

# The Social Significance of Technical Change

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Technology discloses man's mode of dealing with Nature, the process of production by which he sustains his life, and thereby also lays bare the mode of formation of his social relations, and of the mental conceptions that flow from them. <sup>1</sup>

## INTRODUCTION

Technology or technical change is often seen as the prime source of material change within capitalism and, at its most immediate practical level, a cause of unemployment and structural dislocation. It is typically and mistakenly seen as a determining force independent of the relations of production. This view leads one to view technology as a 'thing' and to lose sight of the social process of technical change.

This paper seeks to establish a more satisfactory basis for the analysis of technological change. A critical sketch of the relevant ideas of John K. Galbraith, Herbert Marcuse and Jurgen Habermas is made: these are examples of writers who, although considered 'radical', have fallen into the trap of assuming that technology is an independent variable apart from social relations. They have been chosen for critique primarily because of their intellectual influence over a wide range of students and working people.

In contrast to the views of Galbraith, Marcuse and Habermas, this paper argues that technology is produced from and in turn affects the available productive forces (labour-power and the means of production) and the social relations of production (work organization, authority and hierarchy of power in production). Technology is not a primary causal factor or an independent determining force and should not be viewed as independent of the social relations which produce our livelihood.

## CAPITALIST IDEOLOGY: TECHNOLOGY AS A 'THING'

Ideology is the process through which ideas, values and purpose combine to influence both consciousness and behaviour. Capitalist ideology (the manner of thinking characteristic of the capitalist class and its agents) views the capitalist social formation as the absolutely final form of social production, instead of a passing historical phase of human evolution. Socially-specific concepts, such as profit, efficiency, capital and technology are accepted as fixed points of both departure and return.

The function of ideology is not merely to report and reveal, but also to blur and conceal, to support an elite and to justify the exercise of power. It is not that the ruling class deliberately deceives people through its control of the media, literature and education. Although this may be true on occasion, the dominant ideas of a particular historical period are more typically the expression of the actual material relations that hold between people.

Ideological development is made up of a system of beliefs and activities, reflecting both past and present, which correspond to and support the institutional structure. The critique of this ideological development must centre on denying the autonomy of ideas. We must cut through this system of beliefs and activities by studying social formations as stages through which history passes; and refuse to consider any existing society, or set of ideas, as the standard or absolute to which others must be compared.

Development of any socio-economic system takes place to resolve problems which arise between humans and their environment. One of the most fundamental aspects within this context is technology (with respect to work organization, methods of production and machinery) which exists in order to exploit a particular set of resources for use or exchange. It may, therefore, 'appear' that changes in socio-economic conditions are themselves caused and processed by technological means; and this appearance leads to the assumption that things themselves (in the form of tools and machinery) are endowed with subjective, social qualities and are 'personified' or 'animated' as if they were independent subjects. An example of this can be shown in the writing of the noted neo-classical economist, Harry Johnson:

...technological development is a powerful force for economic and social integration of geographically separated communities ... Also, because technologies have a cost of creation that can be avoided by imitation and absorption there is a natural tendency (emphasis added) for societies to become more similar in consumption habits and ways of thinking as the level of technology rises and as higher-level technologies become diffused among different local and national societies.<sup>2</sup>

