Other books in the series

PUBLISHED

Capitalism in Crisis: Inflation and the State
Andrew Gamble and Paul Walton

The Dialectic of Ideology and Technology
Alvin W. Gouldner

The Radicalisation of Science
Hilary Rose and Steven Rose (eds)

FORTHCOMING

Ideology, Legitimation and Structure
Stuart Hall

The Multinationals
Richard Kronish

Theories of Underdevelopment
Ian Roxborough

Crime at the End of the Welfare State
Ian Taylor

Media as Myth
Jock Young

The Political Economy of Science

Ideology of / in the Natural Sciences

Edited by

Hilary Rose

and

Steven Rose

M

Contents

5

Contradictions of Science and Technology in the Productive Process

Mike Cooley

Any meaningful analysis of scientific abuse must probe the very nature of the scientific process itself, and the objective role of science within the ideological framework of a given society. As such, it ceases to be merely a 'problem of science' and takes on a political dimension. It extends beyond the important, but limited, introverted soul-searching of the scientific community, and recognises the need for wider public involvement. Many 'progressive' scientists now realise that this is so, but still see their role as the interpreters of the mystical world of science for a largely ignorant mass, which when enlightened will then support the scientists in their intention 'not to use my scientific knowledge or status to promote practices which I consider dangerous'.

Those who, in addition to being 'progressive' have political acumen, know that a 'Lysistrata movement', even if it could be organised, is unlikely to terrify monopoly capitalism into applying science in a socially responsible manner. 'Socially responsible' science is only conceivable in a politically responsible society. That must mean changing the one in which we now live.

One of the prerequisites for such political change is the rejection of the present basis of our society by a substantial number of its members, and a conscious political force to articulate that contradiction as part of a critique of society as a whole. The inevitable misuse of science, and its consequent impact upon the lives of an ever-growing mass of people, provides the fertile ground for such a political development. It should constitute an important weapon in the political software of any conscious revolutionary.

Even Marxist scientists seem to reflect the internal political incestuousness of the scientific community, and demonstrate in practice a reluctance to raise these issues in the mass movement. Thus the debate has tended to be confined to the rarified atmosphere of the campus, the elitism of the learned body or the relative monastic quiet of the laboratory.

Clearly, the ruling class, which has never harboured any illusions about the ideological neutrality of science, will not be over-concerned by this responsible disquiet. The Geneens of ITT and the Weinstocks of GEC do not tremble at the pronouncements of Nobel Laureates. It is true of course that the verbal overkill of the ecologist has reverberated through the quality press and caused some concern – not all of it healthy – in liberal circles. But the working class, those who have it within their power to transform society, those for whom such a transformation is an objective necessity, have not as yet been really involved. Yet their day-to-day experience at the point of production brutally demonstrates that a society which strives for profit maximisation is incapable of providing a rational social framework for technology (which they see as applied science).

'Socially irresponsible' science not only pollutes our rivers, air and soil, provides CS gas for Northern Ireland, produces defoliants for Vietnam and stroboscopic torture devices for police states. It also degrades, both mentally and physically, those at the point of production, as the objectivisation of their labour reduces them to mere machine appendages. The financial anaesthetic of the 'high-wage (a lie in any case) high-productivity low-cost economy' has demonstrably failed to numb workers' minds to the human costs of the fragmented dehumanised tasks of the production line.

There are growing manifestations in the productive superstructure of the irreconcilable contradictions at the economic base. The sabotage of products on the robot-assisted line at General Motors Lordstown plant in the United States, the 8 per cent absentee rate at Fiat in Italy, the 'quality' strike at Chryslers in Britain and the protected workshops in Sweden reveal but the tip of a great international iceberg of seething industrial discontent. That discontent, if properly handled, can be elevated from its essentially defensive, negative stance into a positive political challenge to the system as a whole.

The objective circumstances for such a challenge are developing rapidly as the crushing reality is hammered home by the concrete experience of more and more workers in high capital, technologically based, automated or computerised plants. In consequence, there is a

gradual realisation by both manual and staff workers that the more elaborate and scientific the equipment they design and build, the more they themselves become subordinated to it, that is to the objects of their own labour. This process can only be understood when seen in the historical and economic context of technological change as a whole.

SCIENCE AND THE CHANGING MODE OF PRODUCTION

The use of fixed capital, that is, machinery and, latterly, computers, in the productive process marked a fundamental change in the mode of production. It cannot be viewed merely as an increase in the rate at which tools are used to act on raw material. The hand tool was entirely animated by the workers, and the rate at which the commodity was produced – and the quality of it – depended (apart from the raw materials, market forces and supervision) on the strength, tenacity, dexterity and ingenuity of the worker. With fixed capital, that is the machine, it is quite the contrary in that the method of work is transformed as regards its use value (material existence) into that form most suitable for fixed capital. The scientific knowledge which predetermines the speeds and feeds of the machine, and the sequential movements of its inanimate parts, the mathematics used in compiling the numerical control programme, do not exist in the consciousness of the operator; they are external and act through the machine as an alien force. Thus science, as it manifests itself to the workers through fixed capital, although it is merely the accumulation of the knowledge and skill now appropriated, confronts them as an alien and hostile force, and further subordinates them to the machine. The nature of their activity, the movements of their limbs, the rate and sequence of those movements – all these are determined in quite minute detail by the 'scientific' requirements of fixed capital. Thus objectivised labour in the form of fixed capital emerges in the productive process as a dominating force opposed to living labour. We shall see subsequently when we examine concrete situations at the point of production that fixed capital represents not only the appropriation of *living* labour, but in its sophisticated forms (computer hardware and software) appropriates the scientific and intellectual output of the white-collar workers whose own intellects oppose them also as an alien force.

The more therefore that workers put into the object of their labour, the less there remains of themselves. The welder at General Motors who takes a robotic welding device and guides its probes through the welding procedures of a car body is on the one hand building skill into the machine, and deskilling themselves on the other. The accumulation of years of welding experience is absorbed by the robot's self-programming systems and will never be forgotten. Similarly, mathematicians working as stressmen in an aircraft company may design a software package for the stress analysis of airframe structures and suffer the same consequences in their jobs. In each case they have given part of themselves to the machine and in doing so have conferred life on the object of their labour – but now this life no longer belongs to them but to the owner of the object.

