

# Karl Marx and the Industrial Revolution

I have long been greatly impressed by the fact that Karl Marx, though using a conceptual framework derived from and in many ways very similar to classical economic theory, nevertheless reached conclusions radically different from those of the classical economists. Noting that Marx viewed the capitalist process as "one which, in principle, involves ceaseless accumulation accompanied by changes in methods of production," I wrote in 1942:

It is at once apparent that this view of the capitalist process differs radically from that which underlies the classical theory of economic evolution. The latter is, in principle, unconcerned with changes in methods of production; economic development is viewed exclusively in terms of (gradual) quantitative changes in population, capital, wages, profits, and rent. Social relations remain unaffected; the end product is simply a

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state of affairs in which all these rates of change equal zero [the stationary state]. Since the Marxian view lays primary stress on changes in methods of production, it implies qualitative change in social organization and social relations as well as quantitative change in economic variables as such. The way is thus paved for regarding the "end product" as a revolutionary reconstitution of society rather than a mere state of rest.<sup>1</sup>

Part of the explanation of this fundamental difference between Marx and the classics may well lie in the opposing personal and class interests that they represented. But I think it would be a mistake to leave the matter there. Classical political economy, especially in its Ricardian form, was not incompatible with a theory of class conflict: indeed, Ricardo himself pointed out and emphasized the conflict of interest between capitalists and landlords, and the so-called Ricardian socialists soon showed that the theory could equally well be used to underpin a theory of class struggle between capital and labor. Like them, Marx could have espoused the cause of the working class without making any important changes in classical economic theory. That he did not do so but instead transformed classical political economy into a radically new theory of economic development must be explained by something other than, or at any rate additional to, class interest. In what follows I shall try to show that Marx, in contrast to the classics, systematically took into account and incorporated into his theoretical system that interrelated series of events and processes which is generally known as the industrial revolution. Marx's conceptualization of the industrial revolution is, I believe, the basis of his theory of economic development.

Let us begin by noting that Marx used the term "industrial revolution" again and again,<sup>2</sup> not as a mere catch phrase to characterize a period of rapid change but as a descriptive

designation of the process of transformation between what Engels called "two great and essentially different periods of economic history: the period of manufacture proper, based on the division of manual labor, and the period of modern industry based on machinery."<sup>3</sup> These are not, in Marx's view, two different social systems but rather two phases of capitalism.

Manufacture differs from handicraft production in its organization of the labor process, not in its basic methods and instruments. In handicraft production artisans produce saleable commodities and buy what they need (both consumption goods and means of production) from other similarly situated commodity producers. Division of labor within the workshop is severely limited by the fact that the master workman has at most a few journeymen and apprentices working with him. The guilds, with their strict rules and standards, gave appropriate institutional form to this mode of production and fought a long and bitter, though successful, battle to preserve its integrity.

The transition from handicraft production to capitalist manufacture was a part of the stormy process which Marx named "primitive accumulation."<sup>4</sup> It had two sides to it: the separation of a sizeable body of working people from their means of production, and the emergence of a group of persons with liquid wealth which they wished to put to profitable use. The uprooting of peasants through such measures as enclosures and the expropriation of Church lands created the necessary landless proletariat, while trade and plunder, given enormous impetus by the geographical discoveries of the late fifteenth and early sixteenth centuries, spawned an eager and willing capitalist class. The result was the emergence and spread of capitalist manufacture, at first largely in areas outside the jurisdiction of the guilds.

The methods and instruments of production in the new factories were essentially those of the artisan workshop; but

now, owing to the larger number of workers involved and the complete domination of the production process by the capitalist, it became possible to subdivide the work and specialize the workers. The result was a tremendous increase in productivity due largely to the increased division of labor within the factory, a process that was so eloquently and lovingly described in Book I of *The Wealth of Nations*.