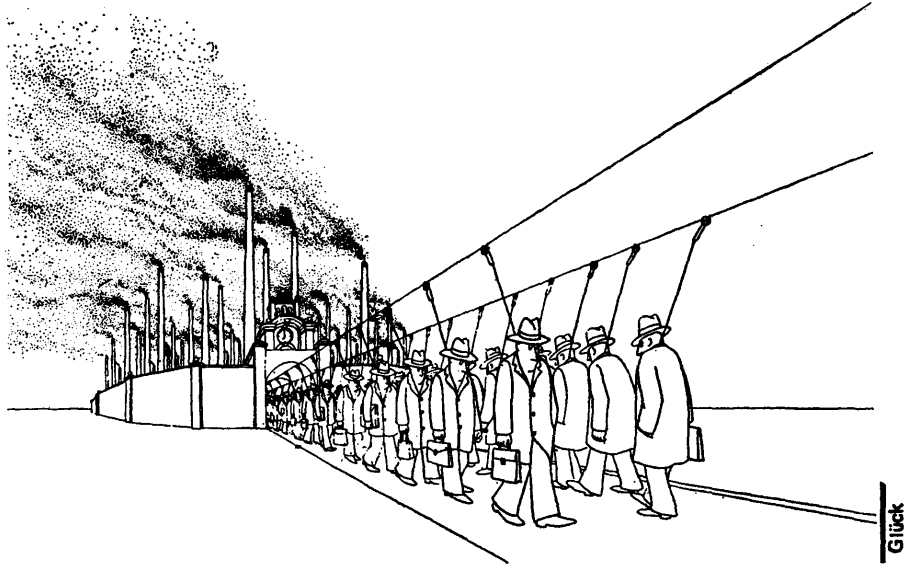
Note that the effect of 'rising and higher level technologies' create a 'natural tendency' which is independent of the social relationships of production manifested by multi-national corporations or the trade-aid policies of nation states. If we merely examine the relation of levels of technology to consumption habits, and the stylistic structures of our thoughts, then we will see a high correlation between the latter two phenomena and the level of technology. In fact, the entire division of labour which springs from capitalism socializes us into both our consumer behaviour as well as the main styles of thought and judgement.

Unwittingly or purposefully, it is in the interest of capital to portray technology as a 'thing' or as having a force of its own independent of the social relations which determine its direction and use. This is of most concern when it pervades the thought and writing of many of our more 'radical' thinkers. Technology is made to appear by some of its opponents as the cause of isolation and self-estrangement for the worker; and by its proponents as the ultimate solution to all contradictions and crises. Both arguments are misguided in separating the discussion of technology from a discussion of class power relations and control over the means of production.

If, as pointed out by Johnson, technology has always been with humankind in one form or another, it must also be recognized that the technologist has always been limited by the material resources which have been available. The environment with which a society reacts is the available environment ... and the available environment is that part of the environment which is placed within reach of the society by its knowledge and techniques."<sup>3</sup> Technology must then be produced from materials and a work process which people themselves

can manipulate. Herein, production, organization of work and distribution are linked to the resource base as a particular group of people begins to derive its power and influence from extending their control over scarce resources upon which a society depends.<sup>4</sup> The power and direction of technology, in these terms, can be seen to stem directly from a class division and social control by one group of people over the access to the social means of livelihood. This presents a different starting point from that which would have us believe that technology is a force with a momentum of its own that puts it beyond human direction or restraint.

To argue that technological change in itself will bring about either a more desirable or less desirable form of society is technological determinism carried to an extreme. Such arguments promote the idea that technology possesses an internal objective logic which separates it from issues of power and control. Rather, the logic of technological development is found in the dialectical relationship between the forces and social relations of production in which issues of power and control are directly confronted.



#### J.K. GALBRAITH: TECHNOLOGY AS IDEOLOGICAL CONTROL

An understanding of the role of technology as the legitimating means of social control has become as important as understanding the social structure itself because they are interdependent. Marx provided evidence that production (and technological change) is dominated by those who control and supply the means of production, i.e. a "constantly diminishing number of magnates of capital who usurp and monopolize all advantages of this process of transformation..."<sup>5</sup> The profit motive becomes the guiding light for both invention and innovation.

Galbraith's alternative premise as to the diffusion of this power within the corporate structure is extremely vague. He argues, "It (power) embraces all who bring specialized knowledge, talent or experience to group decision-making."<sup>6</sup> These 'dis-interested technicians' comprise the technostructure, among whom is lodged effective decision-making capacity based on the rational development of technological potential:

It will be evident that nearly all powers - initiation, character of development, rejection or acceptance - are exercised deep in the company ... Effective power of decision is lodged deeply in the technical planning and other specialized staff.<sup>7</sup>

In other words, the social and economic power relations within capitalism are encapsulated by Galbraith in the mantle of a scientifically necessary

division of labour presided over by those who understand the mysteries of science and technology. This ideological veil prevents him from being able to view the 'technocracy' as a more complex division of powers within the capitalist class that continues to exercise dominance because of its continuing control over the means of production.