Since the product of their labour does not belong to the workers, but to the owner of the means of production in whose service the work is done and for whose benefit the product of labour is produced, it necessarily follows that the object of the workers' labour confronts them as an alien and hostile force, since it is used in the interests of the owner of the means of production. Thus this 'loss of self' of the worker is but a manifestation of the fundamental contradictions at the economic base of our society. It is a reflection of the antagonistic contradiction between the interest of capital and labour, between the exploiter and the exploited. Fixed capital, therefore, at this historical stage, is the embodiment of a contradiction, namely that the means which could make possible the liberation of the workers from routine, soul-destroying, back-breaking tasks, is simultaneously the means of their own enslavement.

It is therefore obvious that the major contradiction can only be resolved when a change in the ownership of the means of production takes place. Much less obvious, however, is whether there exists a contradiction (non-antagonistic) between science and technology in their present form and the very essence of humanity. It is quite conceivable that our scientific methodology, and in particular our design methodology, has been distorted by the social forces that give rise to its development. The question therefore must arise whether the problems of scientific development and technological change, which are *primarily* due to the nature of our class-divided society, can be solved solely by changing the economic base of that society.

The question is not of merely theoretical interest. It must be a burning issue in the minds of those in Vietnam who are responsible for their country's programme of reconstruction. It must be of political concern to those in China, to establish if Western technology can be simply applied to a socialist society. Technology at this historical stage, in a class-divided society, such as Britain, is the embodiment of two oppo-

sites – the possibility of freeing the workers, yet the actuality of ensnaring them. The possibility can only become actuality when the workers own the object of their labour. Because the nature of this contradiction has not been understood, there have been the traditional polarised views: 'technology is good'; and 'technology is bad'. These polarised views are of long standing and not merely products of space-age technology. From the earliest times a view has persisted that the introduction of mechanisation and automated processes would automatically free people to engage in creative work. This view has persisted as consistently in the field of intellectual work as it has in that of manual labour. As far back as 1624, when Pascal introduced his first mechanical calculating device he said, 'I submit to the public a small machine of my own invention, by means of which you alone may without any effort perform all the operations of arithmetic and may be relieved of the work which has so often fatigued your spirit when you have worked with the counters and with the pen.' Only twenty-eight years earlier in 1596 an opposite view was dramatically demonstrated when the city council of Danzig hired an assassin to strangle the inventor of a labour-saving ribbon-loom, a defensive if understandable attempt, repeated time and again in various guises during the ensuing 500 years to resolve a contradiction at an industrial level when only a revolutionary political one would suffice. It is of course true that the contradiction manifests itself in industrial forms even to this day.

THE OBSOLESCENCE OF FIXED CAPITAL

There is first the ever shorter life of fixed capital (the increasing rate of obsolescence of machinery). Early wheeled transport existed in that form for thousands of years; steam-engines made by Boulton and Watt two hundred years ago were still operating about a hundred years later; a century ago, when an employer purchased a piece of machinery, he could rest assured that it would last his lifetime and would be an asset he could pass on to his son.

In the 1930s machinery was obsolete in about twenty-five years, during the 1950s in ten years, and at the moment computerised equipment is obsolete in about three to five years. Then there is the growing volume of fixed capital necessary to provide the total productive environment for a given commodity – the cost of the total means of production is ever-increasing. That is not to say that the cost of individual commodities will continue to increase. The most complicated lathe one could get 100 years ago would have cost the equivalent of ten workers' wages per annum. Today, a lathe of comparable complexity, with its computer-tape control and the total environment necessary for the preparation of those tapes and the operation of the machine, will cost something in the order of a hundred workers' wages per annum. The industrial manifestations of the contradiction now begin to emerge very clearly indeed. Confronted with equipment which is getting obsolete literally by the minute, and has involved enormous capital investment, the employer will seek to recoup his investment by exploiting that equipment for twenty-four hours per day. In consequence of this, employers will seek to eliminate all so-called non-productive time, such as tea breaks, will seek to subordinate the employees more and more to the machine in order to get the maximum performance, and will insist that the equipment is either worked upon on three shifts to attain a twenty-four hour exploitation, or is used on a continuous overtime basis. This trend has long since been evident in the manual field on the workshop floor. It is now beginning to be a discernible pattern in a whole range of white-collar occupations.

THE PROLETARIANISATION OF INTELLECTUAL WORKERS

An analysis of this problem in British companies demonstrates that employers will wish to ensure that all their white-collar employees who use this kind of equipment accept the same kind of subordination to the machine that they have already established for manual workers on the shop floor. To say that this is so is not to make a prediction about the far-distant future. In 1971 my union (AUEW–TASS) was involved in a major dispute with Rolls Royce, which cost the union £250,000. The company sought, amongst other things, to impose on the design staff at the Bristol plant the following conditions:

> The acceptance of shift work in order to exploit high capital equipment, the acceptance of work measurement techniques, the division of work into basic elements, and the setting of times for these elements, such time to be compared with actual performance.

In this instance the union was able, by industrial action, to prevent the company from imposing these conditions. They are, however, the sort of conditions which employers will seek increasingly to impose upon the white-collar workers. When staff workers, whether they be technical, administrative or clerical, work in a highly synchronised, compu-

...ceived environment, the employer will seek to ensure that such elements of their work is ready to feed into the process at the precise time at which it is required. Mathematicians, for example, will find that they have to have their work ready in the same way as a Ford worker has to have the wheel ready for the car as it passes him on the production line. In consequence of this, many graduates, who in the past would never have recognised the need to belong to a real trade union, now find that they need the same kind of bargaining strength that manual workers have accepted on the shop floor for some considerable length of time. In fact, one can generalise and say that the more technological change and computerisation enters white collar areas, the more workers in those areas will become proletarianised. The consequences of this will not be limited to the work situation. They will spread right across the family, social and cultural life of the white collar worker. Consider the consequences of shift working for example. In a survey carried out in West Germany it was demonstrated that the ulcer rate amongst those working a rotating shift was eight times higher than amongst other workers. Other surveys have shown that the divorce rate amongst shift workers is approximately 50 per cent higher than normal, whilst the juvenile delinquency rate of their children can often be 80 per cent higher. There are a whole series of examples in Britain of the manner in which the cultural and social life of ASTMS/TASS members has been disrupted by the introduction of this kind of equipment.