In Marx's view, an economic system based upon manufacture is essentially conservative. "History shows how the division of labor peculiar to manufacture, strictly so called, acquires the best adapted form at first by experience, as it were behind the backs of the actors, and then, like the guild handicrafts, strives to hold fast that form when once found, and here and there succeeds in keeping it for centuries."<sup>5</sup> But it is not only in this technological sense that such an economy is conservative. It also creates a highly differentiated labor force, dominated, numerically and otherwise, by skilled workers who tend to be contentious and undisciplined but incapable of sustained revolutionary activity. The economy and society based on manufacture is thus inherently change-resistant: it expands under the impact of capital accumulation but does not generate forces capable of altering its structure or, still less, of transforming it into something else.

It was this system that provided the model for classical political economy, which found its fullest and best known expression in Adam Smith's *The Wealth of Nations*. "What characterizes . . . him [Smith] as the political economist par excellence of the period of manufacture," Marx wrote, "is the stress he lays on the division of labor."<sup>6</sup> By comparison, Smith paid scant attention to machinery, so little, indeed, that Schumpeter felt justified in saying that with him "division of labor is practically the only factor in economic progress."<sup>7</sup> Nathan Rosenberg argues, persuasively I think, that Schumpeter's view needs qualification. Rosenberg holds

that Smith recognized that the progress fostered by division of labor was limited to improvements within the existing technology and that major inventions are made not by workmen at all, or by capitalists either for that matter, but by "philosophers" who are totally separated from the productive process.<sup>8</sup> Nevertheless, as applied to Smith's economic theory proper, the point made by Schumpeter seems entirely valid: Smith allows for no dynamic force other than the division of labor. And Rosenberg's argument simply underscores the basically conservative character of that force.

Classical political economy reached its intellectual and scientific apex in the work of David Ricardo, and it was of course Ricardo who had the greatest influence on Marx. If Ricardo had shared Smith's interest in productive processes, it seems quite possible that he would have developed a different conception of the dynamics of capitalism; for in the four decades that separated *The Wealth of Nations* from the *Principles*, industrial technology advanced by giant strides. But Ricardo's interest was largely focused on the distribution of income among the major classes of capitalist society. What he had to say about the dynamics of the system was largely incidental.<sup>9</sup> In fact it is in the work of Ricardo that we find in its purest form the view of economic development "exclusively in terms of (gradual) quantitative changes in population, capital, wages, profits, and rent."<sup>10</sup>

Marx did share Smith's interest in productive processes,<sup>11</sup> and the reality which confronted him was so different from that which had confronted Smith nearly a century earlier that he could hardly help coming to radically different conclusions. Marx was certainly the first economist to develop a rounded conception of the industrial revolution and to take full account of its consequences in building his theoretical model of the capitalist process.<sup>12</sup>

We have already noted that for Marx the industrial revolution marked the transition between two essentially

different periods of capitalist development, the first being characterized by the dominance of manufacture and the second by the dominance of "modern industry." Although quite aware that "epochs in the history of society are no more separated from each other by hard and fast lines of demarcation than are geological epochs,"<sup>13</sup> he nevertheless found it useful to tie the industrial revolution to a specific date.<sup>14</sup> By bringing out his spinning machine in 1735, John Wyatt "began the industrial revolution of the 18th century."<sup>15</sup> In the nature of the case, no comparable date for the end of the industrial revolution could be set, but we can infer that Marx considered that the decisive structural change in the system had been effected by the third decade of the nineteenth century. This inference follows from (a) his view that the business cycle is the unique and necessary attribute of the modern-industry phase of capitalist development, and (b) his dating of the first business cycle from the crisis of 1825.<sup>16</sup>

For Marx, the essence of the industrial revolution was the replacement of handwork by machinery (*Capital*, I), a process which takes place "from the moment that the tool proper is taken from man and fitted into a mechanism" and regardless of "whether the motive power is derived from man or from some other machine" (p. 408). Once started in an important part of the economy, this process of mechanization tends to spread in a series of chain reactions. As Marx put it:

A radical change in the mode of production in one sphere of industry involves a similar change in other spheres. This happens at first in such branches of industry as are connected together by being separate phases of a process, and yet are isolated by the social division of labor in such a way that each of them produces an independent commodity. Thus spinning by machinery made weaving by machinery a necessity, and

both together made the mechanical and chemical revolution that took place in bleaching, printing, and dyeing imperative. So too, on the other hand, the revolution in cotton spinning called forth the invention of the gin for separating the seeds from the cotton fiber; it was only by means of this invention that the production of cotton became possible on the enormous scale at present required. But more especially, the revolution in the modes of production of industry and agriculture made necessary a revolution in the general conditions of the social process of production, i.e., in the means of communication and transport. . . . Hence, apart from the radical changes introduced in the construction of sailing vessels, the means of communication and transport became gradually adapted to the modes of production of mechanical industry by the creation of a system of river steamers, railways, ocean steamers, and telegraphs. But the huge masses of iron that had now to be forged, to be welded, to be cut, to be bored, and to be shaped, demanded, on their part, cyclopean machines for the construction of which the methods of the manufacturing period were utterly inadequate.

Modern Industry had therefore itself to take in hand the machine, its characteristic instrument of production, and to construct machines by machines. It was not till it did this that it built up for itself a fitting technical foundation, and stood on its own feet. Machinery, simultaneously with the increasing use of it, in the first decades of this century, appropriated, by degrees, the fabrication of machines proper. But it was only during the decade preceding 1866 that the construction of railways and ocean steamers on a stupendous scale called into existence the cyclopean machines now employed in the construction of prime movers. [Pp. 418-20]

From this passage one could perhaps conclude that it was Marx's view that he was writing the first volume of *Capital* during the final stage of the transition from manufacture to modern industry. If he had had to pick out the single most important step forward in this whole vast movement, it would undoubtedly have been the perfection of the steam engine. Here again it is worthwhile to quote his own words:

Not till the invention of Watt's second and so-called double-acting steam engine was a prime mover found, that begot its own force by the consumption of coal and water, that was mobile and a means of locomotion, that was urban and not, like the water-wheel, rural, that permitted production to be concentrated in towns instead of, like the water-wheels, being scattered up and down the country, that was of universal technical application, and, relatively speaking, little affected in its choice of residence by local circumstances. The greatness of Watt's genius showed itself in the specification of the patent that he took out in April, 1784. In that specification his steam engine is described, not as an invention for a specific purpose, but as an agent universally applicable in Mechanical Industry. In it he points out applications, many of which, as for instance the steam hammer, were not introduced until half a century later. [Pp. 411-12]

I cannot refrain from pointing out in passing the very striking similarity between the steam engine in the industrial revolution and the technology of automation in the radical transformation of production processes through which we are living in the second half of the twentieth century. "What the feedback and the vacuum tube have made possible," wrote the late Norbert Wiener, the father of cybernetics, "is not the sporadic design of individual automatic mechanisms, but a general policy for the construction of automatic mechanisms of the most varied type."<sup>17</sup> Here again we have a technolog-



ical advance the importance of which stems not from its capacity to serve a specific purpose but from its universal applicability. And, as in the case of the steam engine, it seems certain that many of the applications will not be realized until many years later.<sup>18</sup>

To return to Marx's theory of the industrial revolution: Marx saw two respects in which an economy based on modern industry differs fundamentally from one based on manufacture. The first relates to the *modus operandi* of the production process itself; the second to the composition and nature of the working class. The net effect of these factors was to transform capitalism from a relatively conservative and change-resistant society into a super-dynamic society, headed, in Marx's view, for inevitable revolutionary overthrow.

With respect to the production process in modern industry, Marx held that technological progress ceases to depend on the ingenuity of the skilled laborer and/or the genius of the great inventor as it did in manufacture, and, instead, becomes the province of the rational sciences. A few quotations from the chapter on "Machinery and Modern Industry" (*Capital*, I) will show how explicit Marx was on this point and what enormous importance he attached to it:

Intelligence in production . . . is lost by the detail laborers (and) is concentrated in the capital that employs them. . . . This separation . . . is completed in modern industry, which makes science a productive force distinct from labor and presses it into the service of capital. [Pp. 396-97]