The fundamental weakness with Galbraith's position lies in his attempt to understand the social structure merely by describing and analyzing its contemporary manifestations, without taking into account its historical roots. Historically, technology as a form of social development has entailed changes in the relations of workers to one another and to their employers by means of complex machinery, changes in methods of production, and in the re-organization of work. Marx identified the main features of the historical development of monopoly capital and explained the separation of ownership from control which has so fascinated the institutionalist school of thought (of which people like Adolph Berle, Gardiner Means and J.K. Galbraith are all proponents). The development of social capital implied the "transformation of the actually functioning capitalist into a mere manager, administrator of other people's capital, and of the owner of capital into a mere owner, a mere money capitalist ... The manager is divorced from the ownership of capital ... It is the abolition of capital as private property within the framework of capitalist production itself."<sup>8</sup>

The corporate development of capital, the application of science to industry, and increasing governmental involvement in production has replaced the entrepreneurial capitalist with the managerial direction of industry. The transfer of these functions to the manager alters very little in the social relations of production in that the manager continues to purchase labour-power thereby perpetuating the exploitative wage-system.<sup>9</sup>

Another major aspect of Galbraith's analytical method is the attempt to create an artificial duality by separating the social structure from the material base. His emphasis on the 'technostructure' in isolation provides a simplistic deterministic schema;

... the goals of the mature corporation will be a reflection of the goals of the members of the technostructure. And the goals of society will tend to be those of the corporation. If, as we have seen to be the case, the members of the technostructure set high store by autonomy and the assumed minimum level of earnings by which this is secured, this will be a prime objective of the corporation.<sup>10</sup>

The rise of technicians and managers in relation to production workers and the knowledge that technology is bound to condition other aspects of society is a far cry from seeing the vaguely defined 'technocrats' as agents of change. What Galbraith has accomplished at the conclusion of his analysis is the legitimation of the continued generation of wealth and power by those who now own or control the means of production. The class basis of social production is obscured by the emphasis on production techniques. Personified technology appears to create a power group (technocrats) who, endowed with their own subjective social qualities, set the goals of society.

#### JURGEN HABERMAS: TECHNOLOGY AS A CONTROLLING PRODUCTIVE FORCE

In the German Ideology the fact is underlined by Marx that, under

modern conditions, productive forces "appear as a world for themselves, quite independent of and divorced from the individuals, alongside the individuals." As a result, "we have a totality of productive forces, which have, as it were, taken on a material (objective) form and are for the individuals themselves no longer the forces of the individuals, but of private property ..."<sup>11</sup> This should help us to see that technology is not just the physical means by which society supports its needs under the hierarchical authority of its power structure. It also reflects, and shapes, the structure of the class relationships within society.

Jurgen Habermas, on the other hand, sees science and technology as the "rationalized control of objectified processes."<sup>12</sup> Technology takes on the role of a controlling productive force, de-politicizing and legitimating the capitalist economy. His argument is based on a two-fold position which on the one hand rejects the working class as the agent of social change, and on the other hand accepts the power of a non-defined 'technocracy' capable of offering appropriate solutions to existing problems. Society's self-understanding is detached and overwhelmed by a science and technology that is not only capable of producing value but also of legitimating the new forms of domination and control. Here substructure and superstructure are merged as science and technology control both the capitalist production process and its ideological underpinnings.<sup>13</sup>

Thus technology and science become a leading productive force, rendering inoperative the conditions for Marx's labour theory of value. It is no longer meaningful to calculate the amount of capital investment in research and development on the basis of the value of unskilled (simple) labour-power, where scientific-technical progress has become an independent source of surplus-value, in relation to which the only source of surplus-value considered by Marx, namely the labour-power of the immediate producers, plays an ever smaller role."<sup>14</sup>

This premise is then used by Habermas to negate 'social classes' in either theoretical or practical terms. This makes it impossible for him to comprehend the importance of the social relations of production as a necessary complement to his one-sided emphasis on the productive force of technology. The somewhat commonplace assertion that the Marxist analysis of social classes has failed to keep pace with social change cannot in itself justify the assertion that science and technology have, in themselves, replaced labour in the production of value.