Thus, whilst it is true that automated and computerised equipment could free people from routine, and destroying, back breaking tasks, and free them to engage in more creative work, the reality in our profit orientated society is that in many instances it actually lowers 'the quality of life'.

There are also good grounds for assuming that automated and computerised systems will in many instances diminish rather than enhance the creativity of scientific and technological workers. Computer Aided Design (CAD) is a useful occupational aperture through which to view a scenario that will become commonplace to many in the next few years.

In setting the idea of computers in the design community, it is suggested that the computer will merely deal with the quantitative factors and the designer will deal with value judgements and the creative elements of the design process. It is of course true that the design process is, amongst other things, an interaction of the quantitative and the qualitative. It is not, however, true that design methodology is such that these can be separated into two discriminated elements which can then be applied almost as chemical compound. The process by which these two opposites are united by the designer to produce a new whole is a complex and as yet ill defined and ill researched area.

The sequential basis on which the elements interact is of extreme importance. The nature of that sequential interaction, and indeed the ratio of the quantitative to the qualitative, depends on the commodity under design consideration. Even where an attempt is made to define the proportion of the work that is creative, and the proportion that is non creative, what cannot be readily stated is the stage at which the creative element has to be introduced when a certain stage of the non creative work has been completed. The very subtle process by which designers review the quantitative information they have assembled, and then make the qualitative judgement, is extremely complex. Those who seek to introduce computerised equipment into this interaction attempt to suggest that the quantitative and the qualitative can arbitrarily be divided, so that the computer handles the quantitative. (This is in reality a devious introduction of 'Taylorism' into advanced technological work - an attempt to further subdivide an 'intellectual activity' into its 'manual' and 'intellectual' components.)

Since CAD dramatically increases the rate at which the quantitative is handled, a serious distortion of the dialectical interaction takes place, frequently to the detriment of the qualitative. There are therefore good grounds for assuming that the crude introduction of the computer into the design process, in keeping with the Western ethic of 'the faster the better', may well result in a deterioration of the design quality. It is typical of the narrow, fragmented and short term view which capitalism takes of all productive processes, that these important philosophical considerations are ignored. Much design research is limited to considerations of design techniques and computer hardware and software with precious little regard for the objective requirements of the design staff or, more importantly, the public. Such research accurately reflects our economic base: equipment and hence capital first, people last.

Whilst designers, steeped in their traditional professionalism, believed (and many still believe) that their creative talents provide an eternal occupational sanctuary against the creeping proletarianisation of all white collar workers, Architects, for example, contended that there might be problems for aircraft designers, mechanical designers or civil engineers, but not for them. After all, is not architecture the 'queen of

the Arts rather than the Father of Technology'? However, capitalism, in its relentless drive to exploit all who work, has not forgotten the architects. For them there has been specifically produced a software package known (appropriately) as HARNESS. The concept behind this system is that the design of buildings can be systematised to such an extent that each building is regarded as a communication route. Stored within the computer system are a number of predetermined architectural elements which can be disposed around the communication route on a Visual Display Unit to produce different building configurations. Only these predetermined elements may be used and architects are reduced to operating a sophisticated 'Lego' set. Their creativity is limited to choosing how the elements will be disposed rather than considering in a panoramic way the types and forms of elements which might be used. As Marx pointed out in *Capital*: 'a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of bees is this, the architect raises his structure in imagination before he erects it in reality. At the end of every labour process, we get a result that already existed in the imagination of the labourer at its commencement'.[1]

It is clear that HARNESS will reduce the distinction between the architect and the bee and that capitalism will insist that in future architects will work in a more 'bee-like' fashion! This will gradually apply to all technological and scientific workers, whatever systems are devised to control their 'mode of intellectual production' in the same way as manual workers on the shop floor are controlled. Employers have long sought ways and means of controlling 'their' elusive, creative technical and white-collar staff. The computerised system is one Trojan Horse widely used to do so. The process is succinctly described in the magazine *Realtime* by a writer fresh from an IBM customer training ing course:

> Now an operating system is a piece of software, functionally designed to do most efficiently a particular job – or is it? It gradually dawned on me that some rather obnoxious cultural assumptions have been imported lock, stock and barrel into IBM software. Insidious, persuasive assumptions, which appear to be a natural product of logic – but are they? The whole thing is a complete totalitarian hierarchy. The operating system runs the computer installation. The chief and most privileged element is the 'Supervisor'. Always resident in the most senior position in main storage, it controls, through its minions, the entire operation. Subservient to the supervisor is the bureaucratic machinery – job management routines, task management, input/output scheduling, space management and so on. The whole thing is thought out as a rigidly controlled, centralised hierarchy. And as machines get bigger and more powerful, so the operating system grows and takes more powers. One lecturer soared into eloquence in comparing the various parts of the operating system to the directors, top management, middle management, shop foremen and ordinary pleb workers of a typical commercial company. In fact, the whole of IBM terminology is riddled with class expressions – master files, slave cylinders, high and low level languages, controller, scheduler, monitor.[2]

The same writer then generalised some of the contradictions of centralised operating systems. (These coincided closely with my own findings when I investigated the contradiction in the specific field of Computer Aided Design.)

> The drawbacks of the centralised operating system are many. It is a constraining and conservative force. A set of possibilities for the computer system is chosen at a point in time, and a change involves regeneration of the system. It imposes conformity on programming methods and thought. Another amazingly apt quote from an IBM lecturer – 'Always stick to what the system provides, otherwise you may get into trouble'. It mystifies the computer system by putting its most vital functions into a software package which is beyond the control and comprehension of the applications programmer, thus introducing even into the exclusive province of Data Processing the division between software experts and other programmers, and re-inforcing the idea that we do not really control the tools we use, but can only do something 'if the operating system lets you' – a phrase which I am sure many of us have used. The system which results seems absurdly top heavy and complex. The need to have everything centrally controlled seems to impose an enormous strain.

