terminology is riddled with class expressions such as master files, high and low level languages, controller, scheduler, monitor.[26]

The same writer then generalised some of the contradictions of centralised operating systems. These coincided closely with my own findings when I investigated the contradictions 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 was '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 engineer, thus introducing even into the exclusive province of data processing the division between software experts and other programmers, and reinforcing 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.

Six

POLITICAL IMPLICATIONS OF NEW TECHNOLOGY

MALE/FEMALE VALUES

Niels Bjorn-Andersen and his colleagues of the information-systems research group at the Copenhagen School of Economics have named their latest joint computerisation project with the trade unions Daphne.

The name is an acronym in Danish, but it has a much more profound significance. You may recall that in Greek mythology Daphne was a nymph, the daughter of the river Peneius. She was the embodiment of what we would nowadays refer to as the historically determined 'female' characteristics, such as intuition, subjectivity, tenacity and compassion.

She was pursued by Apollo, the embodiment of the so-called male characteristics: logic, analysis, rationality, objectivity. Indeed, one might say, the god of computerisation.

When he failed to win Daphne's favours, Apollo applied the male logic of 'might is right' and decided to take her by force.

As he was about to rape her, she called on the venerable Gaea to help her. Immediately, the earth opened, Daphne disappeared, and in her place a laurel tree sprang from the ground.

Believing that male values have raped science and technology for long enough, Bjorn-Andersen pointed out that 'it was natural for us to choose the name Daphne'.

One of the major problems with Western science and technology is that they have the historically determined male values built into them. These are the values of the white male warrior, admired for his strength and speed in eliminating the weak, conquering competitors and ruling over vast armies of men who obey his every instruction. He makes decisions which are logical, rational and will

lead to victory. Within this, there is little place for the attributes of Daphne.

The introduction of a computerised system is frequently used as a smokescreen to introduce a management control weapon which discriminates against women, that of job evaluation. Pseudo-scientific reasons are given for fragmenting jobs and slotting the subdivided function into a low level of the system's hierarchy with correspondingly low wages for 'appropriate' job grades. My experience of this in industry tends to show that it is frequently used to consolidate the unequal pay and opportunities for women. This is done either by implying, or by ensuring by structural means and recruitment, that the fragmented functions are women's work. This of course can no longer be stated openly since there is the sex-discrimination legislation to watch out for, but it still happens that women are recruited for the input of predetermined data, for example, whereas the higher-status jobs are offered to men.

When we looked over some past issues of the computing magazines covering a period of six months in 1983, 82 per cent of the advertisements that had one person in a photograph with the equipment showed a woman in some kind of absurd posture which was in no way related to the use of the equipment. There is a continual projection of the view, even in the most serious of journals, that women are to be regarded as playthings, draped around the place for decoration.

Not only that, but those who read these journals often do not notice the built-in assumption unless it is pointed out to them. They are conditioned to accept the presence of women in the servicing role, and the absence of women in the organising role, as being quite normal. Even women themselves quite often see nothing untoward in this.

Technological change is starved of values like intuition, subjectivity, tenacity and compassion. It would be an enormous contribution to society if more women were to come into the technological field, not as imitation men or honorary males, but to challenge the 'male' values which have distorted it for so long. It would be a contribution to science itself which would become more caring, liberatory, socially relevant and natural.

Women are going to have to fight, not only the traditional forms of discrimination, but much more sophisticated and scientifically structured ones. There is little indication, even in 1987, that the unions catering for women workers in scientific, administrative and medical occupations which are being restructured around computer-based equipment have really understood the nature and the scale of this problem. However, what we can do is change our attitude to these 'male' and 'female' values and thereby cease to place the objective above the subjective, the rational (mathematical) above the tacit (there are things we know but cannot tell) and the digital above analogical representation.

IS SCIENCE NEUTRAL?

Marxist critics of capitalist society have tended to concentrate, at least since the turn of this century, on the contradictions of distribution. This they have done at the expense of a thorough-going analysis of the contradictions of production within technologically advanced society.