#### HERBERT MARCUSE: TECHNOLOGY AS POLITICAL CONTROL

For Marcuse, the duality between technology as a productive force and as a social relationship also exists. His opposition is directed at 'industrial society' in One-Dimensional Man. The economic sphere of 'capital' which Marx saw as embracing both material production and the production of social relationships, is seen by Marcuse as an isolated sphere emptied of any effective socio-historical content:

... Technology serves to institute new, more effective, and more pleasant forms of social control and social cohesion.<sup>15</sup>

Today political power asserts itself through its power over the machine process and over technical organisation of the apparatus.<sup>16</sup>

Even though Marcuse emphatically warns against all technological fetishism,<sup>17</sup> he has fallen into a trap of his own design. Marcuse imputes to technology (as a thing) the enslavement and oppression of labourers for which capital (as a social relationship) is in fact responsible.

... the traditional notion of neutrality of technology can no longer be maintained ... In the medium of technology, culture, politics and the economy merge into an omnipresent system which swallows up or repulses all the alternatives.<sup>18</sup>

It is this type of analysis which forces both Marcuse and Habermas to eschew class analysis in attempting to understand the social relations of capitalism. As Marcuse puts it: "The new technological work-world then enforces a weakening of the negative position of the working class; the latter no longer appears to be the living contradiction to the established society."<sup>19</sup> While indeed, the working class no longer 'appears' to be the living contradiction, it is incumbent upon Marxist analysis to go beyond appearances.

Marcuse does clarify the historical passage from 'manufacture' to 'machino-facture' which has broken and re-assembled labour craft so as to substitute mechanical operations. But this description comes to a dead-end without a clear conception of class structures. The factory itself was developed as an institution by the capitalist class to organize humans and machines into larger patterns of organized operation. The aim of this re-organization was to re-structure the power relations between classes at the shop floor level. This resulted almost immediately in major advances in tools, production processes and consumer products. An analysis which neglects this interdependence between technical change, class structure and the level of economic activity is unsatisfactory. Taken to its extreme, Marcuse's approach may lead to the denial of any potential benefits of technology and to the 'perspective of Luddism'.<sup>20</sup> Moreover, the approach provides tacit support for a fruitless counter-ideology of isolated individualized response to exploitation and repression.

#### TECHNOLOGY AS FORCES AND RELATIONS OF PRODUCTION

Technological development increases the productivity of the labour force and is maintained by authoritarian and hierarchical regimentation and fragmentation of the labour process. As David Dickson indicates, innovation and the application of technology have never been neutral. They have always reflected the socio-economic system and political process itself.<sup>21</sup> Take, for instance, the example of the cotton industry in the 19th Century. The Lancashire cotton industry of the late 19th Century failed to adopt the most advanced textile technology available, particularly American ring frames and automatic looms. However, it has been shown that both British and American manufacturers, in their opposite responses to the new technology, "exhibited rational economic behaviour."<sup>22</sup> In Britain, the spinners' unions were relatively docile, which encouraged managers to preserve existing technologies. In America, industrial expansion provided an outlet for new investment; and troublesome mule spinner unions impelled manufacturers to switch to the ring frames operated by unskilled labour.

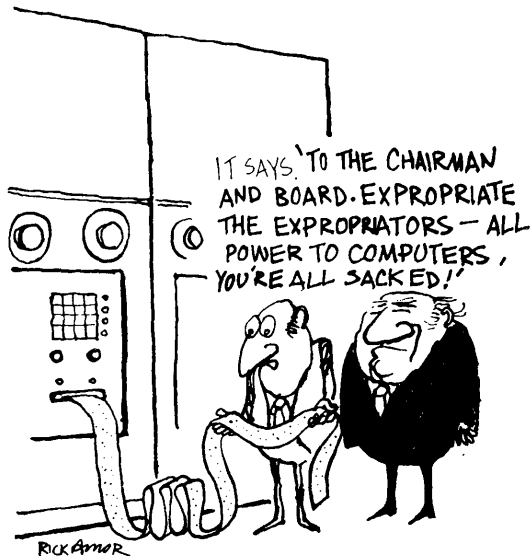
Strikes in particular, and the class struggle in general, have been, and continue to be, a major reason for invention and innovation under capitalism. The history of the automobile industry, for example, attests to the ingenuity of capital in using technology for the control of labour. Over 700 robots