In Manufacture it is the workmen who, with their manual implements, must, either singly or in groups, carry on each particular detail process. If, on the one hand, the workman becomes adapted to the process, on the other, the process was previously made suitable to the workman. This subjective principle of the division of labor no longer exists in production by machinery. Here

the process as a whole is examined objectively, in itself, that is to say, without regard to the question of its execution by human hands, it is analyzed into its constituent phases; and the problem, how to execute each detail process and bind them all into a whole, is solved by the aid of machines, chemistry, etc. [Pp. 414-15]

The implements of labor, in the form of machinery, necessitate the substitution of natural forces for human force, and the conscious application of science instead of rule of thumb. In . . . its machinery system, Modern Industry has a productive organism that is purely objective, in which the laborer becomes a mere appendage to an already existing material condition of production. [P. 421]

When machinery is first introduced into an industry, new methods of reproducing it more cheaply follow blow upon blow, and so do improvements, that not only affect individual parts and details of the machine, but its entire build. [P. 442]

The principle, carried out in the factory system, of analyzing the process of production into its constituent phases, and of solving the problems thus proposed by the application of mechanics, of chemistry, and of the whole range of the natural sciences, becomes the determining principle everywhere. [P. 504]

Modern Industry rent the veil that concealed from men their own social process of production, and that turned the various, spontaneously divided branches of production into so many riddles, not only to outsiders but even to the initiated. The principle which it pursued of resolving each into its constituent movements without any regard to their possible execution by the hand of man, created the new modern science of technology.

The varied, apparently unconnected, and petrified forms of the production processes now resolved themselves into so many conscious and systematic applications of natural science to the attainment of given useful effects. Technology also discovered the few main fundamental forms of motion, which, despite the diversity of the instruments used, are necessarily taken by every productive action of the human body; just as the science of mechanics sees in the most complicated machinery nothing but the continual repetition of the simple mechanical powers. [P. 532]

Immediately following the last passage, Marx stated in its most explicit and succinct form the general conclusion which he deduced from these arguments:

Modern Industry never looks upon and treats the existing form of a process as final. The technical basis of that industry is therefore revolutionary, while all earlier modes of production were essentially conservative.<sup>19</sup> By means of machinery, chemical processes, and other methods, it is continually causing changes not only in the technical basis of production, but also in the functions of the laborer and the labor-process.<sup>20</sup>

Marx's theory of the effects of machinery on the working class is certainly among his best-known doctrines and need not be reviewed in any detail here. His central thesis, from which the rest followed quite logically, was that machinery does away with, or at any rate drastically reduces, the need for special skills and instead puts a premium on quickness and dexterity. It thereby opens the door to the mass employment of women and children and cheapens the labor power of adult males by obviating the need for long and expensive training programs. There follows a vast expansion of the labor supply which is augmented and supplemented by two further factors: (a) once solidly entrenched in the basic industries, machinery invades ever new branches of the

economy, underselling the old handworkers and casting them onto the labor market, and (b) the progressive improvement of machinery in industries already conquered continuously eliminates existing jobs and reduces the employment-creating power of a given rate of capital accumulation. The effects of machinery are thus, on the one hand, to expand, homogenize, and reduce the costs of production of the labor force; and, on the other hand, to slow down the rate of increase of the demand for labor. This means a sea-change in the economic power relation between capital and labor, to the enormous advantage of the former. Wages are driven down to, and often below, the barest subsistence minimum; hours of work are increased beyond anything known before; intensity of labor is stepped up to match the ever increasing speed of the machinery. Machinery thus completes the process of subjecting labor to the sway of capital that was begun in the period of primitive accumulation. It is the capitalistic employment of machinery, and not merely capitalism in general, which generates the modern proletariat as Marx conceived it.