This imbalance can hardly be attributed to a one-sidedness on Marx's own part. Central to volume I of *Capital* is the nature of the labour process and a 'critical analysis of capitalist production'. In this, Marx demonstrates that with the accumulation of capital – the principal motivating force – the processes of production are incessantly transformed. For those who work, whether by hand or brain, this transformation shows itself as a continuous technological change within the labour process of each branch of industry, and secondly, as dramatic redistributions of labour among occupations and industries.

That the overall development of production since then should accord so closely with Marx's analysis is a remarkable tribute to his work, bearing in mind the sparsity of occupations and industries then, compared with the proliferation of these today. Whether this Marxist analysis will be equally consistent and valid when applied to the science-based industries which have emerged since the Second World War is now a matter of considerable discussion. With the integration of science into the 'productive forces' this question is one of growing significance. In some large multinational

corporations 50 per cent or more of all those employed are scientific, technical or administrative 'workers'. This has begun to question, in a very practical way, the relationship between science, as at present practised, and society.

THE USE/ABUSE MODEL

Up to the mid sixties, there hardly seemed any useful purpose in raising this question. At that time, there was hardly a chink in the Bernalian analysis of twentieth-century science. In this analysis, science, although it was integral to capitalism, was ultimately in contradiction with it. Capitalism, it was felt, continuously frustrated the potential of science for human good. Therefore, the problems thrown up by the application of science and technology were viewed simply as capitalism's misuse of their potential. The contradictions between science and capitalism were viewed as the inability of capitalism to invest adequately, to plan for science, and to provide a rational framework for its widespread application in the elimination of disease, poverty and toil.

The forces of production, in particular, science and technology, were viewed as ideologically neutral, and it was considered that the development of these forces was inherently positive and progressive. It was held that the more these productive forces – technology, science, human skill, knowledge and abundant 'dead labour' (fixed capital) – developed under capitalism, the easier the transition to socialism would be. Further, science is rational, and could therefore be counterposed against irrationality and suspicion.

Science had after all, through the Galilean revolution, destroyed the earth-centred model of the universe, and, through Darwin, had made redundant earlier ideas of the creation of life and of humanity. Science, viewed thus, appeared as critical knowledge, liberating humanity from the bondage of superstition – a superstition which, elaborated into the system of religion, had acted as a key ideological prop of the outgoing social order.[1] The past few years have seen a growing questioning of this rather mechanistic interpretation of the Marxist thesis. There is now a growing realisation that science has embodied within it many of the ideological

assumptions of the society which has given rise to it. This in turn has resulted in a questioning of the neutrality of science as at present practised in our society. The debate on this issue is likely to be one of major political significance. The question extends far beyond that of scientific abuses, to the deeper considerations of the nature of the scientific process itself. Science done within a particular social order reflects the norms and ideology of that social order. Science ceases to be seen as autonomous, but instead as part of an interacting system in which internalised ideological assumptions help to determine the very experimental designs and theories of scientists themselves.[2]

Failure to deal with these questions will mean that the anti-science movement of the 1970s, which had its antecedents in the anticulture movement of the 1960s, will not be developed beyond its initial and partly negative premise. In this, science is viewed as evil, totalitarian and devoid of those attributes which make it amenable to the 'human spirit'. This total rejection is now common among many young people. Indeed, in the early seventies the student population in the USA included the following words among those terms it regarded as 'bad': verification, facts, technology, statistical controls, programming, calculate, objectify, detachment.[3]

Not surprisingly, many of these students opt for the arts or social sciences where they feel (sometimes mistakenly) that more opportunity will exist for humanistic concerns.