are presently in use by Ford, General Motors and Chrysler in the United States and Australia to move castings, to load catalytic converters, to weld, and to assemble some underbodies. As Harley Shaiken, a writer and teacher who served as a consultant on computer technology to the United Auto Workers in the United States, has said: "New technology is more than just an efficient way to operate. It's a significant source of power, power in the marketplace, power over people."<sup>23</sup> From the other side of the fence we learn that "the nice thing" (about industrial robot systems) "is that they take no coffee breaks, never get pregnant, never go out on strike, draw no pensions - and uncomplainingly do various nasty jobs that a human workers would disdain."<sup>24</sup>

It is the capitalist mode of production "which makes science (and technology) a productive force distinct from labour, thereby pressing it into the service of capital."<sup>25</sup> While Marx gave primary emphasis to the forces of production, he never conceived it as a simple and unilateral determinism which 'caused' a specific set of social relationships and their interaction.<sup>26</sup> The forces of production grow or evolve within a social system and provide for conflicts between classes within that system, putting the relations between technology and society beyond the reach of any 'determinist' philosophical position. Technology within historical and analytical limits, "instead of simply producing social relations, is produced by the social relation represented by capital."<sup>27</sup> According to Harry Braverman, "the first volume of Capital may be considered a massive essay on how the commodity form in an adequate social and technological setting, matures into the form of capital, and how the social form of capital, driven to incessant accumulation as the condition for its own existence, completely transforms technology."<sup>28</sup>

Marx also anticipated the development of technology through the application of science and specifically related it to the social relationships existing between workers and capitalists:

What enables the machine to perform the same labour earlier performed by the worker is the analysis and application of mechanical and chemical laws arising directly from science. The development of machinery in this direction, however, begins only when large-scale industry has already attained a higher level and the aggregate of the sciences has been taken into the service of capital."<sup>29</sup>



Industrially advanced capitalist nations are expanding the technical control over nature and refining the administration of human activity. Science, technology, industry and administration interlock in a circular process so as to assert the capitalist process as the "rational application of techniques" for control and manipulation of the production process and the associated social relationships. This process is not a mysterious example of "repressive technology" or domination of "technological rationalist" or the value-creating forces of science-technology; but rather the logical result of the forces of capital accumulation and the division of labour.

The marriage of technique with the special needs of capital involves the adjustment of the worker to the on-going production process as designed by engineers and scientists. The development of the 'technocrats', discussed by Galbraith, is given this sort of alternative interpretation by Braverman:

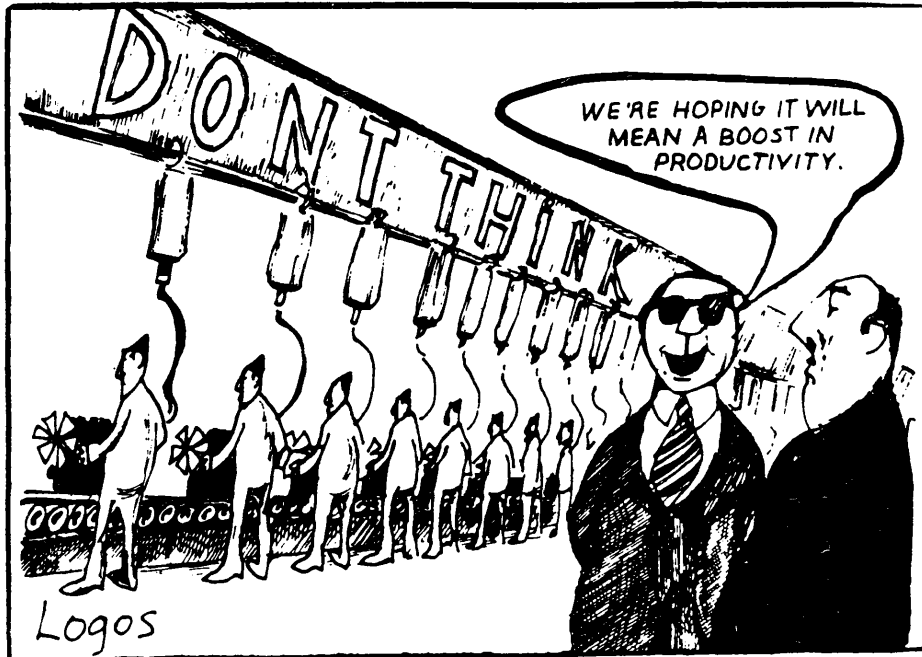
The separation of hand and brain is the most decisive single step in the division of labor taken by the capitalist mode of production. It is inherent in that mode of production from its beginnings, and it develops, under capitalist management, throughout the history of capitalism, but it is only during the past century that the scale of production, the resources made available to the modern corporation by the rapid accumulation of capital, and the conceptual apparatus and trained personnel have become available to institutionalize this separation in a systematic and formal fashion.<sup>30</sup>

This separation of hand and brain is codified under capitalism by the appropriation and harnessing of science in the production process as capitalist property through research and development, scientific education and patent manipulation by private laboratories. Thus, the loss of control over technology is basically the transformation of accumulated social knowledge into private property in order to serve the interest of capital accumulation. As Braverman elaborates, the interdependence of science and industry, developed first in Germany and continued and enhanced by the corporate research laboratories after World War II, was to be one of the most influential developments of the 20th Century. Rather than science as a productive force, in the terms of Habermas, science was transformed into a commodity bought and sold as other goods and services. "The key innovation is not to be found in chemistry, electronics, automatic machinery, aeronautics, atomic physics, or any of the products of these science-technologies, but rather in the transformation of science itself into capital."<sup>31</sup> This description recognizes that the 'capitalist' rather than the nebulous 'technocrat' still controls the direction of capitalism.

To study technology 'in itself' is to lose comprehension of its social role. The 'technical' must always be considered in terms of the relations of production. In this light the 'technical' can be seen as the instrumentation of those to whom the accumulation of capital gives the control over technology; and the technocrat can be seen as a representative of capital controlling the labour process through the instrumentation of capital.

The fashion of speaking of technology as the controlling force shows a misunderstanding of the products of human labour and ingenuity. This is most appropriately portrayed in the ideological pessimism of Jacques Ellul: "It is useless to rail against capitalism. Capitalism did not create our world; the machine did."<sup>32</sup> Here we are asked to suspend our understanding of evolutionary social change. In the beginning, there was the machine! This glorification of the power of a commodity designed and constructed by humans and alterable by them at will is the "... Fetishism which attaches itself to the products of labour, so soon as they are produced as commodities, and which is therefore inseparable from the production of commodities."<sup>33</sup> 'Fetishism' becomes a necessary feature of the socio-economic and psychological phenomena of commodity producing systems. In such circumstances it becomes quite normal for people to lose sight of the social relationships underlying specific technologies and the commodities produced.<sup>34</sup>





The need for a broader view which acknowledges the interrelationship between technology and the social relations of production is also relevant to the study of other social formations. In particular, the dominance of this aspect of capitalist ideology on a world scale can also be traced to the U.S.S.R., and more recently to China, where the leadership have seen fit to introduce Western technology. The same mistake in this instance - viewing technology as a 'thing' - is being made by the ruling elites in these nations. If the technology borrowed from the West is not manipulated according to socialist principles of social, democratic planning and worker control the end results will be the same: subordination and deskilling of working people combined with the massive accumulation of wealth whose control rests in a few hands.

#### CAPITALISM AND TECHNICAL CHANGE

How is the form of technological change in practice influenced by the considerations we have discussed? We have seen that technology does not structure itself on its own terms, but rather, within a mode of production which engenders conflict between those who own and control the means of production and those who own and control their labour-power only. Thus, the real power of capitalist technology is not to develop production for human needs: it is to subordinate and dominate workers for the purpose of profit maximization and capital accumulation.