The introduction of computerised systems is frequently used as a smokescreen to introduce another management control weapon – job evaluation. Pseudo-scientific reasons are given for fragmenting jobs and slotting the subdivided function into a low level of the system hierarchy with correspondingly low wages for 'appropriate' job grades. My experience of this in industry tends to show that it is frequently actually used to consolidate the unequal pay and opportunities of women by

either implying (they can no longer state it openly as they have done in the past), or ensuring by structural means and recruitment, that the fragmented functions are 'women's work'. There is of course no such thing as 'women's work' in this sense any more than there is women's mathematics, women's physics, women's literature or women's music. There is only work – the means by which employers extract profits from all of us but higher profits from women. Thus a contradiction will exist in that although scientific and technological progress could provide the objective circumstances for greater equality between the sexes in the productive process, in our profit-orientated society the reverse will frequently be the case. Women will have to fight not only the traditional forms of discrimination, but much more sophisticated and scientifically structured ones with little indication that the unions catering for such workers have really understood the nature or scale of these problems.

The emergence of fixed capital as a dominant feature in the productive process means that the organic composition of capital is increased and industry becomes capital intensive rather than labour intensive. Human beings are increasingly replaced by machines. This in itself increases the instability of capitalism; on the one hand, capitalism uses the quantity of working time as the sole determining element, yet at the same time continuously reduces the amount of direct labour involved in the production of commodities. At an industrial level, literally millions of workers lose their jobs and millions more suffer the nagging insecurity of the threat of redundancy. An important new political element in this is the class composition of those being made redundant. Just as the use of high-capital equipment has spread out into white-collar and professional fields so also the consequences of high-capital equipment do likewise. Scientists, technologists, professional workers, clerical workers, all now experience unemployment in a manner that only manual workers did in the past. Verbal niceties are used to disguise their common plight. A large West London engineering organisation declared its scientists and technologists 'technologically displaced', its clerical and administrative workers 'surplus to requirements', and its manual workers 'redundant'. In fact they had all got the good old-fashioned sack! In spite of different social, cultural and educational backgrounds, they all had a common interest in fighting the closure of that plant, and they did. Scientists and technologists

paraded around the factories carrying banners demanding 'the right to work' in a struggle that would have been inconceivable a mere ten years ago. Technological change was indeed proletarianising them. In consequence of the massive and synchronised scale of production which modern technology requires, redundancies can affect whole communities. During a recession in the American aircraft industry in the early 1970s a union banner read: 'Last out of Seattle please put the lights out.' Because of this change in the organic composition of capital, society is gradually being conditioned to accept the idea of a permanent pool of unemployed people. Thus we find in the United States, in spite of the artificial stimulus of the Vietnam War, over the past ten years about five million people have been permanently out of work.

We have witnessed in this country the large-scale unemployment of recent years. Unemployment is considerable in Italy, and even in the West German miracle there are sections of workers – particularly over the age of fifty – who are now experiencing long terms of unemployment. This unemployment itself creates contradictions for the ruling class. It does so because people have a dual role in society, that of producers and consumers. When you deny them the right to produce, you also limit their consumption power. In an attempt to achieve a balance, efforts are now being made to restructure the social services to maintain that balance between unemployment and the purchasing power of the community. In the United States, President Kennedy spoke of a 'tolerable level of unemployment'. In Britain in the 1960s Harold Wilson, stoking the fires of industry with the taxpayer's money through the Industrial Reorganisation Corporation to create the 'white heat of technological change' spoke in a typical double negative of a 'not unacceptable level of unemployment'.

A remarkable statement for a so-called socialist Prime Minister! The net result is that there is on the one hand an increased work tempo for those in industry, whilst on the other hand there is a growing dole queue, with all the degradation that that implies; nor is there any indication that the actual working week has been reduced during this period. Indeed, in spite of all the technological change since the war, the actual working week in Britain for those who have jobs is longer now than it was in 1946. Yet the relentless drive goes on to design machines and equipment which will replace workers. Those involved in such work seldom question the nature of the process in which they are

engaged. Why, for example, the frantic efforts to design robots with pattern recognition intelligence when we have a million and a half people in the dole queue in Britain whose pattern recognition intelligence is vastly greater than anything yet conceived even at a theoretical level?

The system seeks in every way to break down the workers' resistance to being sacked. One of the sophisticated devices was the Redundancy Payments Act under the 1964–70 Labour Government. Practical experience of trade unions in Britain demonstrates that the lump sums involved broke up the solidarity at a number of plants where struggle was taking place against a closure.

A much more insidious device is to condition workers into believing that it is their own fault that they are out of work, and that they are in fact unemployable. This technique is already widespread in the United States, where it is asserted that certain workers do not have the intelligence and the training to be employed in modern technological society. This argument is particularly used against coloured workers, Puerto Ricans and poor whites. There is perhaps here fertile ground for some of the 'objective research' of Jensen and Eysenck.

The concept of a permanent pool of unemployed persons as a result of technological change also brings with it the danger that those unemployed would be used as a disciplining force against those still in work. It undoubtedly provides a useful pool from which the army and police force can draw, and during the recent redundancies in Britain, a considerable number of redundant workers from the North-east were recruited into the army and then used against workers in Northern Ireland. Coupled with the introduction of high-capital equipment is usually a restructuring known as 'rationalisation'. The epitome of this in Britain is the GEC complex with Arnold Weinstock at its head. In 1968, this organisation employed 260,000 workers and made a profit of £75 million. In consequence of quite brutal redundancies, the company's work force was reduced to 200,000, yet profits went up to £105 million. These are the kind of people who are introducing high-capital equipment, and they make their attitude to human beings absolutely clear. It is certainly profits first and people last! One quotes Arnold Weinstock not because he is particularly hideous (he is in fact extremely honest, direct and frank) but because he is prepared to say what others think. He said on one occasion that 'People are like elastic,

the more work you give them, the more they stretch.' We know, however, that when people are stretched beyond a limit, they break. My union has identified a department in a West London engineering company where the design staff were reduced from thirty-five to seventeen and there were six nervous breakdowns in eighteen months. Yet people like Weinstock are held up as a glowing example to all aspiring managers. One of his own senior managers once boasted that 'he takes people and squeezes them till the pips squeak'. I think it is a pretty sick and decaying society that will boast of this kind of behaviour.

Most industrial processes, however capital intensive they might be, still require human beings in the total system. Since highly mechanised or automated plant frequently is capable of operating at very high speeds, employers view the comparative slowness of human beings in their interaction with the machinery as a bottleneck in the over-all system. In consequence of this, pay structures and productivity deals are arranged to ensure that the workers operate at an ever faster tempo.