Our Western scientific methodology is based on the natural sciences. Within this, relationships are mathematically quantifiable. There has been a tendency to suggest that if you cannot quantify something it really doesn't exist. This is not without its political significance, for if the mass of ordinary people are incapable of providing 'scientific reasons' for their judgements (which are based on actual experience of the real world), ruling elites can then silence their common sense with quantification. This has caused the brilliant French mathematician, Professor Jean-Louis Rigal, to observe, 'Quantification is the ultimate form of fascism.' Rigal's concern about quantification is even more relevant when applied outside the domain in which it evolved. Attempts to use

this narrow, mathematically-based science in the much more complex and indeterminate social sciences and political activity give rise to very serious distortions, which are inevitable from the abstracted nature of the scientific method.

It is significant that those working in the scientific field are themselves beginning to raise these questions. Thus, Professor R. S. Silver says that there are risks

> in the scientific method, which may abstract common features away from concrete reality in order to achieve clarity and systematisation of thought. However, within the domain of science itself, no adverse effects arise because the concepts, ideas and principles are all interrelated in a carefully structured matrix of mutually supporting definitions and interpretations of experimental observation. The trouble starts when the same method is applied to situations where the number and complexity of factors is so great that you cannot abstract without doing some damage, and without getting an erroneous result.[4]

Those working in the field of cybernetics have also expressed their concern about this misuse of 'science'. 'There is no doubt that a very important influence nowadays is a revised reductionism within the theory of cybernetics. It reduces processes and complex objectives to black boxes and dynamic control systems. Not only in the natural sciences, but also in the social sciences.'[5]

To address these problems it will be necessary to challenge the idea of what constitutes scientific development. The role of science and technology in society will need to be recast and a social structure provided which will be capable of nurturing the coexistence of the subjective and the objective, of tacit knowledge based on contact with the physical world, and abstracted knowledge. More simply, a society and a culture which would reduce and gradually eliminate the divisions between hand and brain, and provide the stimulus, encouragement and infrastructure to permit human beings to develop in a well-rounded and heuristic fashion. This will mean challenging the fundamental assumptions of our present society and, indeed, the assumptions of societies in the so-called socialist countries. One of the important factors now

moulding the social forces to give rise to such a challenge is the contradictions of science and technology experienced by an ever increasing section of the population.

CONTROL THROUGH TECHNOLOGY

The elitist right of the scientific worker or researcher to give vent to his or her creativity will now be increasingly curbed by the system as it seeks to control human behaviour in all its aspects. This is part of the general attempt of the small elite who control society to gain complete control over all those who work, whether by hand or by brain, and to use scientific management and notions of efficiency as a vehicle for doing so. It will be seen, then, that the organisation of work, and the means of designing both jobs and the machines and computers necessary to perform them, embody profound ideological assumptions. So, by regarding science and technology as neutral, we have

> failed to recognise as antihuman, and consequently to oppose the effects of values built into the apparatus, instruments and machines of their capitalist technological system. So, machines have played the part of a Trojan horse in their relation to the Labour movement. Productivity becomes more important than fraternity. Discipline outweighs freedom. The product is in fact more important than the producer, even in countries struggling for socialism.[6]

It has been suggested[7] that by ignoring these considerations the Soviet Union was laying the basis for the present situation in which it would be hard to argue that a worker there enjoys the sense of fulfilment through his or her work envisaged by the early Marxists. It may well be that in merely trying to adapt forms of science and technology developed in the capitalist societies instead of developing entirely different ones, the Soviet Union has made a profound error. The development in that country must find part of its origins in the attitude of Lenin to Taylorism, which, he said,

> like all capitalist progress is a combination of the refined brutality of bourgeois exploitation, and a number of the greatest scientific achievements in the field of analysing mechanical

motions during work, the elimination of superfluous and awkward motions, the elaboration of the correct methods of work, the introduction of the best system of accounting and control etc. The Soviet Republic must at all costs adapt all that is valuable in the achievement of Science and Technology in this field. The possibility of building socialism depends exactly on our success in combining the Soviet Power and the Soviet Organisation of Industry with the up-to-date achievements of capitalism. We must organise in Russia the study and teaching of the Taylor system, and systematically try it out and adapt it to our ends.[8]

Socialism, if it is to mean anything, must mean more freedom rather than less. If workers are constrained through Taylorism at the point of production, it is inconceivable that they will develop the self-confidence and the range of skills, abilities and talents which will make it possible for them to play a vigorous and creative part in society as a whole.