But there are no medals without two sides. Economically, the power of the proletariat under modern industry is much reduced compared to that of its predecessor in the period of manufacture. But politically, its potential power is infinitely greater. Old geographical and craft divisions and jealousies are eliminated or minimized. The nature of work in the modern factory requires the organization and disciplining of the workers, thereby preparing them for organized and disciplined action in other fields. The extreme of exploitation to which they are subjected deprives them of any interest in the existing social order, forces them to live in conditions in which morality is meaningless and family life impossible, and ends by totally alienating them from their work, their products, their society, and even themselves. Unlike their predecessors in the period of manufacture, these workers

form a proletariat which is both capable of, and has every interest in, revolutionary action to overthrow the existing social order. They are the ones of whom Marx and Engels had already said in the *Communist Manifesto*: "The proletarians have nothing to lose but their chains. They have a world to win." In *Capital* this bold generalization is supported by a painstaking analysis of the immanent characteristics and tendencies of capitalistic "modern industry" as it emerged from the industrial revolution.

In this paper I have tried to explain the difference between the theory of capitalist development of the classics and that of Marx as being due, at least in part, to the fact that the former took as their model an economy based on manufacture, which is an essentially conservative and change-resistant economic order; while Marx, recognizing and making full allowance for the profound transformation effected by the industrial revolution, took as his model an economy based on modern machine industry, which is certainly highly dynamic and which Marx himself thought was headed for inevitable revolution. In conclusion, I should like to add a few remarks contrasting Marx's treatment of technological change with that of post-classical bourgeois economics and assessing the validity—or perhaps it would be better to say the fruitlessness—of his views on the implications of machinery for the functioning and future of the capitalist system.

While Marx put technological change at the very center of economic theory, it is hardly an exaggeration to say that the bourgeois successors of classical political economy—the marginalists of various countries and schools—banished it altogether. Consumption rather than production became the starting point of economic theorizing, and its adepts concerned themselves more and more with tendencies to equilibrium and less and less with the macrodynamics of the system as a whole. This of course did not happen all at once

or completely: men like Marshall and Taussig, for example, were very much interested in methods of production or, to use a term which was current around the turn of the century, the state of the industrial arts. But their interest was akin to that of the historian, the intelligent observer, the educated man—it was not vitally related to their economic theory. And later on, as economists became increasingly specialized and decreasingly educated, interest in real production was progressively replaced by interest in imaginary “production functions.”

There was one great exception among bourgeois economists, one outstanding figure who sought, under the influence of Marx and in opposition to the Marxists, to establish a rival theory of economic development centering on technological change. I refer of course to Joseph Schumpeter, whose *Theory of Economic Development* was first published (in German) in 1912. A detailed comparison of the theories of Schumpeter and Marx would certainly be a useful project but one which obviously cannot be undertaken within the scope of the present essay. I will content myself with observing that Schumpeter's treatment of technological change departed from Marx's on an issue that Marx considered to be of decisive importance, namely, the objective character of the process. For Marx, once machinery had taken firm hold it was bound to spread, to evolve into progressively more elaborate and productive forms, to harness all the natural sciences to its imperatives—and all this quite apart from the desires or intentions of individual capitalists or scientists.<sup>21</sup> For Schumpeter, on the other hand, technological change is essentially a by-product of the spontaneous innovating activity of individual entrepreneurs. There is no need for us, living in the second half of the twentieth century, to pass judgment on this theory: history has already done so. The interconnection between science, technology, and production was largely informal and unstructured a hundred years ago;

since then, and especially during and after the Second World War, it has become ever closer, more institutionalized, more deliberately planned. Without denying that individual inventors and entrepreneurs still play a role in the process of technological change, we surely cannot compare their importance to that of the great government- and industry-financed laboratories where the bulk of research and development in today's advanced technologies takes place.

Schumpeter himself saw this coming as long ago as the 1920s, and in his book, *Capitalism, Socialism and Democracy*, he included a section ("The Obsolescence of the Entrepreneurial Function") in which he virtually abandoned his old theory of innovation. "Technological progress," he wrote, "is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways."<sup>22</sup>

Nothing in Schumpeter's original theory of economic development could have led us to expect this outcome. But, from the point of view of Marx's theory of the objectivization of the process of technological progress and the harnessing of science to its requirements, it is precisely the outcome which is most logical and natural. Indeed, what must strike one today as one re-reads Marx's chapter on "Machinery and Modern Industry" in the light of recent history is its modernity, its direct relevance to what is happening under our very eyes. One is even tempted to assume that much of what Marx wrote on the subject a hundred years ago was more prophetic than literally true of mid-nineteenth-century Britain.