In many instances the work tempo is literally frantic. In one automobile factory in the Midlands in Britain they reckon that they 'burn a man up' on the main production line in ten years. They recently tried to get our union to agree that nobody would be recruited for this type of work over the age of thirty. For the employer it is like having a horse or dog. If you must have one at all, then you have a young one so that it is energetic and frisky enough to do your bidding all the time. So totally does the employer seek to subordinate the worker to production, that he asserts that the worker's every minute and every movement 'belong' to the employer. Indeed, so insatiable is the thirst of capital for surplus value, that it thinks no longer in terms of minutes of workers' time, but fractions of minutes. The grotesque precision with which this is done to workers can be seen from a report which appeared in the *Daily Mirror* of 7 June 1973. It gave particulars of the elements which make up the 32.4 minute rest-allowance deal for body press workers on the Allegro car: trips to the lavatory 1.62 minutes (note; not 1.6, not 1.7, but 1.62!): recovery from fatigue 1.30 minutes, sitting down after standing too long sixty-five seconds, for monotony thirty-two seconds. The report went on to point out that, in a recent dispute, the workers sought to increase the monotony allowance by another sixty-five seconds! The methods may vary from company to company, or from country to country, but where the profit motive

reigns supreme, the degradation and subordination of the worker is the same. George Friedmann has written of two different methods used by great French companies, Berliot in Lyons and Citroen in Paris:

> Why has the Berliot works the reputation, in spite of the spacious beauty of its halls, of being a jail? Because here they apply a simplified version of the Taylor method of rationalising labour, in which the time taken by a demonstrator, an 'ace' worker, serves as the criterion imposed on the mass of workers. He it is who fixes, watch in hand, the 'normal' production expected from a worker. He seems when he is with each worker, to be adding up in an honest way the time needed for the processing of each item. In fact if the worker's movement seem to him to be not quick or precise enough, he gives a practical demonstration, and his performance determines the norm expected in return for the basic wage. Add to this supervision in the technical sphere the disciplinary supervision of uniformed warders to patrol the factory all the time and go as far as to push open doors of the toilets to check that the men squatting there are not smoking, even in workshops where the risk of fire is non-existent.
>
> At Citroen's the methods used are more subtle. The working teams are in rivalry with one another, the lads quarrel over travelling cranes, drills, pneumatic grinders, small tools. But the supervisors in white coats, whose task is to keep up the pace, are insistent, pressing, hearty. You would think that by saving time a worker was doing them a personal favour. But they are there, unremittingly on the back of the foreman, who in turn is on your back; they expect you to show an unheard of quickness in your movements, as in a speeded-up motion picture! Within this context, the desire of companies to recruit only those under the age of 30 can be seen in its dehumanised context.[3]

Although this is the position on the workshop floor, it would be naive indeed to believe that the use of high-capital equipment will be any more liberating in the fields of clerical, administrative, technical, scientific and intellectual work.

Age limits are now gradually being introduced in the white-collar areas. In 1971 the *Sunday Times* gave a list of the peak-performance ages for mathematicians, engineers, physicists and others. For some of these the peak-performance age was twenty-nine and thirty. It has been suggested that in order to utilise this high-capital equipment as effectively as possible, a careers profile should be worked out for those who have to interface with it.

When workers reach their peak-performance age, it is suggested that this should be followed by a careers plateau for three or four years and thereafter, unless the employee has moved into management, that they be subjected to a 'careers de-escalation'. The obvious extension of the careers de-escalation is redundancy. Practical experience demonstrates, particularly during periods of redundancy, that older people are being eliminated in this way. They are being eliminated or down-graded to lower-paid work simply because they have committed the hideous crime of beginning to grow old. We are, as Samuel Beckett once said, 'all born of the gravedigger's forceps'. Growing old is the most natural human process. It is a biological process, but, in the contradictory nature of our profit-orientated society, it is treated almost as a crime. It is true that the kind of equipment we have been discussing imposes very stringent demands upon those who have to interface with it. Seen in terms of the total man/machine systems, people are slow, inconsistent, unreliable, but still highly creative. The machine is the dialectical opposite, in that it is fast, reliable, consistent, but totally non-creative. As people attempt to respond to the machine, enormous stress is placed upon them. My union has identified areas within the design activity where by using interactive graphic systems the decision-making rate of the designer is increased by 1900 per cent.

HUMANS AS MACHINES

Again there are analogies to be drawn from the shop floor. In the British Steel Corporation a productivity agreement has introduced medical checks. In practice these medical checks meant the operators were tested to ensure that their response rates were fast enough to interface with the equipment. They were merely tested for their response rates as a diode might be. A series of occupational suitability tests and character compatibility assessments are now gradually being used to do the same sort of thing to white-collar workers who have to use high-capital equipment. The object is to transform the worker, whether by hand or brain, into a suitable machine appendage. To do this, all the human requirements of the individual must be denied. They must be transformed into operating units. The 'scientific' manner in which this man/machine interface is planned emphasises the total dehumanisation of the so-called technologically advanced production techniques. Robert Boguslaw has recently pointed out how some behavioural scientists view the human being in this situation:

> Our immediate concern let us remember, is the explication of the operating unit approach to system design, no matter *what* materials are used. We must take care to prevent this discussion from degenerating into a single-sided analysis of the complex characteristics of one type of system material: namely human beings. What we need is an inventory of the way in which human behaviour can be controlled and a description of some instruments which will help us to achieve control. If this provides us with sufficient 'handles' on human materials *so that* we can think of them as one thinks of metal parts, electrical power, or chemical reactions, then we have succeeded in placing human material on the same footing as any other materials and can *proceed* with our problems of systems design.[4]

This, then, is the objective dehumanisation which takes place side by side with this advanced technology.

> There are however, many disadvantages in the use of human operating units. They are somewhat *fragile*; they are subject to fatigue, obsolescence, disease and death; they are frequently stupid, unreliable and limited in memory capacity. But beyond all this, they sometimes seek to design their own circuitry. This, in a material, is unforgiveable. Any system utilising them must devise appropriate safeguards.