Examples of this process are numerous. One is provided by Theo Nichols and Huw Beynon in their study of the British petro-chemical sector.<sup>35</sup> They point out that in this sector each worker is supplied with an average of \$800,000 worth of capital assets. Yet, the workforce is divided up on the basis of 25% who are labelled technicians and 75% whose labour is called 'donkey-work'. The criteria for technological advance in this industry has always been the need to make higher profits, not to make work easier. In these terms, it is profitable for production to be serviced by 'donkey-work' in one of the most technologically advanced industries in the world. Technology has not produced an extensively skilled working class in this industry; on the contrary, the workers have been systematically deskilled.

A second example involving the deskilling process was recently described by an engineering employer at the first South Pacific Die-casting Conference in Melbourne. Describing the effect of introducing Numerical Control (NC) processes where the machine is programmed to perform repetitive engineering tasks, John Rabin of Diecraft Australia said:

The choice of the operator is very important, and we have learned through experience never to put a top-class tradesman or an older man on an NC machine. The young take to NC like a duck to water, and I believe this is because of their limited experience on conventional machines and also that they do as they are told ... Numerically Controlled machining and spark erosion have taken much of the skill out of tool-making, and as time passes the duties of the toolmakers will become even simpler.<sup>36</sup>

The capitalist class cannot count on the voluntary cooperation of workers in this process. This is why it is essential for machinery to impose its rhythm on the shop floor. In every productive process, work must be definable, quantifiable and controllable from the outside. Peter Robson has shown in a recent study that automated production processes have centralized information systems giving senior corporate executives power and control over the means of production and the workforce. He argues that "automatic machinery can dominate the productive process even more effectively and make its operators simple machine minders. Decision-making is removed from the individual production worker by escalating the decision level up the management hierarchy."<sup>37</sup> The fact that much of the technical expertise required by the modern production process has been transferred from the shop floor to management desks does not imply that the ultimate capitalist control has changed, as Galbraith would argue. It simply involves the formalization of decisions on the part of management of what had formerly been handled on an informal basis by the workers themselves.<sup>38</sup> A seemingly invisible process of decisions by workers has now become a visible, detailed mass of records and calculation under the control of Galbraith's technocracy. Moreover, as Braverman points out, "Since both capital and professional management - at its top levels - are drawn, by and large, from the same class, it may be said that the two sides of the capitalist, owner and manager, formerly united in one person, now become aspects of the class ... Capital has now transcended its limited and limiting personal form and has entered into an institutional form."<sup>39</sup>

It is the totality of these decisions based on profitability and control that gives us a technology which 'appears' as an independent force, displacing jobs and changing the character of work in many industries. Some see the process as "out of control" . To quote again from Ellul: "The new milieu has its own specific laws which are not the laws of organic or inorganic matter. Man is still ignorant of these laws. It nevertheless begins to appear with crushing finality that a new necessity, 'technique', is taking over ..."<sup>40</sup> However, as we have seen, this appearance of uncontrollable technology shows a total lack of understanding of capitalist social relations. It is not that society is controlled by technological advance, but that technology is under the control of a small, but dominant class - those who own and control the means of production.

#### FOOTNOTES

- \* I wish to extend appreciation to Frank Harman, Mark Kennedy and Howard Sherman for their constructive criticism on earlier drafts of this paper; and to Evan Jones and Frank Stilwell for their incisive editorial comments and suggestions.

For editorial reasons, the number of footnotes has been reduced from the original version: anyone interested in a fuller exposition should contact the author.