The same cannot be said about Marx's analysis of the effects of machinery on the working class. The trends which he stressed and projected into the future—flooding of the labor market by women and children, homogenization of the labor force, abasement of living standards and conditions, etc.—reached their maximum intensity in the first half of the

nineteenth century and had already been checked or reversed before the publication of the first volume of *Capital*. There were many factors at work here. One was state action, resulting partly from the political struggles of the working class itself and partly from the interest of the bourgeoisie in a healthier and better-trained labor force. Another was the growing strength of trade unions. And still another was the expansion of what is nowadays called the service sector of the economy, an expansion made possible by, and sustained from, the rising surplus product associated with the progressive mechanization of production.

Marx's failure was not that he did not recognize the existence of these counteracting forces. In the case of state action, he provided a detailed analysis of legislation regulating the length of the working day and of the factory acts; and the principles underlying this analysis could easily be extended to apply to other forms of social welfare legislation. And in various passages scattered throughout his writings he showed that he was well aware not only of the importance of trade unions as weapons in the working class struggle but also of the proliferation of what he, following the classics, called the "unproductive" occupations. Marx's failure was rather in not understanding that all these counteracting forces taken together could actually come to prevail and thus turn a potentially revolutionary proletariat into an actual reformist force.

But we must also note another failure of Marx which cuts in a rather different direction. He saw very clearly the most striking international consequence of the industrial revolution:

So soon . . . as the general conditions requisite for production by the modern industrial system have been established, this mode of production acquires an elasticity, a capacity for sudden extension by leaps and bounds that finds no hindrance except in the supply of



raw material and in the disposal of the produce. On the one hand, the immediate effect of machinery is to increase the supply of raw material in the same way, for example, as the cotton gin augmented the production of cotton. On the other hand, the cheapness of the articles produced by machinery, and the improved means of transport and communication furnish the weapons for conquering foreign markets. By ruining handicraft production in other countries, machinery forcibly converts them into fields for the supply of its raw material. In this way East India was compelled to produce cotton, wool, hemp, jute, and indigo for Great Britain. . . . A new and international division of labor, a division suited to the requirements of the chief centers of modern industry springs up, and converts one part of the globe into a chiefly agricultural field of production for supplying the other part which remains a chiefly industrial field.<sup>23</sup>

What Marx did not foresee was that this "new and international division of labor" might harden into a pattern of development and underdevelopment which would split mankind into haves and have-nots on a scale far wider and deeper than the bourgeois/proletarian split in the advanced capitalist countries themselves. If Marx had foreseen this momentous development, he could have easily conceded the existence of meliorative trends within the advanced countries without for a moment giving up the prediction of inevitable revolutionary overthrow for the system as a whole.

*Notes:*

1. *The Theory of Capitalist Development* (New York: Monthly Review Press, 1953), p. 94; originally published in 1942 by Oxford University Press.

2. See especially the first section of Marx's chapter on "Machinery and Modern Industry," *Capital*, I, pp. 405-522.
3. Editor's "Preface to the First English Translation," *ibid.*, p. 29.
4. The German is *ursprüngliche Akkumulation*, which literally means "original accumulation," and in this case the literal translation would have been better since what Marx wanted to convey was that this kind of accumulation preceded capitalist accumulation proper. "Primitive accumulation," however, is the generally accepted translation and to change it is to risk being misunderstood.
5. Marx, *Capital*, I, p. 399.
6. *Ibid.*, p. 383n.
7. Schumpeter, *History of Economic Analysis*, p. 187.
8. Nathan Rosenberg, "Adam Smith on the Division of Labour: Two Views or One?" *Economica*, XXXII (May 1965), p. 128.
9. David Ricardo's chapter "On Machinery" was tacked onto the third edition of the *Principles* and was concerned entirely with the question of whether it was possible for machinery to displace labor. In the course of this analysis, he stated that "with every augmentation of capital, a greater proportion of it is employed on machinery" and that the demand for labor "will continue to increase with an increase in capital, but not in proportion to its increase; the ratio will, necessarily, be a diminishing ratio" (*Principles of Political Economy and Taxation*, Everyman's ed. [New York: E. P. Dutton and Co., 1933], p. 387). These propositions could have formed the starting point of a fruitful line of analysis, but with Ricardo they remained hardly more than *obiter dicta*. It was left for Marx to explore their implications.
10. Ricardo, *Principles*, p. 107.
11. In his biography of Marx, Mehring tells of an incident in which a manufacturer remarked that Marx too must have been a manufacturer at some time. Marx's reply (in a letter to Engels) was: "If people only knew how little I know about all this business!" Franz Mehring, *Karl Marx: The Story of His Life* (New York: Covici, 1935), p. 285.
12. I am tempted to say that the whole idea of the industrial revolution, which in my student days was commonly associated with the name of the elder Toynbee, really originated with Marx. But I confess that I do not know the relevant literature well enough to be sure.