So it is that, in the technologically advanced nations, there are now beginning to emerge a range of contradictions which will necessitate a radical examination of how we use science and technology, and how knowledge should be applied in society to extend human freedom and development.

TECHNOLOGICAL CHANGE AND PROLETARIANISATION

The emergence of fixed capital as a dominant feature in the productive process means that the organic composition of capital is changed 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 determining element in production, yet at the same time it 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 have the consequences of high-capital equipment. Scientists, technologists, professional workers and 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 other words they had all got the 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 factory carrying banners demanding 'the right to work' in a struggle that would have been inconceivable a few 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, 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 persons. In the United States, the 1970s saw some 5 million people permanently out of work in spite of the artificial stimulus of the Vietnam War. It is true that some of the more recent Reagan policies have resulted in job creation in limited sectors and small businesses. However, this may be more of a transitional phenomenon than one heralding the end of mass unemployment, and has been due partly to American external financial policies and at the expense of jobs in other countries. Japan and the United States have tended to export unemployment to maintain employment at home.

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 and there is no sign of this being reversed. (See Figure 15.) 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, having fuelled the fires of industry with the taxpayers' 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.

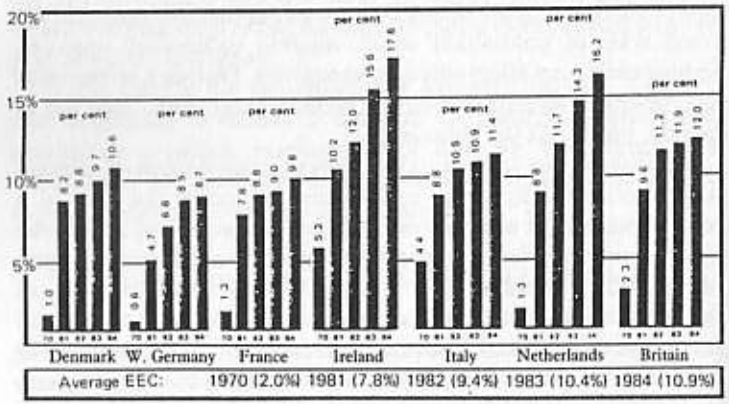

Fig. 15. Unemployment rates in the EEC.

This concept has now been extrapolated and developed by the Thatcher government to condition the population to accept that 3.5 million is a 'not unacceptable level of unemployment'. It is implied that those out of work have only themselves to blame, are scroungers or are too unimaginative, unwilling or downright lazy to avail themselves of leisure activities. Given the lack of infrastructure and resources, and the absence of job-sharing mechanisms

with shorter working hours, those out of work experience not leisure but enforced idleness.

THE FRUITS OF EARLY OPTIMISM

The net result is that there is on the one hand an increased work tempo for those in industry and on the other hand a growing dole queue with all the degradation that implies. Nor has the actual working week been reduced during this period. In spite of all the technological change since the war, the working week in Britain for those who have the jobs is now longer than it was in 1946, if we include overtime, moonlighting and travel time. 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 three million people in the dole queue in Britain whose pattern-recognition intelligence is infinitely greater than anything yet conceived even at a theoretical level?

The policies of the labour and trade-union movement have in the past been to accept redundancies and to cut expenditure on, for example, defence without any concrete proposals whatsoever about alternative work. The argument in support of this has been that defence cuts would release capital, which could then be used in the social services. It is of course then grudgingly admitted that there would be the residual problem of further unemployment.

