he

rejected private property, he was called a socialist, and because he rejected the state in favor of cooperative organizations, he was called an anarchist.

Bakunin and Anarchism

One of Proudhon's admirers was the Russian anarchist Mikhail Bakunin (1814–1876), who believed that the state was the cause of the common man's afflictions. Bakunin, who espoused and engaged in terrorist action against the state, was an exile from Russia and familiar with the inside of many European jails. From his base in Switzerland, Bakunin continued to work for revolution against the social order in which he found himself. The true revolutionary, he wrote, "has severed every link with the social order and with the entire civilized world." Bakunin believed that industrial workers constituted a vanguard of revolutionary activity that would lead to the replacement of capitalist industrial society. Two other Russians, Prince Peter Kropotkin (1842–1921) and Count Leo Tolstoy (1828–1910) also contributed to criticism of capitalist industrial society. They, like many Russian intellectuals and similar to Fourier, saw small rural communes as a basis for an alternative society.

The Marxist Critique of Capitalist Industrialism

The critique of capitalist industrial society that would have the greatest impact appeared in the half century following the 1848 revolutions. Two Germans, Karl Marx (1818–1883) and Friedrich Engels (1820–1895), presented their case against capitalist industrial society in their *Communist Manifesto* (1848) and in Marx's *Capital* (published between 1867–1883). These two works became the basic scriptures of "scientific socialism" or communism. Indebted to earlier German and French thinkers and based on his study of history, Marx's critical analysis of the capitalist industrial state was one of the most forceful attacks on the society of his time.

Marx definitively shaped his view of history once he had joined Engels in England. He believed that events over time were the result of material factors, such as modes of production (slavery, serfdom, the factory system), and that all other activities (politics, social patterns, ideas, culture in general) were determined by the forces of production. Accordingly, changes in modes of production were the basis for all other changes in history. Changes in modes of production, and thus society in general, proceeded in a dialectical fashion. That is, every innovation provoked a reaction that was resolved in a synthesis, a combination of elements of old and new modes of production, which itself became subject to innovation and change.

Marx's analysis of history provided a rational basis for understanding the problems and conflicts of his own time. Throughout history, changes in modes of production had resulted from conflict between producers and the

owners of the means of production. The characteristic conflict of the ancient world was between slave and master; that of the feudal age was between peasant and landowner; and that of capitalist industrial society was between those who worked in factories (wage earners whom Marx labeled the proletariat) and the capitalists who owned the factories.

Class Theory

Marx introduced the concept of “class,” divisions of society arising from economic and social differences. He thought that the widening gap between capitalists and proletariat had produced a heightened class consciousness in both classes and that the outcome of the conflict between them would produce a final synthesis in which the proletariat would be victorious. The outcome of the victory of the proletariat would ultimately be a classless society, one in which conflict would disappear, since producers themselves would own the means of production.

The Labor Theory of Value

Marx analyzed nineteenth-century contests between workers and capitalist industrialists on the basis of a labor theory of value. The true value of an object, he argued, is determined by the labor that goes into it. The difference between the cost of production (wages and material) and the market price is the surplus value, of which those who own the means of production (capitalists) rob those who produce (the proletariat). Keeping surplus value for themselves permits capitalists to get richer while the proletariat grows poorer as a result of rising costs and stagnant wages. This widening gap between capitalists and the proletariat increased class consciousness and the hostility between capitalist industrialists and the proletariat that culminated in increasing conflict.

As the unsavory aspects of capitalist industrialism – urban blight, economic cycles, the slow progress of change by political processes – became common in the second half of the nineteenth century, Marx’s vision gained widespread appeal in Europe and ultimately found wide acceptance outside Europe. In a world that increasingly valued science, Marx’s claim that his views were based on a scientific analysis of history and were inevitable was a powerful one. At the same time vagueness in Marx’s thought allowed for conflict among his followers. Marxism came to incorporate competing versions of Marx’s ideas, many of which were often far removed from his intentions.

Crisis at the Crossroads: Technology, Material Life, and Social Change

Technology has shaped both urban and rural environments and the daily lives of people who migrated to cities and those who remained in rural areas. Developments in technology altered the quality, conduct, and even length of daily life. Industrialization took place not only in factories, public transport systems or market places but also in the home.

Electrifying Change

Although Michael Faraday built the first electric motor in 1831, more than half a century passed before Nicola Tesla, with the Westinghouse Company, successfully patented a small electric motor for use as an electric fan (1889). In the 1890s electric current was still a luxury discussed everywhere but generally agreed upon as being too expensive for common use. Inventors like Tesla, on the other hand, predicted that electricity would soon be used as casually as water. The electrification of the home took place in industrialized parts of the world first: electric lights rapidly replaced gas lamps between 1918 and 1928.

Changes in the lighting of community streets and individual homes were not the most profound effects of electrification. The advent of electric lighting increased the length of the work day and altered material life. In the United States and other industrialized parts of the world in the 1920s, electric irons and electric washing machines became widespread symbols of the industrial revolution in the home. Yet these and other innovations and appliances did not reduce the amount of household labor performed by women; the number of tasks multiplied and increased awareness of such things as germs and hygiene required more frequent washing as new standards imposed additional tasks.