Thus, if workers use their greatest attribute – that is, their ability to think – their ability to design their own circuitry – this is regarded as disruptive. The objective requirement of industry, then, is for people who will act as robots, people who are interchangeable with robots. Some scientists and technologists take the smug view that this can only happen in any case to mere manual workers on the shop floor. They fail to realise that the problem is now at their own doorstep. At a conference on robot technology at Nottingham University in April 1973, a programmable draughting or design system was accepted by definition as being a robot. One of the manufacturers of robotic equipment pointed out that 'Robots represent industry's logical search for an obedient workforce.' This is a very dangerous philosophy indeed. The great thing about people is that they are sometimes disobedient. Most human development, technical, cultural and political, depended upon those movements which questioned, challenged and where necessary disobeyed the then established order.

The ruling class views all workers, whether by hand or brain, as units of production. Only when that class reality has been firmly grasped can

the chasm which divides the potentialities of science and technology from the current reality be understood. The gap between that which is possible, and that which is, widens daily. Technology can produce a Concorde but not enough simple heaters to save the hundreds of old-age pensioners who each winter die in London of hypothermia. Only when one realises that the system regards old-age pensioners as discarded units of production does this make sense – capitalist sense. This is part of their social design, and from a ruling-class viewpoint is quite 'scientific' and abides closely by the principles observed in machine design. I know, as a designer, that when you design a unit of production you ensure that you design it to operate in the minimum environment necessary for it to do its job. You seek to ensure that it does not require any special temperature-controlled room unless it is absolutely essential. In designing the lubrication system you do not specify any exotic oils as lubricants unless it is necessary. You ensure that its control system is provided with the minimum brain necessary for it to do its job. You do not, for example, have a machine tape controlled if you can get away with a manual one. Finally, you provide it with the minimum amount of maintenance; in other words, you design for it the maximum life span in which it will operate before a failure.

Those who control our society see human beings in the same way. The minimum environment for people means that you provide them with the absolutely lowest level of housing which will keep them in a healthy enough state to do their job. If one doubts that, it is still worth remembering that 7,000,000 people live in slums in Britain. The equivalent of fuel and lubrication for the machine is the food provided for a person. This is also kept at a minimum for those who work. We even find Oxford dieticians still telling old-age pensioners how they can manage on £2 of food per week. The minimum brain is provided by an educational system which gives people enough knowledge to do their job, which trains them to do their job, but does not educate them to think about their predicament or that of society as a whole.

The minimum maintenance necessary is provided through the National Health Service, which concentrates on curative rather than preventive medicine, and the reality, the harsh reality, is that when people have finished their working life, they are thrown on the scrap heap like an obsolete machine.

If that is felt to be an extreme position, it is worth recalling the statement of the doctor at Willesden Hospital, who said there was no need for National Health patients over the age of sixty-five to be resuscitated (the doctor was actually sixty-eight!). When a barrage of

protest was raised the statement was hurriedly withdrawn as a mistake! The real mistake he made was to reveal in naked print one of the underlying assumptions of our class-divided society. Science and technology cannot be humanely applied in an inherently inhuman society, and the contradictions for scientific workers in the application of their abilities will grow and, if properly articulated, will lead to a radicalisation of the scientific community.

A source of great stress, particularly for white-collar workers, is the problem of knowledge obsolescence. This problem is closely related to the rate at which technology itself is changing. It seems desirable to attempt to quantify technological change.

The scale of technological development in the last twenty years is probably equal to that in all of humanity's previous existence. The scale of scientific effort, which is closely related to technological change, has in the present century increased out of all recognition. Bernal calculated that in 1896 there were perhaps in the whole world some 50,000 people who between them carried on the whole tradition of science, not more than 15,000 of whom were responsible for the advancement of knowledge through research. Today, the total number of scientific workers in industry, government and academic circles in Britain alone is over 400,000. This is merely a reflection in manpower of the statistics of the actual rate of technological change, which in the last century alone has meant that our speed of communication was increased by 10^7, our speed of travel by 10^2, data-handling by 10^6, energy resources by 10^3 and weapons power by 10^6.

As the rate of technological change increases, so also does the rate at which knowledge becomes obsolete. Mathematical models described by Sir Frederick Warner indicate that in order to keep abreast of this knowledge engineers would have to spend 15 per cent of their time in up-dating his current knowledge. Mr Norman McRae, Deputy Editor of *The Economist*, stated in the January 1972 issue that

> The speed of technological advance has been so tremendous during the past decade that the useful life of knowledge of many of those trained to use computers has been about three years. [and, further] A man who is successful enough to reach a fairly busy job at the age of 30, so busy that he cannot take sabbatical periods for study, is likely at the age of 60 to have about one-eighth of the scientific (including business scientific) knowledge that he ought to have for the proper functioning in his job.

It has even been suggested that if one divided knowledge into quartiles of out-datedness, those in the age bracket over forty-five would find themselves in the same quartile as Pythagoras and Archimedes.

The stress that this places upon staff workers, in particular older people, should not be under-estimated. It is the responsiblity of the trade unions to protect these older people. This they should do not in any patronising, benevolent fashion, but in recognition of the right of these older people to work at a civilised tempo. For these are the ones who in the past have created the real wealth that has made the purchase of this kind of high-capital equipment possible. All younger technologists should fully understand that however energetic and forceful they may feel now, they will inevitably begin to grow old, and if they allow older members to be treated in this way they are creating a framework of oppression which will be used against them in the future.

THE FRAGMENTATION OF SKILLS

A major part of the process of technological change is the fragmentation of jobs into deskilled, narrow elements. It is also part of the historical division between intellectual and manual work. In the past, many jobs which were essentially manual did contain within them major elements of intellectual and scientific work. Sir William Fairbairn's definition of a millwright in 1861 illustrates the point.

> The millwright of former days was to a great extent the sole representative of mechanical art... he was an itinerant engineer and mechanic of high reputation. He could handle the axe, the hammer and the plane with equal skill and precision; he could turn, bore or forge with the despatch of one brought up to these trades and he could set out and cut furrows of a millstone with an accuracy equal or superior to that of the miller himself .... Generally he was a fair mathematician, knew something of geometry, levelling and mensuration, and in some cases possessed a very competent knowledge of practical mathematics. He could calculate the velocities, strength and power of machines, could draw in plan and section, and could construct buildings, conduits, or water course in all forms and under all conditions required in his professional practice. He could build bridges, cut canals and perform a variety of work now done by civil engineers.[5]

All the intellectual work has been long since withdrawn from the millwright's function.