This reveals the extent to which those of us in the labour movement have been conditioned by the criteria of the market economy. We see the freeing of capital as an asset, and the freeing of people as a liability. In doing this we ignore our most precious asset – people, with their skill, ingenuity and creativity. In the defence and aerospace industries we have some of the most highly skilled and talented workers in Britain. Yet, like the ruling class, we have thought of capital first and people last, and ignored the great contribution which their skill and ability could make to the wellbeing of the people.

Confronted with these contradictions, the bleating and whimpering of the European trade-union bureaucracies (to be

contrasted with the creative Luddism of at least some sections of the Australian movement) has failed to disguise the reality that they have no independent view of how science and technology should develop. Indeed, when they are not demanding more investment in the same forms of technology that have given rise to the problems in the first place, they are making minor, pathetic, window-dressing modifications to the proposals of the vast multinational corporations. A more constructive trade-union response is illustrated in Figure 16.

Given the gradual incorporation of the trade unions through membership of state planning bodies, industrial sector strategy teams, co-determination in West Germany, and, in Britain, quangos (although this trend has been halted and somewhat reversed under Thatcher), this form of response is perhaps not so surprising. What is, however, disconcerting is the total disarray and confusion of the Marxist Left as the political pigeons of blind unthinking technological optimism come home to roost with a vengeance.

'USING' PEOPLE

The system seeks in every way to break down workers' resistance to being sacked. One of the sophisticated devices was the Redundancy Payments Act under the 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 the 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

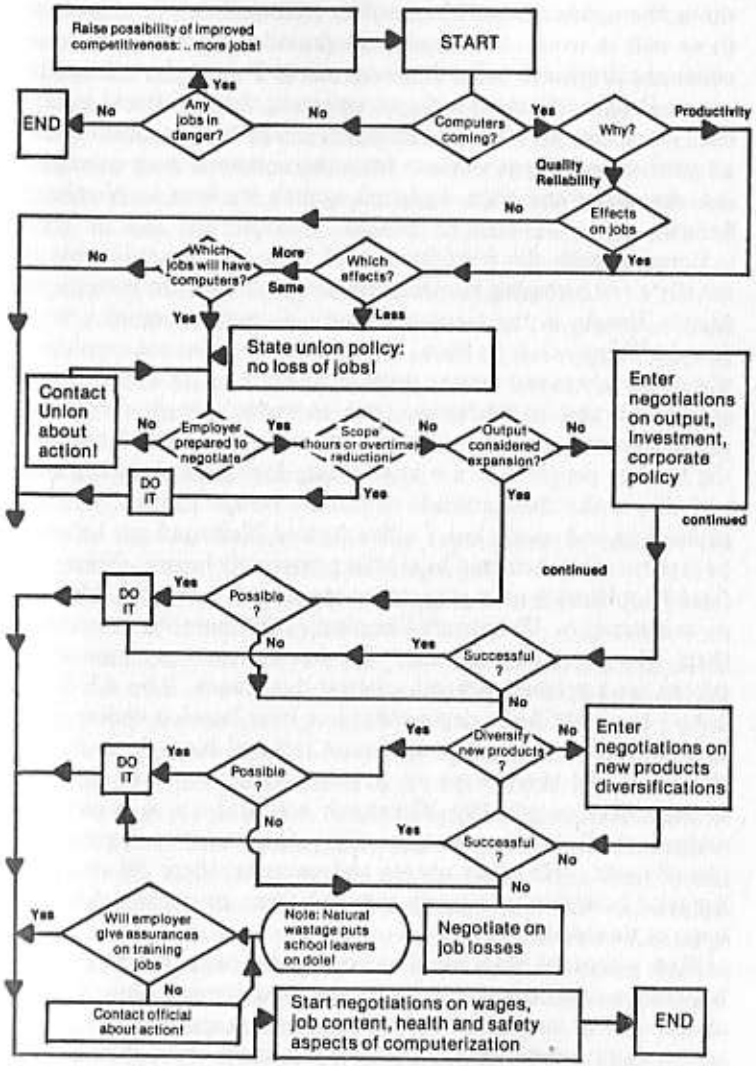

Fig. 16. A typical trade-union response to new technology.