The increased consumption of material goods created by industrial technology in turn brought women to the forefront of a consuming public. A study in Oregon in 1928 revealed that farm wives (many without electricity) spent 61 hours a week on housework; “electrified” town wives spent 63.4 hours. Just after World War II, economists reported that farm wives spent 60.55 hours on housework each week, women in small cities spent 78.35 hours, and women in large cities spent 80.57 hours, a trend that some historians have viewed as contributing to the women’s liberation movement of the late twentieth century. In turn, inventions that rely on electricity, such as the radio, television, and computer have changed the nature of family and household life. Whereas listening to the radio in the 1940s or watching television in the 1950s was often a family ritual that linked isolated households to the larger community, technological changes have made these innovations more widely available to

individuals, with the result that their use is less social. The proliferation of technological change has increased the awareness of its unpredictable interaction with social forces, and change contributes to an age of uncertainty. More than one cultural observer has commented that change has become the only global constant of the twentieth century.

Living on the Earth: Population, Resources, and Technology

Both technological innovations and the growth of population have had a profound impact on the consumption of resources and transformed the physical landscape. Though humans have altered their landscapes since prehistoric times through the use of fire and other manipulations of the environment, the human impact on the landscape has intensified dramatically in the past two centuries. The period between 1800 and 1914 witnessed an unprecedented expansion of agriculture and population growth throughout the world, both of which had devastating effects on world resources and the physical landscape. These forces can be held directly responsible for global deforestation beginning in the nineteenth century.

The Landscapes of Imperialism

The Western attitude toward nature as a force to be controlled and exploited by civilization intersected with the powerful political ideas of imperialism in the nineteenth century. The Western attitude has increasingly become the model and pattern for non-Western peoples, and its global acceptance has brought humanity to the threshold of ecological disaster at the end of the twentieth century. For example, the British Raj exploited and destroyed the forests of the western Himalayas between 1815 and 1914 while building the most sophisticated forestry service in the colonial world. The colonization of nature was viewed as just as inevitable as the subjugation of “inferior” peoples by colonial powers.

Europeans considered fenced and cultivated gardens as the most appealing and idyllic landscapes during the nineteenth century, a kind of colonization of nature. The landscape legacy of this colonization is found in the national parks of the world: from Kenya to Ghana to Yosemite, protected landscapes became necessary to preserve at least some semblance of the wilderness and its wildlife that was nearly lost to the nineteenth- and early-twentieth-century rampages of imperialism. Colonial officers and other Europeans collected plants and animals from around the world to create botanical gardens and zoological parks.

Deforestation

From Thailand to the Amazon to equatorial Africa to the Pacific Northwest of the United States and Canada, the exploitation of forests changed global

landscapes dramatically and impinged on centuries-long patterns of land and resource use. The global trend toward deforestation was not so much a response to the pressure of growing population as it was a consequence of world market forces, generated by European demand for commodities and raw materials. In particular, the markets of industrialized nations have demanded timber for construction, newsprint, and other paper products. A product of the collaboration between wealthy and less-developed nations, deforestation made many rural populations more dependent on international market needs and external control. The irony is that in many parts of the world, as scientific information about the forest systems was increasing, the forests themselves, increasingly exploited, disappeared.

Deforestation is but one aspect of the global attack on environmental balance. Growing demands for electric power created by the needs of expanding technology and population have resulted in massive alterations in the landscape and the environment. The Aswan High Dam along the southern Nile was built in the 1960s at a cost of \$1 billion to provide hydroelectric power. Supported in part by Soviet aid, the dam created a 300-mile-long lake, named Lake Nasser after Egypt's president, and inundated many villages along the Nile as well as some historical monuments. In the 1990s China planned the enormous Three Gorges Dam along the upper reaches of the Yangzi River at a projected cost of \$25 billion. If completed, this dam will inundate farmland and villages to create a 400-mile-long reservoir, forcing the evacuation of an estimated 1 million people from their homes. Criticism by environmental groups sensitive to its impact on landscape and people has delayed international financing for the project, which was to come largely from American, Canadian, and European banks.

Tropical Rainforests

The best current illustration of a global environmental problem is the fate of tropical rainforests. Rainforests girdle the globe in a 3200-mile belt near the equator, between the southern tropic of Capricorn and the northern tropic of Cancer. They make up 7 percent of the world's land surface but contain half of the globe's approximately 5 million plant and animal species. Only 2.5 billion of the original 4 billion acres of rainforest remain; a conservative deforestation rate (fifty acres a minute) means that the rainforests will be entirely gone in 100 years.

Plant and animal species that have adapted to the virtually fire-resistant rainforests cannot adapt to land that technology has allowed humans to ravage, and as many as 20 percent of all species on earth may be extinct within twenty years. Tropical plants vital to industry, medicine, agriculture, and horticulture will accordingly disappear. In addition to plants and

animals, numerous human cultures that have thrived for centuries in the rainforests without harming their environment will disappear.