This fragmentation of skills now applies equally in the white-collar areas. The draughtsman of the 1930s in Britain was the centre of design. He could design the component, stress it, specify the materials to be used, define the method of lubrication, and write the test specifications. With the increasing complexity of technology, each of these have now been fragmented into narrow, specialised areas. The draughtsman draws, the stressmen carry out the calculations, the metallurgist specifies the materials, the tribologist decides upon the means of lubrication.

It has been common for some time to talk about 'dedicated machines'. It is now a fact that when defining a job function employers define a dedicated appendage to the machine, the operator.

Even our educational system is being distorted to produce these 'dedicated people for dedicated machines'. It is no longer a matter that the people are being educated to think; they are being trained to do a narrow, specific job. Much of the unrest amongst students is recognition that they are being trained as industrial fodder for the large monopolies in order to fit them into narrow fragmented functions where they will be unable to see in an over-all panoramic fashion the work on which they are engaged.

In order to ensure that the right kind of 'dedicated product' is turned out of the university, we find the monopolies attempting to determine the nature of university curricula and research programmes. Warwick University was a classical example. In particular, at research level, the monopolies increasingly attempt to determine the nature of research through grants which they provide to universities or research projects undertaken in their own laboratories. Many research scientists still harbour illusions that they are in practice 'independent, dedicated searchers of truth'.

The 'truth' for them has to coincide with the interests of the monopolies if they are to retain their jobs. William H. Whyte Jr pointed out that in the United States, out of 600,000 persons then engaged in scientific research, not more than 5000 were allowed to choose their research subject and less than 4 per cent of the total expenditure was devoted to 'creative research', which does not offer immediate prospects of profits.

He recognises the long-term consequences of this and concludes: 'If corporations continue to mould scientists the way they are now doing, it is entirely possible that in the long run this huge apparatus may actually slow down the rate of basic discovery it feeds on.'[6]

PERSPECTIVES FOR REVOLUTIONARY ACTION

I have up to now concentrated on the contradictions as they affect the worker by hand or brain. There are of course problems for the employer, and an understanding of some of these is of considerable tactical importance.

One of the contradictions for the employer is that the more capital he accumulates in any one place, the more vulnerable it becomes. The more closely he synchronises his industry and production by using computers, the greater becomes the strike power of those employed in it. Mao Tse Tung once said, in his military writings, that the more capitalised an army becomes, the more vulnerable it becomes also. This has been demonstrated in Vietnam, where NLF cadres with £1.50 shells were able to destroy American aircraft with airborne computers costing something like £2.5 million each. A Palestinian guerilla with a revolver costing perhaps £20 can hijack a plane costing several million dollars and destroy it at some safe airfield. High-capital equipment, although it appears all powerful and invincible, always has a point of vulnerability, and possibilities for sabotage and guerilla warfare are considerable. A quite small force can destroy or immobilise plant equipment or weapons costing literally millions. The capitalisation of industry also produces an analogous situation. In the past, when a clerical worker went on strike, it had precious little effect. Now if the wages of a factory are carried out by a computer, a strike by clerical workers can disrupt the whole of the plant. It is also true on the factory floor that in the highly synchronised motor-car industry, a strike of twelve workers in the foundry can stop large sections of the entire motor-car industry.

The same is happening in the design area. As high-capital equipment, through Computer Aided Design, is being made available to design staffs, first it proletarianises them, but second it also increases their strike power. In the past, when draughtsmen went on strike, they simply put down their 6H pencils and their rubbers, and there was unfortunately a considerable length of time before an effect was felt upon production, even when the manual workers were blacking their drawings. With the new kind of equipment described, where computer tapes are being prepared or where high-capital equipment is used for interactive

work, the effects of a strike will in many instances be immediate, and production will be affected in a very short length of time.

This will apply equally to hosts of other jobs and occupations, in banking, insurance, power generation, civil transport, as well as those more closely connected with industry and production.

Thus, whilst the introduction of fixed capital enables the employer to displace some workers and subordinate others to the machine, it also embodies within it an opposite in that it provides the worker with a powerful industrial weapon to use against the employer who introduced it.

This is even the case when industrial action short of strike action is taken. As has been pointed out, the activity of the worker is transformed to suit the requirement of fixed capital. The more complete that transformation, the greater is the disruptive effect of the slightest deviation by the worker from a predetermined work sequence. Industrial militants with an imaginative and creative view of industrial harassment have been able to exploit this contradiction by developing such techniques 'working to rule', 'working without enthusiasm' and 'days of non co-operation'. I know from personal experience that these techniques can reduce the output of both manual and staff workers by up to 70 per cent without placing on the workers involved the economic hardship of a full strike.

Since much of the sophisticated equipment I have described earlier is very sensitive and delicate in a scientific sense, it has to be handled with great care and is accommodated in purpose-built structures in conditions of clinical cleanliness. In many industries the care the employer will lavish on 'his' fixed capital is in glaring contrast with the comparatively primitive conditions of 'his' living capital. The campaign for parity with equipment, which perhaps started facetiously in 1964 with that placard at Berkeley which parodied the IBM punchcard ('I am a human being: Please do not fold, spindle or mutilate') has now assumed significant industrial dimensions. In June 1974 designers and draughtsmen members of the AUEW-TASS employed by a large Birmingham engineering firm, officially claimed 'Parity of environment with the CAD Equipment' in the following terms:

> This claim is made in furtherance of a long standing complaint concerning the heating and ventilation in the Design and Drawing Office Area going back to April 1972. Indeed to our certain knowledge these working conditions have been unsatisfactory as far back as 1958. We believe that if electromechanical equipment can be

> considered to the point of giving it an air conditioned environment for its efficient working the human beings who may be interfaced with this equipment should receive the same consideration.

It is an interesting reflection on the values of advanced technological society that it subsequently took three industrial stoppages to achieve for the designers conditions approaching those of the CAD equipment. The exercise also helped to dispel some illusions about highly qualified design staff not needing trade unions.