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. During the redundancies in Britain throughout the seventies, as the traditional industries were restructured or eliminated altogether, a considerable number of redundant workers from the northeast were recruited into the army and then deployed 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 General Electric Company 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: profits first and people last. I quote Arnold Weinstock not because he is particularly heinous (he is in fact extremely honest, direct and frank) but because he is prepared to say what others think. He said on one occasion, '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. The AUEW-TASS 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 senior managers once proudly said, '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 the human being in his interaction with the machinery as a bottleneck in the overall system. In consequence of this, pay

structures and productivity deals are arranged to ensure that the workers operate at an even faster tempo.

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 him, 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 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, that shrewd observer of industrial politics, has written of two different methods used by great French companies, Berliot in Lyons and Citroën 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 seems 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 by uniformed warders who patrol the factory all the time and go as far as to push open the doors of the toilets to check that the men squatting there are not smoking, even in workshops where the risk of fire is nonexistent.
>
> At Citroën'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 thirty can be seen in its dehumanised context.[9]

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.

Some scientists and technologists take the smug view that this can only happen to 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, '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, has depended on those movements which questioned, challenged and, where necessary, disobeyed the established order.

MINIMUM MAINTENANCE FOR THE HUMAN APPENDAGE

The controllers of production view all workers, whether by hand or brain, as units of production. Only when that 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 what is possible and what is actual widens daily. The latent capacities of science and technology grow exponentially at the same time as the plight of many ordinary people in the West and dramatically of those in Third World countries becomes relatively worse. Technology can produce a Concorde but not enough simple heaters to save the hundreds of elderly pensioners

who die in London each winter of hypothermia. Only when one realises that the system regards 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 it 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 don't, for example have a complex CAD three-dimensional system if you can get away with a simple two-dimensional plotter. 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 it fails. Those who control our society see human beings in the same way. The minimum environment for workers 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. The equivalent of fuel and lubrication for the machine is the food provided for a worker. This is also kept at a minimum for those who work – and is completely inadequate for those who cannot work.

In the early 1970s Oxford dietitians were telling pensioners precisely how much margarine and which scraps of meat to purchase so that they could survive on £2 worth of food per week. Despite the stir this caused at the time, the amount which working-class pensioners have available today for food is relatively unchanged in terms of actual purchasing power.

The minimum brain is provided for the worker by an educational system which imparts enough knowledge to be of use to the industrial system, and which trains him or her to do the job, but does not educate the worker to think about his or her own predicament or that of society as a whole.

The minimum maintenance is provided through the National

Health Service, which concentrates on curative rather than preventive medicine. The harsh reality is that when workers have finished their working life they are thrown on the scrap heap like obsolete machines.

If all this sounds like an extreme position, it is worth recalling the statement of the doctor at Willesden Hospital who said there was no need to resuscitate National Health patients over the age of sixty-five. (The doctor himself was 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.

NEED FOR PUBLIC INVOLVEMENT

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' (as correctly advocated by some members of the British Society for Social Responsibility in Science).

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 international capital 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 on 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 radical.

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

Clearly those who control the vast multinational corporations, who have never harboured any illusions about the ideological neutrality of science, will not be overconcerned 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 pronouncements of the ecologists have reverberated through the quality press and caused some concern – not all of it healthy – in liberal circles. But ordinary people – those who have it within their power to transform society, those for whom such a transformation is an objective necessity – have not 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, produces CS gas for Northern Ireland, 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. Although the

organisation of work seeks to reduce them to zombies, they develop coping mechanisms, sometimes through compensation outside work in the form of hobbies, frequently through trade-union activity and making plans for the day when they will 'escape' from the production line altogether.

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 US, the 8 per cent absentee rate at Fiat in Italy, the 'quality' strike at Chrysler 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.