- 1 Karl Marx, Capital, Volume I, New York: The Modern Library, 1906, p.406.
- 2 Harry G. Johnson, Technology and Economic Interdependence, London: Trade Policy Research Centre, 1975, p.7.
- 3 James K. Feibleman, "Pure Science, Applied Science, Technology, Engineering: An Attempt at Definitions" in Noel de Nevers (ed.) Technology and Society, London: Addison-Wesley Publishing Company, 1972, p.40.
- 4 Richard G. Wilkinson, Poverty and Progress, London: Methuen and Company, 1973, p.109.
- 5 Karl Marx, op.cit., Chapter 32, p.836.
- 6 Ibid, p.71.
- 7 Ibid, p.68.
- 8 Karl Marx, Capital, Volume III, Moscow: Progress Publishers, 1971, pp. 436-438.
- 9 Paul Mattick, Marx and Keynes: The Limits of the Mixed Economy, London: Merlin Press, 1969, pp.301-302. Marx also stated the case succinctly as "An industrial army of workmen, under the command of a capitalist requires, like a real army, officers (managers), and sergeants (foreman), who while the work is being done, command in the name of the capitalist." Karl Marx, Capital, Volume I, p.36.4
- 10 Ibid, p.161.
- 11 Karl Marx and Frederick Engels, "The German Ideology", in Collected Works, London: Lawrence and Wishart, Volume 5, 1976, p.86.
- 12 Jurgen Habermas, Towards a Rational Society: Student Protest, Science and Politics, translated by Jeremy Shapiro, London: Heinemann, 1971, p.57.
- 13 An excellent introduction to the paradigm of both Herbert Marcuse and Jurgen Habermas is provided by James Farganis, "A Preface to Critical Theory", Theory and Society, Volume 2, No. 4, Winter, 1975.
- 14 Jurgen Habermas, op.cit., p.104.
- 15 Herbert Marcuse, One-Dimensional Man, Boston: Beacon Press, 1964, p.xv.
- 16 Ibid, p.3.
- 17 Ibid, p.235.
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- 20 Lucio Colletti, From Rousseau to Lenin: Studies in Ideology and Society, London: New Left Books, 1976, p.139.
- 21 David Dickson, Alternative Technology and the Politics of Technical Change, London: Fontana/Collins, 1974. With reference to this point in particular see Chapter 4.
- 22 See the argument presented in Lars G. Sandburg, Lancashire in Decline: A Study in Entrepreneurship, Technology and International Trade. Columbus: Ohio State University Press, 1974.
- 23 As cited in the Australian Financial Review. November 7, 1979.
- 24 Bernard Sallot, executive director of the Robot Institute of America, "Blue-Collar Robots", Newsweek, April 23, 1979, p.44.
- 25 Karl Marx, Capital, Volume I, op.cit., p.397.
- 26 See letter from Engels to J. Bloch, 21 September, 1890 in Marx and Engels, Selected Correspondence, Moscow:Progress Publishers, 1963, p.498.
- 27 Karl Marx, The Poverty of Philosophy, Moscow: Progress Publishers, 1966, p.121. See also p.122 and p.146.
- 28 Harry Braverman, Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century, New York:Monthly Review Press, 1974, p.20.
- 29 Karl Marx, Grundrisse, p.591 cited in Jurgen Habermas. Knowledge and Human Interests, London, Heinemann, 1972, p.326.
- 30 Braverman, op.cit., p.126.
- 31 Ibid, p.167.
- 32 Jacques Ellul, The Technological Society, New York, Vintage Press, 1964, p.5.
- 33 Karl Marx, Capital, Volume I, op.cit., p.83.
- 34 For development of this point see Haskell Lewin and Jacob Morris, "Marx's Concept of Fetishism", Science and Society, Volume XLI, No.2, Summer, 1977, pp 172-90.
- 35 Theo Nichols and Huw Beynon, Living with Capitalism: Class Relations and the Modern Factory. London:Routledge and Kegan Paul, 1977, pp.13-17.
- 36 See the Australian Financial Review, April 3, 1980.
- 37 Peter Robson, "Advanced Technology and Decision-Making Processes in the Industry", as cited in the Australian Financial Review, March 20, 1980, p.16.
- 38 For a frank statement of this managerial objective of capturing ... "all of the planning which under the old system was done by the workman," see F.W. Taylor, Scientific Management, New York, Harper & Row, 1947, pp.36-38.
- 39 Braverman, op.cit., p.258.
- 40 Jacques Ellul, op.cit., p.428.

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