Scientists must now begin to learn the lessons of such experiences, and to understand that their destiny is bound up with all of those 'moulded' by the systems. Only when they are prepared to be involved in political struggle with them, can they ever begin to move towards a society where scientists will be able to give 'according to their ability'. It is the historical task of the working class to effect such a transformation, but in that process scientists and technologists can be powerful and vital allies for the working class as a whole. This will mean that scientists will have to involve themselves in the political movement. Above all, they must attempt to understand that the products of their ingenuity and scientific ability will become the objects of their own oppression and that of the mass of the people until they are courageous enough to help form that sort of society

> When the enslaving subordination of the individual to the division of labour, and with it the antithesis between mental and physical work has vanished; when labour is no longer merely a means of life but has become life's principal need; when the productive forces have also increased with the all-round development of the individual and all the springs of co-operative wealth flow more abundantly. Only then will it be possible completely to transcend the narrow outlook of bourgeois right and only then will society be able to inscribe on its banners: From each according to his ability, to each according to his needs.[7]

Then, and then only will scientists be able to truly give of their ability to meet the needs of the community as a whole rather than maximise profits for the few.

9. Marx, *Capital*, unedited (Florence, La Nuova Italia, 1969) vol. IV, p. 91.

10. K. Marx, *Grundrisse* vol. II, (Florence: La Nuova Italia, 1970) pp. 393 - 9.

11. Marx, *Capital*, vol. I, p. 477.

12. *Capital*, Italian edn, vol. IV, p. 79.

13. W. T. Knox, *Science*, 181 (1974) p. 415.

14. V. Fuchs, *The Service Economy* (New York: Columbia University Press, 1970) p. 109.

15. Marx, *Grundrisse*, vol. II, p. 405.

16. B. Commoner, *The Closing Circle* (New York: Knopf) p. 267.

17. K. Marx, *Critique of Policial Economy*, p. 279 - 80.

18. H. B. G. Casimir, 'The Ominous Spiral', *Studium Generale*, 24, 1460 (1971).

19. D. J. de Solla Price, *Little Science, Big Science* (Columbia University Press, 1963).

20. Working Group On Appointment Policy Report, CERN (31 August 1972).

21. G. Jona-Lasinio, 'Changes in Scientific Practice in Technological Society', unpublished manuscript (1972) p. 14.

22. Marx, *Capital*, vol. I. pp. 352.

23. Marx, *Critique of Political Economy*, p. 302.

24. H. Brooks, *Daedalus*, 102 (1973) p. 125.

25. R. J. Yaes, 'Physics from another Perspective. A Cynical Overview', duplicated (*Memorial University of Newfoundland*, St John's Newfoundland, Canada).

26. G. Morandi, F. Napoli and C. Ruzzo, 'Un indagine sociologica sulla ricerca in fisica dello stato solido', duplicated.

27. J. R. Cole and S. Cole, *Science*, 183 (1974) p. 32.

28. Yaes, 'Physics from another Perspective'.

29. S. E. Luria, *Science*, 180 (1973) p. 164.

30. M. Perl, *Science*, 173 (1971) pp. 1211 - 15.

31. Jona-Lasinio, 'Changes in Scientific Practice'.

32. T. S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, University Press, 1962).

33. Marx, *Capital*, vol. IV, p. 72.

CHAPTER FOUR

1. H. Rose and S. Rose, 'The Radicalisation of Science', *The Socialist Register* (1972) pp. 105 - 32.

CHAPTER FIVE

1. K. Marx, *Capital*, vol. I (London: Lawrence & Wishart, 1974) p. 174.

2. Quoted in *Realtime*, 6 (1973).

3. G. Friedmann; quoted in E. Mandel, *Marxist Economic Theory* (London: Merlin Press, 1971) p. 183.

4. R. Boguslaw, *The New Utopians: a Study of System Design and Social Change* (Englewood Cliffs, N.J.: Prentice-Hall, 1965).

5. W. Fairbairn; quoted by J. B. Jefferys, *The Story of the Engineers* (London: Lawrence & Wishart for the AEU, 1945) p. 9.

6. W. H. Whyte, *The Organisation Man* (New York: Simon & Schuster, 1956).

7. K. Marx, *Critique of the Gotha Programme*, ed. C. P. Dutt (London: Lawrence & Wishart, 1938).

CHAPTER SIX

1. S. Rose, *The Conscious Brain* (London: Weidenfeld & Nicolson, 1973).

2. H. Osmond and J. R. Smythies, 'Schizophrenia, a New Approach', *Journal of Mental Science*, 98 (1952) pp. 309 - 15.

3. L. L. Iversen and S. P. R. Rose, *Biochemistry and Mental Disorder* (London: The Biochemical Society, 1974).

4. W. Sargent, *The Unquiet Mind* (London: Heinemann, 1967).

5. O. Sacks, *Awakenings* (London: Duckworth, 1973).

6. F. F. de la Cruz, B. H. Fox and R. H. Roberts, 'Minimal Brain Dysfunction', *Annals of the New York Academy of Science*, 205, entire volume (1973).

7. P. H. Wender, *Minimal Brain Dysfunction in Children* (New York: Wiley, 1971) pp. 20, 90 - 1, 94, 131.

8. J. M. R. Delgado, *Physical Control of the Mind: Towards a Psychocivilized Society* (New York: Harper & Row, 1971).

9. P. R. Breggin, *U.S. Congressional Record H.R.*, vol. 118, no. 26 (Washington, 1972).

10. V. Mark and F. Ervin, *Violence and the Brain* (New York: Harper & Row, 1970).

11. E. M. Opton, Documents circulated at Winter Conference on Brain Research, Vail, Colo. (1973).

12. L. S. Penrose, in *The Social Impact of Modern Biology*, ed. W. Fuller (London: Routledge & Kegan Paul, 1971).

SOME POSSIBLE IMPLICATIONS OF MICROELECTRONICALLY CONTROLLED EQUIPMENT

(Summary on p.12)

Briefing Sheet No. 2: Machine Tools (Background information)

> "Mike Bayless, 28 years old with the maximum intelligence level of a 12 year old, has become the company's NC machining centre operator, because his limitations afford him the level of patience and persistence to carefully watch his machine and the work that it produces.
>
> "Ronald Tremme, the owner of the company said:
>
> > 'If a so called normal individual had been assigned to the machine he would have been doing inspection work or deburring while the machining centre worked and would never have known what was happening until it was too late.'
>
> "Mike's meticulous attention saved [illegible] and reject costs.
>
> > "He loads the table exactly the way he has been taught - watches the [illegible] then unloads. It's the kind of [illegible] that some non-handicapped individual might have difficulty coping with."

[illegible] July 1979, p. 58

For Lucas Aerospace Combine Shop Stewards' Committee

[illegible] Dec. 1979