FUNDAMENTAL DIFFERENCE

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 geared to profit and the convenience of the

machine. The scientific knowledge which predetermines the speeds and feeds of the machine, and the mathematics used in compiling the numerical control program, do not exist in the consciousness of the operator; they are external to him and act upon him 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 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 building skill into the machine and deskilling himself. The accumulation of years of welding experience is absorbed by the robot's self-programming systems and will never be forgotten. Similarly, a mathematician working as a stressman in an aircraft company may design a software package for the stress analysis of airframe structures and suffer the same consequences in his job. In each case they have given part of themselves to the machine and in doing so have conferred 'life', in systems terms, 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 is used in his interests, it necessarily follows that

the object of the workers' labour confronts them as an alien and hostile force. 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, backbreaking tasks is rather the means of their own enslavement.

IS 'POLITICAL' CHANGE ENOUGH?

It will therefore be necessary to change the nature and the ownership of the means of production, although this of itself will by no means be adequate. In addition there is the question as to whether there is 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, in particular our design methodology, has been distorted by the social forces that have given rise to it. The question is therefore 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 one of mere theoretical and academic interest. It must be a burning issue in the minds of those attempting to build a people's democracy. It must be of political concern to them to establish if Western technology can be simply applied to a socialist society. Technology, at this historical stage, is the embodiment of two opposites: the possibility of freeing workers and the actuality of ensnaring them. The possibility can only become actuality when the workers own the objects 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. As far back as 1642, when Pascal introduced his mechanical calculating device, he expected it to free people to engage in creative work. Only forty-six

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. This reaction has been repeated time and again in various guises during the ensuing 500 years to resolve a contradiction at an industrial level when only a radical political one would suffice. That contradiction manifests itself in industrial forms even to this day.

THE DEDICATED APPENDAGE

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 men for dedicated machines'. People are no longer being educated to think, they are being trained to do a narrow, specific job. Much of the unrest amongst students is caused by 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 overall 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 classic 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 after 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 in 1960 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.'[10]

PROBLEMS FOR THE EMPLOYER

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. This was demonstrated in Vietnam, where a National Liberation Front cadre with a £1.50 shell could destroy an American aircraft with an airborne computer costing something like £2.5 million.

A Palestine guerrilla with a revolver costing perhaps £20 can hijack a plane costing several million dollars and destroy it at some airfield. High-capital equipment, although it appears all-powerful and invincible, always has a point of vulnerability and possibilities for sabotage and guerrilla 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 plant. It is also true on the factory floor that in the highly synchronised motorcar industry a strike of twelve workers in the foundry can stop large sections of the entire industry.

The same is happening in the design area. As high-capital equipment, through computer-aided design, is being made available to design staffs, it proletarianises them, but it also increases

their strike power. In the past when a draughtsman went on strike he simply put down his 6H pencil and his rubber, and there was unfortunately a considerable length of time before an effect was felt on production, even when the manual workers were blacking his drawings. With the new kind of equipment described, where control data is 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 time.

PARITY WITH THE MACHINE

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

This is even the case when industrial action short of strike action is taken. As I have pointed out, the activity of the worker is transformed to suit the requirement of fixed capital. The more complete the transformation, the greater is the disruptive effect of the slightest deviation by the worker from his predetermined work sequence. Industrial militants with an imaginative and creative view of industrial harassment have been able to exploit this contradiction by developing techniques like 'working to rule', 'working without enthusiasm' and 'days of noncooperation'. 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 a 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 1973, designers and draughtsmen, members of 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 those 'moulded' by the system. 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 be involved in political struggle with them. It is the historical task of the working class to effect a transformation of society, but in that process scientists and technologists can be powerful and vital allies for the working class as a whole. This means that scientists will have to involve themselves in the political movement.

> 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 cooperative wealth flow more abundantly. Only then will it be possible completely to transcend the narrow outlook of the 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'. 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.[11]