13. Marx, *Capital*, I, p. 405.
14. Similarly the recognition that "a critical history of technology would show how little any of the inventions of the eighteenth century are the work of a single individual" (*ibid.*, p. 406) did not prevent him from associating inventions with the names of individuals.
15. *Ibid.*
16. Speaking of the period 1820 to 1830 in the Preface to the second edition of Volume I of *Capital*, Marx wrote that "modern industry itself was only just emerging from the age of childhood, as is shown by the fact that with the crisis of 1825 it for the first time opens the periodic cycle of its modern life" (*ibid.*, p. 18).
17. Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton Mifflin, 1954), p. 179.
18. Should the current technological transformation of the process of production, in which automation unquestionably plays a decisive role, be called a new industrial revolution? In purely technological terms it is doubtless as radical and thoroughgoing as the industrial revolution of the eighteenth and nineteenth centuries. And yet to a Marxist, at any rate, the appropriateness of the designation must seem at least doubtful. Capitalism has entered a new phase since Marx's day, the phase of monopoly capitalism. In technological terms, however, as Marx well understood, this transition was but the logical consequence of trends inherent in the very modern industry which he described and analyzed in *Capital* ("concentration" and "centralization" of capital: see Marx, *Capital*, I, especially pp. 685-89). It has yet to be shown that the current technological transformation is introducing yet another phase of capitalist development. Unless this can be shown, it seems to me that the use of the term "revolution" to describe what is now taking place can only lead to confusion.
19. In order to drive home the point still further and to extend the scope of its significance, Marx here adds a footnote quoting a famous passage from the *Communist Manifesto*:

"The bourgeoisie cannot exist without continually revolutionizing the instruments of production, and thereby the relations of production and all the social relations. Conservation, in an unaltered form, of the old modes of production was on the contrary the first condition of existence for all earlier industrial classes. Constant revolution in production, uninterrupted distur-

balance of all social conditions, everlasting uncertainty and agitation, distinguish the bourgeois epoch from all earlier ones. All fixed fast-frozen relations, with their train of ancient and venerable prejudices and opinions, are swept away, all new formed ones become antiquated before they can ossify. All that is solid melts into air, all that is holy is profaned, and man is at last compelled to face with sober senses his real conditions of life, and his relations with his kind."

If, in the *Manifesto*, this can be said to have had the character of a brilliant insight, the corresponding but less sweeping passage in *Capital* has the character of a reasoned deduction from an exhaustive study of the actual processes of production prevailing in England in the middle of the nineteenth century.

20. Marx, *Capital*, I, pp. 532-33.
21. The *objectivity* of technique and technological advance must not be confused with the *supremacy* of technique as preached for example by the Frenchman Jacques Ellul (*The Technological Society* [New York: Alfred A. Knopf, 1964]). Technique does not operate and advance independently of the social framework but only independently of the will of individuals within the social framework. Ellul's book is a wonderful demonstration of what nonsense can result from failing to make this crucial distinction.
22. Schumpeter, *Capitalism, Socialism and Democracy*, p. 132.
23. Marx, *Capital*, I, pp. 492-93.