The plight of rainforests is specifically related to global warming. Their loss is cited as the second leading cause of the increased concentration of carbon dioxide in the atmosphere, just behind the burning of fossil fuels by internal combustion engines such as the automobile. Plants absorb carbon dioxide for growth and give off oxygen and thus help control the greenhouse effect. The massive destruction of forest areas severely lessens that control. The irony of the destruction of forest resources in many parts of the world is that its recognition has come at a time when scientific information indicates how essential forests are to the global environment and the survival of species. The need to balance forest ecology with the needs of expanding populations and the demands of international market forces is one of the major global issues at the end of the twentieth century.

Ecology and Technology

The soaring of human numbers continues to have a direct impact on the environment today. Two factors decide how much damage each person does to the environment: (1) consumption patterns, and (2) technological style (the kind of technology used and the waste and pollution it creates). While industrialized countries, the “top billion” have lower birth rates, they are responsible for the largest share of resources used, waste created, damage to the ozone layer, acidification, and roughly two-thirds of global warming. The combination of poverty and population growth among the “bottom billion” is, of course, also damaging the environment through deforestation and land degradation. Resultant climate change is a major threat to human life. The projected rise in temperature in the next half century is 2.8 degrees Celsius, a climate shift unmatched in human history.

Much of the responsibility for the world’s ecological crisis lies in the kind of technology developed since World War II. Contemporary technology is potentially cleaner than the coal-produced iron technology of the eighteenth-century industrial revolution, but most technical developments in the last half century have been more harmful than earlier ones. The main difference is the development of synthetic products to replace natural, organic ones.

Since the end of World War II, synthetic fibers have replaced natural ones (cotton products have declined by 36 percent, wool by 42 percent, while synthetic fibers have increased by nearly 6000 percent), and lumber (down 1 percent) has given way to plastic (up nearly 2000 percent). In agriculture, land has been abused by emphasis on synthetic (nitrogen) fertilizers, herbicides, and synthetic pesticides, which have replaced the traditional use of animal fertilizers and methods of pest control. In transportation rail freight

has given way to truck freight, and low-powered automobile engines to high-powered ones.

Environmental Pollution

Technological transformations have not produced a conspicuous rise in the quality of life since World War II, and their ecological impact has reached crisis proportions. In the United States alone, pollution levels have risen between 200 and 2000 percent since 1946. This situation is not the result of population growth or affluence alone, but to the unqualified uses of late-twentieth-century technology. New technologies – and the profits made from them – account for as much as 95 percent of the added environmental pollution of the last quarter century.

The Minamata Sickness

In the 1970s industrial pollution became a serious national issue in Japan and revealed the most negative aspects of Japan's rapid economic growth over the last century. Mercury poisoning was suspected in the town of Minamata on the southern-most island of Kyūshū, but authorities refused to recognize the obvious source of pollution, a chemical company that was pouring wastes into the bay where most of the residents caught fish for food.

Although the link between effluents discharged into Minamata Bay by the company and the cases of mercury poisoning began to be made as early as 1953, twenty years passed before formal legal action was taken and before any compensation was awarded to the victims of "Minamata disease." Reluctant to jeopardize its relations with business and to threaten productivity, the government hesitated to pursue the claims of victims until it could no longer ignore the evidence.

Cars and Trucks

The greatest source of urban pollution is the automobile, and the bigger the automobile, the greater the pollution. But the bigger the automobile, the larger the profit. Detroit makes less than a 10 percent profit on compact cars and more than a 10 percent profit on larger, more expensive models. As Henry Ford II remarked, "Minicars made mini-profits." A similar situation exists in the use of trucks in preference to trains to transport goods. Trucks require six times the amount of fuel as trains; that is, trucks emit six times the environmental pollution for the same haulage compared to trains. In addition, the amount of cement and steel needed for a four-lane highway takes about four times the energy required for a similar mileage of railroad. Nonetheless, the profits from trucking are 8.84 percent, while those from railroads are 2.61 percent, which goes far toward explaining the expansion of freight hauled by trucks and the relative decline of rail haulage.

There are countless other examples of the union of technology and profit at the expense of the environment. Obviously, the problem is not technology alone. Modern technology does exactly what is asked of it. It is asked to overlook long-term global needs in the interests of immediate and individual profit. The goal of technology has been separated from the total context in which it functions. The modern technological flaw is the tubular vision that commands it.

Technology so construed cannot cope with the whole ecological system into which pesticides and synthetic fertilizers, automobiles and trucks, not to mention the atomic bomb, intrude; accordingly disastrous ecological "surprises," such as water pollution, smog, and global radioactive fallout, cannot be avoided. The twentieth-century technological explosion has created the first worldwide culture, a technological culture. It has resulted in fundamental environmental problems that, as the century draws to an end, are truly global concerns and the ultimate concerns of our time.